Supplementary Environmental Impact Assessment (SEIA) Report Construction & Up-gradation of the NH127B – Meghalaya Portion (Nidanpur- Rongram)

Supplementary Environmental Impact Assessment report

CETEST Engineering Consultants

C. E. TESTING COMPANY PRIVATE LIMITED

Report No PI/CETKI20-03/R0

Revision No. A1

21-04-2022

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List of Abbreviations

AADT		Annual Average Daily Traffic
AAQ		Ambient air quality
AAQM		Ambient air quality monitoring
AH		Asian Highway
ASI		Archaeological Survey of India
BDL		Below detectable limit
BGL		Below ground level
BOD		Biochemical oxygen demand
BOQ		Bill of quantity
CCE		Chief Controller of Explosives
CGWA		Central Ground Water Authority
CITES		Convention on International Trade in Endangered Species
CO		Carbon monoxide
COD		Chemical oxygen demand
CPCB		Central Pollution Control Board
CSC		Construction Supervision Consultant
DFO		Divisional Forest Officer
DG		Diesel generating set
DO		Dissolved oxygen
DPR		Detailed project report
DSC		District Steering Committee
E&S		Environment and social
EA		Executing agency
EAC		Expert Appraisal Committee
EFP		Environmental Focal Person
EHS		Environment Health and Safety
EIA		Environmental impact assessment
EMOP		Environmental monitoring plan
EMP		Environmental management plan
ESCAP		United Nations Economic and Social Commission for Asia and Pacific
ESSU		Environmental and Social Safeguard Unit
GHG		Greenhouse gas
GIS		Geographical information system
GOI		Government of India
GRC		Grievance redress committee
GRM		Grievance redress mechanism
HFL		Highest flood level
IA		Implementing Agency
IMD		Indian Meteorological Department
IRC		Indian Road Congress
IUCN		International Union for Conservation of Nature
IVI		Important value index
JICA		Japan International Cooperation Agency
LHS		Left hand side
LPG		Liquefied petroleum gas
MOEF		Ministry of Environment and Forests
MORTH		Ministry of Road Surface Transport and Highways
MPRSD		Master Plan Road Sector Development

NGO		Non-governmental organization
NH		National Highway
NOC		No Objection Certificate
PCR		Public Community Resources
PCU		Passenger Car Units
PCMC		Project Construction Management Consultant
PD		Project Director
PM		Particulate Matter
PMU		Project Monitoring Unit
PMUHSGO		Public Management Unit Head, Safeguards and Gender Officer
PIU		Project Implementation Unit
PPE		Personal protective equipment
PUC		Pollution Under Control
R&R		Rehabilitation and Resettlement
RHS		Right hand side
ROW		Right of way
RSPM		Respiratory suspended particulate matter
SEIAA		State Environmental Impact Assessment Authority
SEMU		Social and Environmental Management Unit
SIA		Social Impact Assessment
SPCB		State Pollution Control Board
SPM		Suspended Particulate Matter
TDS		Total dissolved solids
TSS		Total Suspended Solids
UNESCO		United Nations Educational, Scientific and Cultural Organization
USEPA		United States Environmental Protection Agency

WEIGHTS AND MEASURES		
dB(A)	–	A-weighted decibel
ha	–	hectare
km	–	kilometre
km^2	–	square kilometre
KWA	–	kilowatt ampere
Leq	–	equivalent continuous noise level
µg	–	microgram
m	–	meter
MW (megawatt)	–	megawatt
PM 2.5 or 10	–	Particulate Matter of 2.5 micron or 10 micron size

1. INTRODUCTION

A. General

Meghalaya is a state in Northeast India.Meghalaya was formed by carving out two districts from the state of Assam: the United Khasi Hills and Jaintia Hills, and the Garo Hills on 21 January 1972. The state is bound to the south by the Bangladeshi divisions of Mymensingh and Sylhet, to the west by the Bangladeshi division of Rangpur, and to the north and east by India's State of Assam. The capital of Meghalaya is Shillong. During the British rule of India, the British imperial authorities nicknamed it the "Scotland of the East". It comprises of seven districts extending over an area of 22,429 sq.km.

Transportation is the backbone of any country. It plays very vital role in the infrastructure development leading to economic growth of a country. The Meghalaya state has transportation network consisting of roads and airways, which form the lifeline for the economic and social activities of the state. The road network of Meghalaya State comprises of National Highways, State Highways, Major and Other District Roads. The state has only 5 main National Highway transitory i.e. National Highway number 40, 51, 62, 44 and 44E with a distance of approximately 461 Km. Road transport is a dominant mode in the state for goods and passengers. In this context the study for improving the road connectivity assumes greater importance, not only for benefit of the economic development, but also for improving the accessibility and mobility of the people living in the region. Project stretch is one such corridor where the intensity of traffic has increased and there is requirement of augmentation of capacity for safe and efficient movement of traffic.

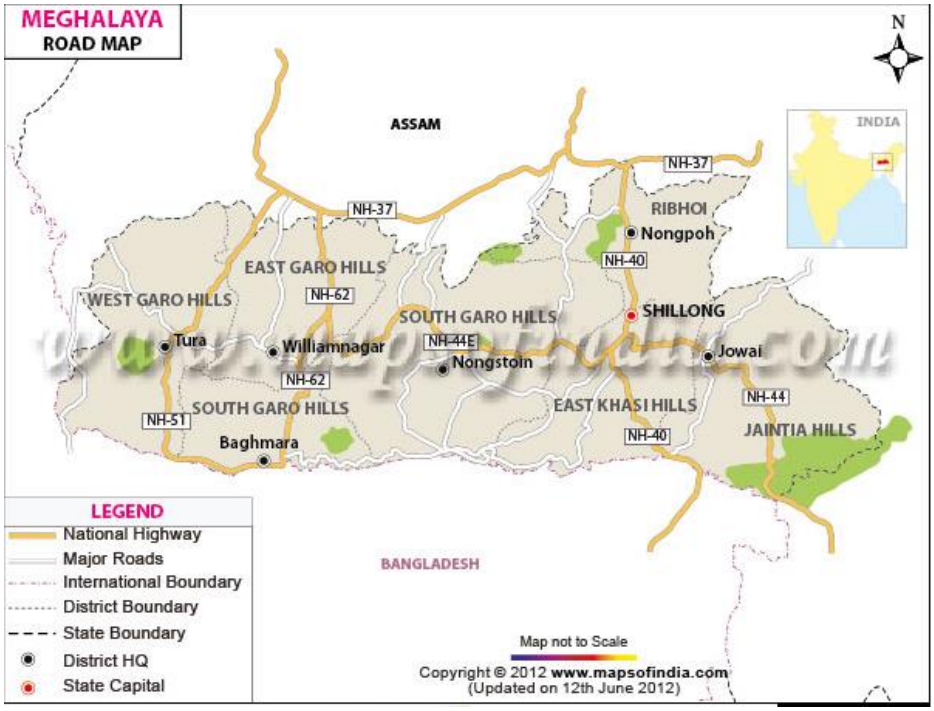


Figure 1: Road Map of Meghalaya State

The deficient road network and the quality of the road infrastructure is an important deterrent factor constraining the development of major parts of the state. In this regard, the state government has invested on extending the road network rather than on improving the quality of roads. The total length of the project road is about 62.000 km (as per design length).
On behalf of MoRT&H, MeghalayaPublic Work Department(PWD) NH Works acting as an executing agency had appointed M/s EDMAC Engineering Consultant (India) Pvt Ltd as consultant to carry out

the Detailed Project Report for the proposed improvement and up-gradation of the roadway.After the approval of the project PAPR by NHIDCL in 2019, the Government of India requested Japan International Co-operation Agency (JICA), the aid agency of Japan, to provide this project finance for the NH-127B improvement and widening Project. Subsequently, C.E. Testing Company Pvt. Ltd. (CETEST) is appointed to provide Supplementary Environmental Impact Assessment (SEIA) report for this project road.

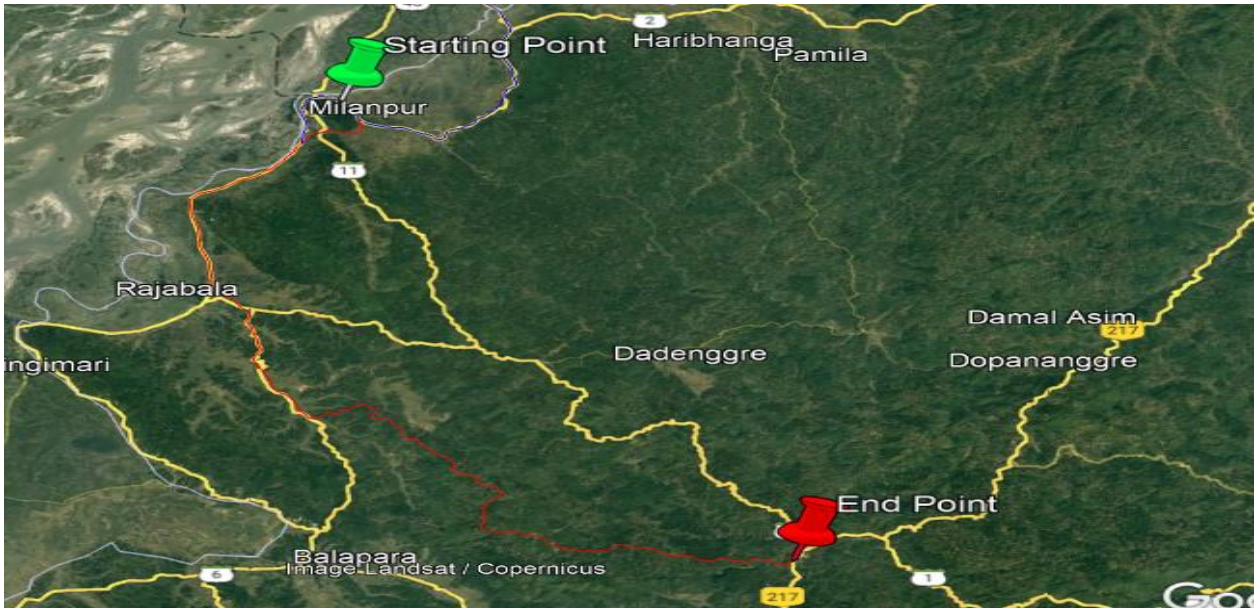
B. Project Background

Government of Meghalaya, India through PWD Roads National Highways has decided to take up the development of various National Highway corridors across Meghalaya for the augmentation of capacity for safe and efficient movement of traffic by widening and strengthening to standard 2 lanes with paved shoulders. The new National Highway 127B is one such corridor starting from Phulbari and connecting to Rongram near Tura (Meghalaya). Project road traverses through Nidanpur, Phulbari, Rajabala, Selsella & Babadamgare and Groigre en route to Rongram. This road passes through the only one district namely West Garo Hills of Meghalaya. The total length of New NH-127B is 62.000 Km. Initally, the total length of the road was 81.293 km. However, Chainage 0+000 km to 15+450 km was descoped later because the adjacent stretch is being improved under World Bank funding and one-time improvement may be allowed. Also, a bypass was taken up to minimize LA and RR in the town portion.

As per the JICA's guidelines for environmental and social considerations (2010)[1], a supplemental EIA is being undertaken to disclose the key environmental aspects before the intended stakeholder meetings**.**

C. Nature, Size and Location of Sub-project Road

The new National Highway 127B (Meghalaya) starts from Phulbari in Assam-Meghalaya border and connects to Rongram near Tura (Meghalaya). Project road traverses through Phulbari, Rajabala, Selsella & Babadamgare and Groigre enroute to Rongram. Alignment from Selsella to Goiragre is a new alignment consisting of existing village road on both end and cart track. Satellite image ofexisting road alignment of Nidanpur to Rongram road stretch is shown in Figure 2.



[1]https://www.jica.go.jp/english/our_work/social_environmental/guideline/index.html

Figure 2: Proposed Road Alignment of Phulbari to Rongram road stretch on satellite imagery

Starting Coordinates: Lat 25°53'16.00"N Long 90° 2'25.06"E
End point coordinates: Lat 25°35'4.19"N Long 90°14'22.97"E

The existing road has anumber of geometric deficiencies as the existing road is of Major District Road (MDR) standard and towns & villages are only connected with road facilities without proper geometrics. For the improvement of existing alignment, a number of realignments & bypasses are required with land acquisition at large extent. The longitudinal profile of the project road from Ch 0.000 to Ch 32.000 is generally flat / rolling gradients and these mostly appear to be within the maximum value permitted in the Standards. The vertical curves do not appear to meet the Standards at few locations in hill stretch from Ch 32.000 to Ch 62.200, also including approaches to major bridges, and this leads to reduced sight distance.
The high embankment sections are at approaches to major/minor Bridges. However, the part of project road which is in Brahmaputra River flood zone, requires significant road embankment to be kept high. On the other hand, for the road passing through hilly area and community forest, proper management plan should be implemented.

D. Objective and Scope of the Study

D.1. Objective of the project

The JICA guidelines require both EIA and RAP surveys due to the proposed project's "Category A" status. Processes of EIA and RAP preparation in the JICA Guidelines are different from that of Indian EIA Notification 2006 and its amendments thereafter. In order to evaluate the project's environmental impacts in accordance with the JICA guidelines, this Supplementary EIA is being conducted.

D.2. Scope of the Study

The scope of supplementary EIA study is presented in **Error! Reference source not found.**.

Table 1: Scope of study as per TOR

1	Air pollution	**Present and estimated values (quantitative)** 1. Impact of construction periods (by construction vehicles, and machinery) shall be evaluated quantitatively. 2. Impact of operation time (vehicles/trucks) evaluated in the same manner. 3. Mitigation measures shall be proposed, if necessary.	Quantitative analysis and discussion on mitigation measures. At least eight points should be selected for the 5 parameters (PM10, PM2.5, NOx, Sox, CO), make estimated values in at least 5 relevant locations in all parameters. Relevant areas shall be in the major residential areas in both construction and operations times. Comparison with EHS guidelines and other applicable international guidelines such as WHO. Detailed methodology shall be proposed.

2	Water pollution	**Present (quantitative) values and estimated impacts (qualitative)** 4. Turbidity dispersion of the major existing river, streams, and other channels along with the project site shall be evaluated. 5. Mitigation measures shall be proposed, if necessary.	Common 8 parameters of groundwater, and 39 parameters of surface water in at least 5 location eachshould bemeasuredat 4 locations. Discuss the estimated values in each location in both construction and operations times. Discussion on mitigation measures. Comparison with EHS guidelines and other relevant international guidelines such as WHO. Assumptions and countermeasures calculated from the increased risks based on expected the bridge constructions
3	Waste	**Present and estimated values(quantitative)** 6. Present waste management systems 7. Impact in both construction and operation periods shall be evaluated quantitatively. 8. Mitigation measures shall be proposed, if necessary.	Quantify the waste from the present management systems and estimated wastes volume and disposal during construction and operation, managementrecommendation through discussion with competent authorities as per C&D waste management rule 2016
4	Soil Pollution	**Present values (quantitative) and expected impacts (qualitative)** 9. Present values 10. Impactson both construction and operation periods shall be evaluated quantitatively. 11. Mitigation measures shall be proposed, if necessary.	Quantitative measures for common19 parameters in at least four locations. Estimate the impacts on soil contamination during both construction and operation and their mitigation measures. Relevant pollutants mentioned in the present EIA and other pollutants of international standards. Comparison with EHS guidelines and other relevant international guidelines such as WHO. A detailed methodology shall be proposed.
5	Noise and Vibration	**Present values and estimated values of noise/ vibrations (quantitative)** 12. Present values 13. The impact of transportation during construction time shall be evaluated quantitatively. 14. The impact of operation period shall be evaluated quantitatively. 15. Mitigation measures shall be proposed, if necessary.	**Noise:** **Present values**in at least 8 locations. Quantitative analysis and discussion on mitigation measures based on mathematical noise impact modelling[2]. Using the presentvalues, estimate the values in both construction and operation time

[2]Ref. Anticipated Impact, 5.3 Air Environment, Ministry of Environment & ForestsEIA GUIDANCE MANUAL – HIGHWAYS (2010)

			Vibration: Quantitative analysis and discussion on mitigation measures based on mathematical noise impact modelling Construction and Operation time shall be discussed in general and in the relevant areas (if any). Comparison with EHS guidelines and other relevant international guidelines such as WHO. A detailed methodology shall be proposed.
6	Bottom Sediment	**Present values and anticipated impacts** 16. Present values and estimated impact of bridge/pier construction. Discussions on sedimentation and erosion. 17. Mitigation measures shall be proposed, if necessary.	Present: investigate the planned bridge areas of at least **three (3)** representative rivers/creeks Quantitative analysis and discussion on mitigation measures. (Including the reviews of the engineer portion of the report) A detailed methodology shall be proposed.
7	Protected Area	**Present conditions and anticipated impacts** 18. Mapping of the protected areas, 10km radius map from the alignment 19. Consultants should qualitatively assess the impacts to the protected areas and propose mitigation measures.	Clarify the boundaries of the forest (FCA, community forest, other forests identified by the state rules) and prepare a GIS based map (ESRI/QGIS, etc. & Google earth), wildlife protected area (core and ESZ), and other designated area by authorities Describe the process of acquiring approval from the competent authorities for the required clearances. A detailed methodology shall be proposed.
8	Ecosystem	**Present and anticipated impacts** 20. Ecosystem data for two seasons (dry and rain) by primary data collection or secondary data collection 21. Terrestrial ecosystem (forests, hills) 22. Aquatic ecosystem (rivers, streams, wetlands) distribution and its composition 23. Comparison with the list of endangered species (IUCN red list categories, Attachment 2) 24. Distribution map of ecosystem (ecology map for mangrove,	Data collection: through the recognized ecological studies in the project region, additional primary survey or secondary data from other studies shall be collected. Consultation with recognised expert in the region shall be conducted before finalizing the baseline survey and impact assessment. MAP: GIS based and separate layers and

		seagrass bed), within the 10km radius, shall be developed using available data and supplemental field survey.	combined them with protected area map above with google earth kmz file Study on impact on ecosystems during construction and operation phase. Analysis shall be 10km radius from the ROW. Clarify whether there are seasonal ecosystem changes along the project area and, assess the seasonal impact if any, and propose practical mitigation measures referring to the available guidelines[3]. A detailed methodology shall be proposed.
9	Hydrology	**Present and anticipated impacts** 25. Impact on the existing rivers/creeks during and after completion of the bridge on the river 26. Mitigation measures shall be proposed, if necessary.	Quantitative/qualitative assessment of the hydrological change during construction and after the bridge and other structures on the river by the careful reviews of the engineer portion of the reports. A detailed methodology shall be proposed.
10	Topography and Geology	**Present and estimated conditions** 27. Detailed information shall be obtained to evaluate the appropriateness Construction period: civil works, such as cutting and filling will cause slope failures or landslides, soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites Operation period: soft ground on the route, landslides possibility, soil runoff 28. Mitigation measures shall be proposed, if necessary.	Consultants should pursue a detailed evaluation of the information of the existing studies. Qualitative evaluation after completion of the Bridge on the River A detailed methodology shall be proposed.
11	Working condition	**Present and anticipated impacts** 29. Working safety (legal frameworks & safety policies of -NHIDCL) shall be summarized. Improvement practices shall be proposed if it is necessary in accordance with national and JICA safety guidelines.	Review of relevant JICA appraisal reports and NHAI, NHIDCL safety guidelines and good practices into the EMP/EMoP A detailed methodology shall be proposed.
11	Accident	**Present anticipated impacts** 30. Review of the road accidents and their countermeasures in EIAs & Assessment of road accidents caused by increased vehicle traffic 31. Improvement plan of the safety management plan shall be proposed	Understanding of the present accident situation and authorities' policies and actions for safety measures based on the consultation with relevant authorities and statistics

[3]IRC SP 19-2001: "Manual for Survey, Investigation and Preparation of RoadProjects" and Wildlife Institute of India Manual on "Eco-friendly Measures to Mitigate Impacts of Linear Infrastructures on Wildlife", cf. MoRTH Circular No RW-NH-11013 /02/2019-S&R(P&B), 29/5/2019

		as per JICA safety guidelines, if necessary.	Based on the DPR, particularly construction plan, assumption of anticipated risks and propose national/regional good practices during construction and operation phase. Detailed methodology shall be proposed.
12	The cross border & Climate change	**Present and estimated values** 32. CO_2 emissions from the following items shall be estimated based on JICA Survey Team's construction plan and available secondary data. • Impact sources (construction stage): construction machineries, trucks, construction/transportation vehicles, cutter-suction dredgers • Impact sources (operation stage): increased trucks/vehicles for other areas based on present logistic patterns and their emissions 33. Estimation of CO2 emissions from the existing facilities based on available secondary data and hearing 34. General impact assessment of the present values includes a review of the Indian emission standards and a summary of the necessary actions by existing facilities Refer to: Basic Information and Data Collection Study on Connectivity Improvement in North Eastern Region of India Ch6. Final Report	Assumption of emission based on available secondary data and published data (ex. CO_2 emission factors, present logistic patterns) and recommendations on mitigation measures to reduce CO_2 emission. Discussion on ADDITIONAL CO_2 emission from new facilities in compliance with the India National Distribution Contribution (NDC) of the United Nations Framework Convention on Climate Change (UNFCCC) or other relevant national plans to reduce CO_2 emissions. Please also refer to Japan International Cooperation Agency (JICA) Climate Finance Impact Tool for Adaptation JICA Climate-FIT (Adaptation) and include in your methodology. Use: Highway Development and Management Model (HDM-4). HDM-4 can compute the estimated amount of CO2 emissions as well as the standard benefit items of travel time cost (TTC) savings and vehicle operating cost (VOC) savings.

E. Extent of the EIA

This Supplementary Environmental Impact Assessment (SEIA) report has been prepared on the basis of detailed engineering design, field investigations and stakeholder consultations to meet the applicable requirements as per prevailing policy statement. EIA extent has been decided considering all the risks involved and likely impacts in the context of the project's area of influence.The study area is considered up to 10 km on either side of road alignment for larger analysis of landuse and other environmental features**.**

E.1. EIA Objectives

The Supplementary EIA (SEIA) report covers the general environmental profile of the study area and includes an overview of the potential environmental impacts and their magnitude on physical,

ecological, economical, social and cultural resources within the project's area of influence during design, construction, and operation stages. It also reflects the gaps of environmental issues of previous EIA report (March 2020). An Environmental Management Plan (EMP) is also proposed as part of this report which includes mitigation measures for identified environmental impacts during construction and operation of the project, environmental monitoring program, and the responsible entities for mitigation and monitoring.

SEIA has four basic objectives; (i) identify the environmental issues that should be taken into account (ii) determine the magnitude of potential environmental concerns and to ensure that environmental considerations are given adequate weight at planning/design stage (iii) identify need for further environmental studies or EIA and (iv) suggest enhancement measures, if any**.**

F. Methodology Adopted for EIA Study

EIA commenced with the review of technical details provided by the DPR team and preceding environmental assessment reports conducted for the project road. This was followed by a reconnaissance site visit and discussion with the implementing agency to reconfirm the technical details of the project road improvement work. This helped to identify those environmental attributes which may get altered with the passage of time and incorporate additional information to the baseline environmental scenario/environmental setting of the project. Further steps followed for SEIA have been concisely described in following paragraphs**.**

Review of Country's Legal Framework: India has a well-defined policy/legal framework for the safeguard of environment. Prior to initiation of any civil work, it is essential to analyze the various permissions/clearances required for any developmental project. Same has been presented in later section of this chapter.

Primary Data Collection: Environmental resource inventory is prepared for all environmental features viz. terrain, landuse, waterways/water bodies, road side vegetation, sensitive receptors, common property resources, utilities, drainage, flooding/water logging, industries, accident prone areas etc. within the area of interest/core zone. Information about this will be done by trained persons under the supervision of an expert team. Baseline monitoring was conducted at the locations for which data was not available in the previous environmental assessment report conducted by a detailed design team.

Secondary Data Collection: Secondary sources include published government reports, environmental impact assessments conducted in the similar region, government websites, recognized institutions and relevant government departments (forest, irrigation, pollution control board, fisheries, statistics, Indian Meteorological Department (IMD) etc. Recent Google images have been captured to view environmental features at regional scale.

Public Consultation: Meaningful consultations were organized with the NHIDCL, local people/beneficiary population to know the level of project acceptability, understand their concerns, apprehensions, and overall opinion. Information was gathered about the existing baseline environmental condition viz. ambient levels and its effects on health, water resources, water logging/flooding, flora and fauna, socio-economic standing of local people, impact due to loss of land other assets and common property resources, accident risk during construction and operation stage, perceived benefits and losses, etc. Information thus gathered was used to integrate it in the project design and formulate mitigation measures and environmental management plan.

Other Tools, Surveys and Studies: Assessment of landuse of larger area beyond the project site has been prepared for better planning and decision-making. Remote sensing and Geographic Information System (GIS) based landuse map of the study area (10 km buffer) was prepared through recent satellite imagery. A rapid bio-diversity assessment was also carried out to generate

baseline on floral and faunal elements in the project area. The survey also helped in assessing impact on any rare threatened or endangered species of floral species in the project area. Extensive air, noise, water & soil quality monitoring & analysis has been carried out in the project road.

Assessment of Potential Impacts: The impact assessment has been done undertaken to ascertain whether the project is environmentally sustainable or not. Nature of impacts is classified as significant, insignificant, short-term, long-term, reversible, irreversible etc. After identification of nature and extent of impacts, mitigation measures have been suggested.

Preparation of the Environment Management Plan: The project specific Environment Management Plan (EMP) was formulated with an aim to avoid, reduce, mitigate, or compensate for adverse environmental impacts/risks and propose enhancement measures. This includes

- Mitigation of potentially adverse impacts
- Monitoring of impacts and mitigation measures during project implementation and operation
- Institutional capacity building and training
- Compliance to statutory requirements
- Integration of EMP with Project planning, design, construction and operation.

Environment Monitoring Plan: Monitoring involves periodic checking to ascertain whether activities are going according to the plan or not. It provides the necessary feedback for project management to ensure project environmental objectives are met and on schedule.

The reporting system is based on accountability to ensure that the mitigation measures are implemented efficiently. Environmental monitoring program has the underlying objective to ensure that the intended environmental mitigations are realized and these results in desired benefits to the target population causing minimal deterioration to the environmental parameters. Such program targets proper implementation of the EMOP. 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
- To enhance environmental quality through proper implementation of mitigation measures.
- To meet existing environmental regulatory framework and community obligations.

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 (PIs) for monitoring because of their regulatory importance and the availability of standardized procedures and relevant expertise. Performance indicators requiring quantitative measurements are:

- Air quality with respect to $PM_{2.5}$, PM_{10}, NO_x and SO_2 at selected location.
- Water quality as per CPCB prescribed standards
- Noise levels at sensitive receptors (schools, hospitals, community/religious places).
- Survival rates of trees planted as compensatory plantation.

Assessment of impacts to address the environmental concern of the project:
EIA assess the capacity of the executing agency for effective implementation of EMP. Accordingly, if needed, a training and awareness program will be formulated to enhance the capacity of officials for implementing proposed mitigation measures and monitoring the resultant effects, as well as create awareness amongst workers and public. The institutions/agencies like regional office of MoEF, SPCB/CPCB, and Indian Institute of Technologies can be consulted for such trainings. Independent subject's experts/consultants can also be the resource persons to impart trainings. A separate budget

for the training shall be allocated under the Construction Supervision Consultant budget**.**

F.1. Delineation of Project Impact Zone

The environmental impacts caused due to the development of the project road sections can be categorised as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project whereas the secondary impacts are those which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action.

The study area for the environmental screening is categorized in two influence areas:

i. **Corridor of Impact (CoI):** Proposed ROW of the alignment

ii. **Indirect influence area:** 10km around the project road.

F.2. Approach to Environmental Impact Assessment

Environmental Impact Assessment (EIA) is an assessment of the possible impacts, positive or negative, that a proposed project may have on the environment, together consisting of the natural, social and economic aspects. Its purpose is to identify, examine, assess and evaluate the likely and probable impacts of a proposed project on the environment and, thereby, to work out remedial action plans to minimize adverse impact on the environment.
For the purpose of a transparent presentation and evaluation, a tabulated evaluation (Table 2) has been applied. On the basis of a point scale, the severity of the particular environmental or social impact together with its general trend - that is, negative or positive - is described. The following evaluation scale is applied:

Extent of impact:

ΔΔΔ = high negative
ΔΔ = medium negative
Δ = low negative
Θ= nil
+ = locally positive
+ + = regionally positive

As a basis for the evaluation, the duration of an impactand the impact magnitude is estimated

Table 2:Impact Evaluation Matrix

Severity	**Duration**		
	Transient	Long Term	Irreversible
Catastrophic	Medium	High	High
Major	Low	Medium	High
Minor	Low	Low	Medium

The severity classification is presented below on a qualitative scale. It may be noted that severity of magnitude ‘Notable’ has been treated in this project as ‘Nil’.

Table 3: Severity classification based on a qualitative scale

Effect	Area	Air	Water	Waste	Biodiversity	Resources	Regulation	Society
Catastrophic	Extending Over a wide Area 50 km^2 from site	Significant Acute impact On the receptor(s) potentially Leading to fatality. Significant Deterioration ofAir quality on aNational and Regional level.	Regional or Inter-state contamination or depletion of potable groundwater. Regional or inter-state contamination of marine environment.	Significant uncontrolled generation, handling, Storage or Disposalof priority hazardous Waste leading tocatastrophic contamination of valued groundwater, soil and/or loss of non- renewable natural resources.	Significant Effect on regionally important attributesof the ecological environment is observable or measurable over a wide area notified by National authorities	Significant damage to archaeological, culturalor natural resources regional /international importance.	Constant very high exceedance of statutory or prescribed limits (Assessed not To be ALARP) Immediate Intervention by Third parties or governmental body	High profile community outrage/ repeated complaints
Major	Extending Over 10 km^2 from site	Acute impact On the receptors. Significant Deterioration ofAir quality on a national level.	Serious local contamination or depletion of potable groundwater. Serious local Orconsiderable national contamination of marine environment.	Serious uncontrolled generation, handling, storage or disposal of hazardous waste leading to serious contamination of valued groundwater, soil and/or loss of non- renewable natural resources.	A serious effect on locally important attributes of the ecological environment is observable or measurable locally.	Serious damage to archaeological, cultural or natural resources of national importance.	Repeated Exceedance of Statutory or prescribed limits (Assessed not To be ALARP) Significant Alarm raised by Third partiesor governmental body with instruction to mitigate	Serious community concern and complaints.

Effect	Area	Air	Water	Waste	Biodiversity	Resources	Regulation	Society
Minor	Extending Over 10,000 m^2 area.	Limited Deterioration of Air quality on a limited level. Some odor And irritation Caused by Deterioration of air quality	Limited Degradation of potable groundwater quality or reduction of its volume Limited contamination of marine environment.	Limited uncontrolled generation, handling, storage or disposal of waste leading to limited loss of natural resources and/or land contamination without putting valued ground- water at risk.	A limited effect on significant attributes of the ecological environment is observable or measurable	Limitedimpactonnatural resourcesordamage any archaeological or cultural resources of local importance.	Few Exceedance of Statutory or prescribed limits but assessed to be ALARP No complaint from third parties or governmental body	Some community concern raised.
Notable	Measurable above background Confined within Fenceline	Slightchange of ambient air quality over a limited area. Some local influence.	Slight degradation of quality or reduction of volume of potable groundwater. Some contamination of marine environment.	Controlled generation, handling, storage disposal of waste.	Negligible effectonany attribute of the or ecological ofenvironment is observable or measurable above background.	Some impact on natural resources or damage to archaeological or cultural resources.	No exceedance of statutory or prescribed limits but assessed to be ALARP. No third party or government concern.	No Possible community focuses.

G. Structure of the Report

SEIA has been structured based on JICA Guidelines for Environmental and Social Considerations (April, 2010) as presented bellow;

Chapter 1 – Introduction
Chapter 2 – Policy, Legal and Administrative Framework
Chapter 3 – Project Description
Chapter 4 – Analysis of Alternatives
Chapter 5 – Baseline Environmental Studies
Chapter 6 –Anticipated Environmental Impacts and Mitigation Measures
Chapter 7 – Public Consultation & Information disclosure
Chapter 8 – Environmental Management Plan, Monitoring Plan
Chapter 9 – Grievance Redress Mechanism
Chapter 10 – Conclusions and Recommendations.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

India has well defined institutional and legislative framework. The legislation covers all components of environment viz. air, water, soil, terrestrial and aquatic flora and fauna, natural resources, and sensitive habitats. The Ministry of Environment, Forest & Climate Change made it mandatory for introducing environment assessment into the planning process of road projects as well as environmental impact appraisal as per Environmental Protection Act, 1986. The MoEFCC have assigned all central and State authorities to develop policies towards protection of environment for any infrastructure development activities as per the act. The Ministry of Environment, Forest & Climate Change (MoEFCC) has overall authority for the administration and implementation of government policies, laws and regulations. In the present project the environment acts, policy guidelines of both State and Central Government will be applicable. The environmental management and protection policies, regulations and administrative framework governing the project is reviewed in this section. The review includes sector-specific environmental policies & regulations of the Government of India, State Govt of Meghalaya, JICA Guidelines for Environment and Social Considerations (2010), and the administrative framework of various agencies, such as the MoEF&CC, the State Pollution Control Boards (SPCB) and other bodies associated with the implementation of the proposed project. The following subsections summarized the legislative framework in which the present project will be addressed with respect to the environment including social issues.

A. National Laws & Regulations

The Government of India has formulated various policy guidelines; acts and regulations aimed at protection and enhancement of environmental resources. The following table surmise the existing legislations pertaining to the project, the various clearances required for the project and the status as on date.

Table 4: Relevant National Environmental Laws & Regulations

The Environmental (Protection) Act. 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes.	All environmental notifications, rules and schedules are issued under the act.	MoEF. (Govt. of Meghalaya) State Gov. SPCB
The EIA Notification, 14th September 2006 and subsequent amendments	The EIA Notification of 2006 set out the requirement for environmental assessment in India. Environmental Clearance is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence.	No	Environmental clearance is not required as project activity does not attract provisions of EIA notification 2006 and its amendment till date.	MoEF SEIAA
Water (Prevention and Control of	Act was enacted to provide for the prevention	Yes	Consent to Establish (CTE) before start of	SPCB

Pollution) Act of 1974, Rules of 1975, and amendments (1987)	and control of water pollution and the maintaining or restoring of wholesomeness of water, by Central and State Pollution Control Boards and for conferring on and assigning to CPCB/SPCBs powers and functions relating to water pollution control. Such projects have to obtain Consent to Establish (CTE) under Section 25 of the Act from State Pollution Control Board (SPCB) before starting implementation and Consent to Operate (CTO) before commissioning.		construction works and Consent to Operate (CTO) before start of operation will be required for (if any)- • Batching Plant • Hot mix plants; and • Sand mining	
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	This Act was enacted to achieve prevention, control and abatement of air pollution activities by assigning regulatory powers to Central and State boards for all such functions. The Act also establishes ambient air quality standards.	Yes	Following will require CTE and CTO from SPCB: Establishment of DG sets more than 10 KVA. • Batching Plant • Hot mix plants; and • Crushers • Sand mining, if any	SPCB
Noise Pollution (Regulation and Control) Rules, 2000 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	Yes	Ensure applicable noise standards and noise limits for DG sets.	SPCB
Central Motor Vehicle Act Central Motor Vehicle Rules and (Amendment) Rules (1988 and amendment thereafter)	Objective of this Act is to check vehicular air and noise pollution. Vehicles to be used for construction and other purposes need to meet the standards and certificates prescribed as per the Rules, 1989 to control noise, pollution, etc.	Yes	Ensure vehicle exhaust emission standards.	Motor Vehicle Department
Ancient Monuments and Archaeological Sites and Remains Act, 1958 and Ancient Monuments and Archaeological	The Act designates areas within 100 meters (m) of the "protected monument/area" as "prohibited area" and beyond that up to 200 m as "regulated area" respectively. No	No	Not applicable as no such monuments within the project corridors.	National Monument Authority

Sites and Remains (Amendment and Validation) Act, 2010	"construction" is permitted in the "prohibited area" and any construction activity in the "regulated area" requires prior permission of the Archaeological Survey of India (ASI).			
Seventy Third Constitution Amendment Act 1992	This act guides governments to establish rules for Panchayat involvement in project preparation and implementation. The Act stipulates involvement of the institutions especially, the Gram Sabha/ Panchayat during project preparation and implementation. The Panchayats at the village level will be involved for preparation and implementation of the project.	Yes	Ensure involvements of Gram Sabha/Gram Panhayat in the project design.	Ministry of Rural Development, Panchayat
Labor Laws	The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractor shall provide equal wages and benefits to men and women for work of equal value or type.	Yes	Applicable labor laws including amendments issued from time to time applicable to establishments engaged in construction of civil works.	Ministry of Labor and Employment
Wildlife Protection Act, 1972 amendment 1991	This overarching Act provides protection to wild animals, birds, plants and matters connected with habitat protection, processes to declare	No	There is no national park, wildlife sanctuary along the project road. Furthermore, the project road does not come under any ESZ.	Forest Department, GoI and Govt. of Meghalaya

	protected areas, regulation of wildlife trade, constitution of state and national board for wildlife, zoo authority, tiger conservation authority, penalty clauses and other important regulations.			
Forest (Conservation) Act, 1980	The Forest (Conservation) Act prohibits the use of forest land for non-forest purposes without the approval of Ministry of Environment and Forests and Climate Change (MoEF&CC), Government of India	No.	This particular project road widening and improvement work does not require diversion of significant forest land	Forest Department, GoI and Govt. of Meghalaya
Solid Waste Management Rules 2016	Responsibility of Solid Waste Generator (i) segregate and store the waste generated in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized waste pickers or waste collectors as per the direction or notification by the local authorities from time to time.	Yes	Contractor to follow all the rules during construction works.	SPCB and local municipality
Construction and Demolition Waste Management Rules 2016	(i) Every waste generator shall segregate construction and demolition waste and deposit at collection centre or handover it to the authorized processing facilities (ii) Shall ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains. (iii) Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and	Yes	Contractor to follow all the rules during construction works.	SPCB and local municipality

	get appropriate approvals from the local authority before starting construction or demolition or re-modeling work, (iv) Large generators shall have environment management plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal / reuse of C & D Waste. (v) Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar, Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities;			
Hazardous Waste Rules 2016	Responsibilities of the occupier for management of hazardous and other wastes. - (1) For the management of hazardous and other wastes, an occupier shall follow the following steps, namely: - (a) prevention; (b) minimization; (c) reuse, (d) recycling; (e) recovery.	Yes	Contractor to comply all the requirements of this Act during construction works.	SPCB
Notification for use of fly ash, 25.01.2016	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	Yes	Bongaigaon NTPC (63km away from project road)	MOEF&CC
Office memorandum dated 18.05.12 by MoEF in view of Apex Court order dated 27.2.2012	Conserve top soil, aquatic biodiversity, hydrological regime etc. by haphazard and unscientific mining of minor minerals	Yes	In case of renewal of quarries and opening of new borrow areas	SEIAA
National Environment Appellate Authority Act (NEAA) 1997	Address Grievances regarding the process of environmental clearance.	No	This project will not require environmental clearance.	NEAA

Public Liability and Insurance Act 1991	Protection from hazardous materials and accidents.	Yes	Contractor needs to stock hazardous material like diesel, Bitumen, Emulsions etc.	SPCB
Minor Mineral and concession Rules	For opening new quarry.	Yes	Regulate use of minor minerals like stone, soil, river sand etc.	District Collector
The Explosives Act (& Rules) 1884 (1983)	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying.	No (Not anticipated)	New quarrying operation	Chief Controller of Explosives
Manufacture, storage and Import of Hazardous Chemical Rules 1989	Storage of fuel oil, lubricants, explosives, diesel etc. at construction camp.	Yes	Storage of hazardous material	State Pollution Control Board & PESO.
Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Protection against chemical accident while handling any hazardous chemicals resulting	yes	Handling of hazardous (flammable, toxic and explosive) chemicals during road construction	District & Local Crisis Group headed by the DM and SDM
International conventions and treaties				
Ramsar Convention, 1971	The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. India is one of the signatories to the treaty. The Ramsar convention made it mandatory for the signatory countries to include wetland conservation in their national land use plans.	No	Not applicable to this project as there is no declared site within the vicinity of the project.	-
Wetlands (Conservation and Management) Rules, 2017	The Rules specify activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents, and reclamation. The Central Government may permit any of the prohibited activities on the	No	Not applicable as project components are not located in designated wetland area.	-

	recommendation of Central Wetlands Regulatory Authority.			
Montreal Protocol 1992	India is a signatory of this convention which aims to reduction in the consumption and production of ozone-depleting substances (ODS), while recognizing differences in a nation's responsibilities. Ozone depleting substances are divided in two groups Chlorofluorocarbons (CFCs) and Hydro chlorofluorocarbons (HCFCs).	No	Not applicable in this project as no ODS are involved in construction works.	-
Basel Convention on Trans-boundary Movement of Hazardous Wastes, 1989	India is a signatory of this convention which aims to reduce trans-boundary movement and creation of hazardous wastes.	Yes	Contractor to follow the provisions of Hazardous Waste Rules 2016 for storage, handling, transport and disposal of hazardous waste generated during construction works/operational activities.	-
Convention on Migratory Species of Wild Animals (CMS), 1979 (Bonn convention)	CMS, also known as Bonn convention was adopted in 1979 and entered into force on 1 November 1983, which recognizes that states must be the protectors of migratory species that live within or pass through their national jurisdictions, and aims to conserve terrestrial, marine and avian migratory species throughout their ranges. CMS Parties strive towards strictly protecting these species, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.	No	Not applicable to this project as no migratory species of wild animals are reported in the project areas.	-

Based on the conversation with Meghalaya PWD (Reference – Annexure 2), it is known that, this project road does not come under any Eco Sensitive Zone (ESZ). Hence wildlife clearance may not be required for this project road.

A.1. Environmental Categorisation as per MoEF&CC

According to the Environmental Impact Assessment Notification, dated 14th September 2006 (amended till date) various development projects and activities require prior Environmental Clearances. All these projects and activities are categorized into two categories - Category A andB, based on the spatial extent of potential impacts on human health, natural and manmade resources.

The requirements for highway projects are specified in schedule item 7(f) of the Notification, 2006,

		A	**B**	
(1)	(2)	(3)	(4)	(5)
7 (f)	Highways	(i) New National Highways; and (ii) 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.	(i) All New State Highway Projects; and (ii) State Highway expansion projects in hilly terrain (above 1000 MSL) and/or ecologically sensitive areas.	General Condition shall apply. General Conditions: Any project or activity specified in Category 'B' will be treated as Category 'A', if located in whole or in part within 10km from the boundary of: i) Protected Areas notified under Wild Life (Protection) Act, 1972; ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time; iii) Notified Eco-sensitive areas; iv) Inter-state boundaries and international boundaries. Note: Highways include Expressways.

The project includes the widening and strengthening of National highway with length less than 100km. Therefore, the project does not belong to Category 'A' projects. Further, this being a National Highway, Category 'B' is also not applicable. Hence, this project does not require prior 'Environmental Clearance' as per EIA Notification, 2006 and amendments made thereafter.

B. State Laws & Regulations

The following table shows lists the state legislations and which clearances are required from the state. Further, Table 5 details estimated time requirements for various clearances, agency responsible for obtaining clearance, and the stage at which these clearances will be required.

Table 5: Summary of Clearances & NOCs Applicable as per State Legislation

1.	Tree felling permission	State Department of Environment and Forest	Felling of trees	Pre construction	1-2 months

2.	NOC And consents under Air, Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For establishing Hot mix plants and batching plants.	Construction (Prior to work initiation)	2-3 months
3.	NOC and consents under Air, Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For operating Hot mix plants & batching plant,	Construction (Prior to work initiation)	1-2 months
4.	Permission to store Hazardous Materials	State Pollution Control Board	Generation, Storage and Transportation of Hazardous Materials and Explosives	Construction (Prior to work initiation)	2-3 months
5.	PUC certificate for use of vehicles for construction	Department of Transport	For all construction vehicles	Construction (Prior to work initiation)	1-2 months
6.	NOC for water extraction for construction and allied works	Ground Water Authority	Ground water extraction	Construction (Prior to work initiation)	2-3 months
7.	NOC for establishment of DG sets of capacity more than 10 KVA	State Pollution Control Board	For use of DG sets	Before use of DG sets	1-2 months

Table 6: Summary of Clearances & NOCs Not Applicable for this Sub-Project

1	Prior Environmental Clearance	MoEF / SEIAA	Not a category A / B project
2	Permission for Activities near archaeological protected area	Archaeological survey of India / the state department of Archaeology	No Archaeological structures in the project road
3	Diversion of Sanctuary land / Permission for road construction	NBWL	Project road is not passing through any sanctuary

C. Social Regulatory Requirements in India

There are many rules and regulations framed by the Government of India for the protection of workers. Most of these legislations will be applicable to contractors in charge of construction. EA will ensure compliance to these social legislations through contractual obligation and regular checks & penalties. These legislations include;

- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996;
- Child Labour (prohibition and Regulation) Act, 1986;
- Minimum Wages Act, 1948;
- Workmen Compensation Act, 1923;
- Payment of Gratuity Act, 1972;
- Employee State Insurance Act; Employees P.F. and Miscellaneous Provision Act, 1952;
- Maternity Benefit Act, 1951;
- Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013, Govt. ofIndia;
- RFCTLARR (Removal of Difficulties) Order, 2015;

- The Meghalaya Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2015;
- Scheduled Caste and Scheduled Tribes Orders (Amendment) Act, 2002;
- The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; National Tribal Policy, 2006;
- Payment of Wages Act, 1936;
- Equal Remuneration Act, 1979;
- Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act, 1979;
- Equal Remuneration Act, 1979 etc.

D. JICA Safeguard Policy

In accordance with JICA's Guidelines for Environment and Social Considerations **(ESC)** is a pre-requisitefor all project funded by JICA. If a significantly adverse impact on the environment or society is identified in JICA-assisted project, following steps are taken:

1. ESCs are pre-requisite

a. JICA will take necessary measures to ensure that the appropriate ESC is given;

b. When JICA reviews a project proposal and finds that the project could cause negative impacts on the environment or society, JICA advises the project proponents to provide appropriate ESC;

c. If the negative impact of the project cannot be avoided or mitigated to an acceptable level, JICA will not support its implementation.

2. Respect human rights

a. Development project should aim for fair distribution of its benefits and must not burden or exclude certain stakeholders for the sake of others;

b. The project proponents must respect the rights of all people concerned, and pay special attention to vulnerable social groups such as women, elderly, the poor, people with disabilities, indigenous peoples, ethnic minorities, and other minority groups to ensure that they are involved in decision-making processes and that they benefit from the project;

c. JICA's ESC Guidelines defines 'stakeholders' as local residents including non- titleholders who are affected by the project as well as local NGOs. By involving local stakeholders from the early stage of the project, the project proponents can receive their inputs and plan appropriate measures to address their concerns, avoid conflict, and achieve higher results with their support. For this reason, the project proponents should conduct a series of consultations with local stakeholders in an interactive and meaningful manner. During this process, appropriate consideration must be given to socially vulnerable or different people such as women, children, the elderly and ethnic minorities.

3. Avoid adverse impacts

a. Priority should be given to the avoidance of adverse impacts on the environment or society when a project is planned;

b. Minimization or mitigation of impacts should be considered only if avoidance is not feasible and if the benefit of the project outweighs the cost of mitigation measures;

c. The project proponents must assess the environmental and social impacts at the earliest possible stage of planning, and implement ESC measures in accordance with the ESC Guidelines.

4. Information on ESC must be disclosed to the public

a. Information disclosure is key in ESC. Project proponents must proactively release relevant information to the public;

b. Sharing information with a wide range of stakeholders from the early stage, the project proponents can utilize their feedback to improve the plan/project. In addition, the project proponents can ensure that unnecessary concerns and misunderstandings among the stakeholders are ameliorated.

5. Host country's laws, standards, policies and plans

a. JICA-funded project must comply with the laws, standards, policies, and plans of the host country;

b. If the standard set by the host country differs from the international standard, the project proponents are advised to adopt international standard that better serves the purpose of attaining a higher level of ESC.

D.1. Categorization of the Project as per JICA Safeguard Policy

Projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and projects located in or near sensitive areas are consider as Category A project as per JICA guideline (April 2010)[4]. In accordance with Appendix 3 of JICA Guideline, flood plain and erosion prone areas and primary forests or natural forests in tropical areas are considered as sensitive areas. Hence some part of the project road is located in flood prone area and most of the project road is located close to primary or natural forests, it comes under category A project as per JICA guidelines for environmental and social considerations (April, 2010).

[4] https://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf

3. PROJECT DESCRIPTION

A. Introduction

The project road is currently a single lane/ Intermediate Road. The total length of the road is about 62.000 km (as per Design length).

The project road is of significant importanceThe project road is traverses in plain terrain passing through rural areas as well as few intermittent semi-urban and community forests areas. 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 3.75 m to 7 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.

B. Project Type

The improvement proposal consists 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 for reconstruction / widening / new construction of Hume Pipe Culverts / Slab drains to meet the National Highway standards.

C. Project Details

C.1. ProjectLocation

The new National Highway 127B (Meghalaya) starts from Phulbari in Assam-Meghalaya border and connecting to Rongram near Tura (Meghalaya). Project road traverses through Phulbari, Rajabala, Selsella & Babadamgare and Groigre enroute to Rongram. Alignment from Selsella to Goiragre is a new alignment consisting of existing village road on either end andboth end and cart track.

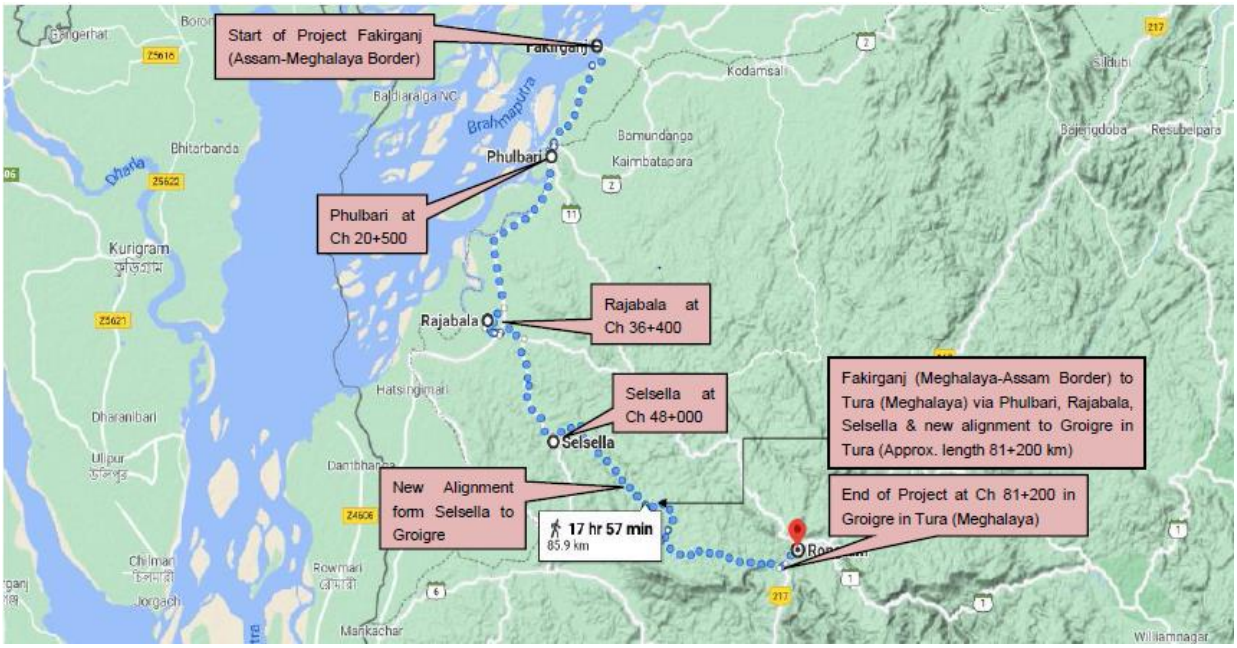


Figure 3: Existing Road Alignment fromFakirganj to Rongram via Phulbari road stretch on satellite imagery

C.2. Settlement along the project road

Project Road traverse through mainly semi-urban and rural settlements. The towns/ Built-up section along the stretch are not many and small with pockets of habitation. The following are the major built-up places on the project stretch and also shown below. Surrounding road network and places along the project road is shown in Figure 4.

- Phulbari Village at Ch 0+500
- Rajabala Village at Ch 18+700
- Selsella Village at Ch 30+500
- Rangrigiri Village at Ch 32+200
- Chambagiri Village at Ch. 33+300
- Tura City Built-up towards the end

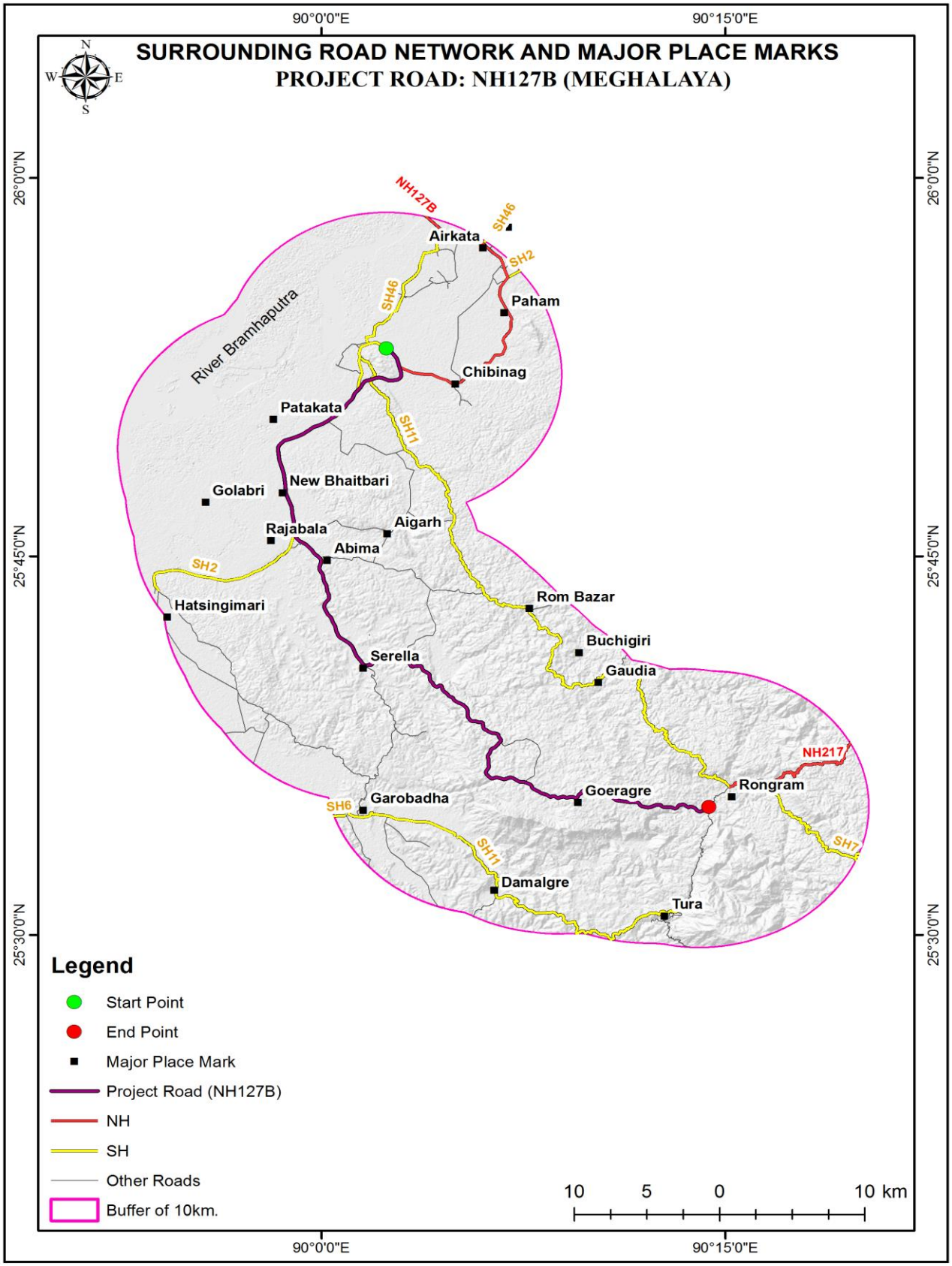


Figure 4: Map showing surrounding road network and major place marks along the road within a 10 km radius

C.3. Terrain type

The terrain on this stretch is broadly divided into three parts, section one from Ch 0+000 to Ch 9+500 (9.500 km) is mostly plains, second section from Ch 9+500 to 30+500 (21.0km) is both mostly plains and rolling whereas last section from Ch 30+000 to Ch 62+000 is mostly rolling and hill section. The topography is mostly rural in nature. Satellite Image of the terrain classification along the project road area within a 10 km radius is shown in Figure 5.

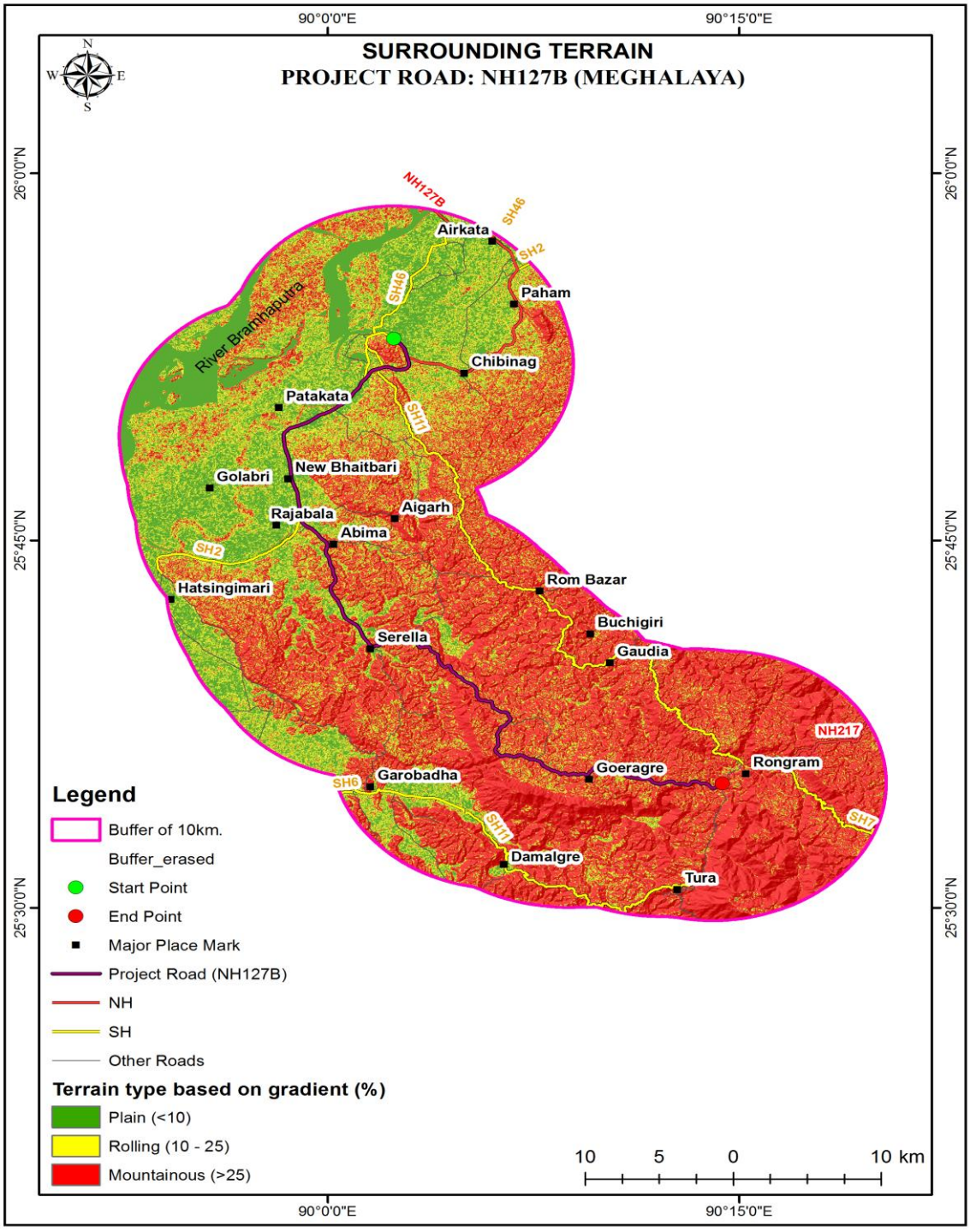


Figure 5: Satellite Image of terrain classificationalong the project road around a 10 km radius

C.3. Land Use Pattern

The abutting land use pattern includes built up areas, agricultural land, Forest land and barren lands along the Project Highway.Satellite Image of land use of the project road area is shown in Figure 5.

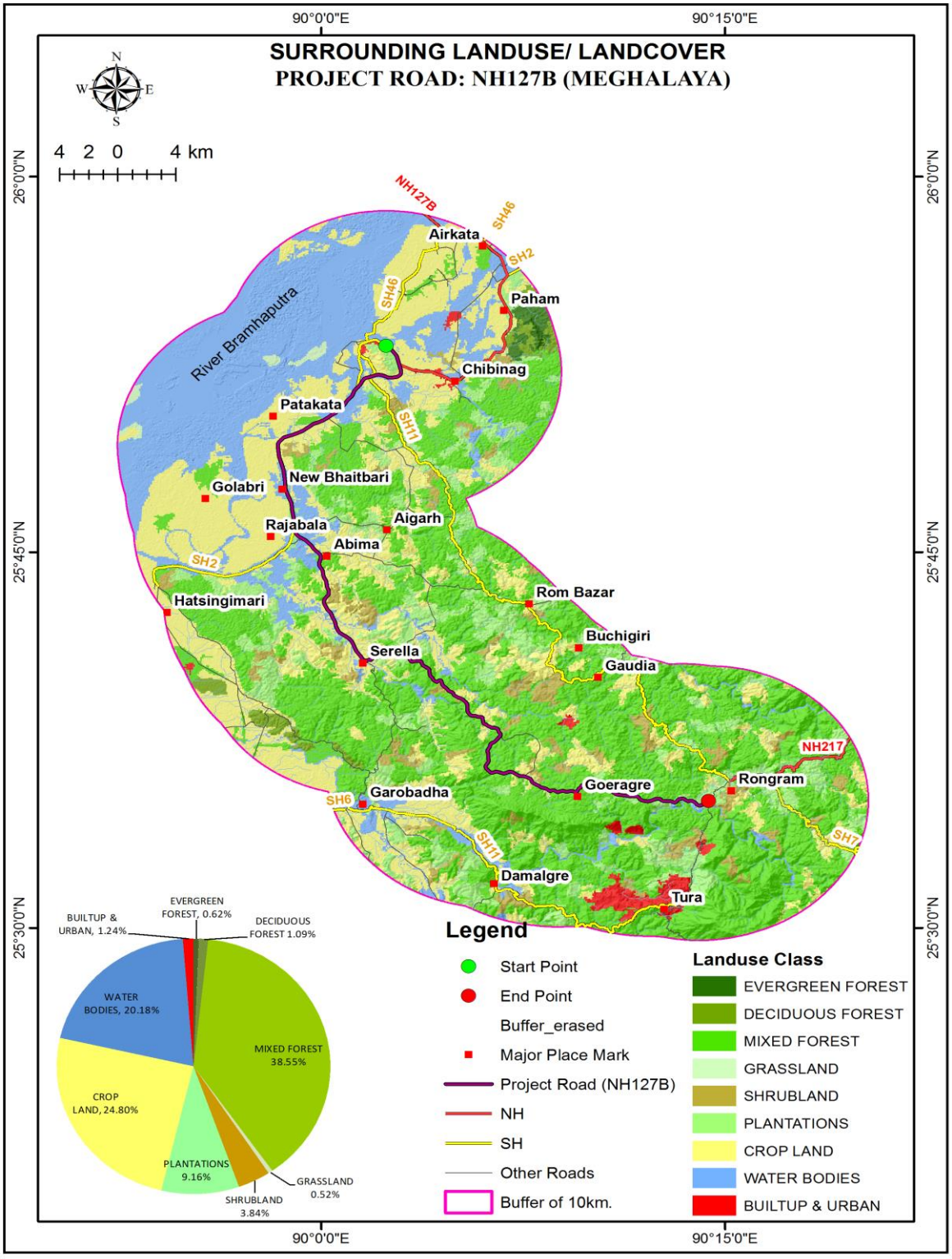


Figure 6: Satellite Image of Land Use along the project road within a 10 km radius

C.4. Right of Way (ROW)

Right of Way (RoW) is observed at number of locations along the project road. Considering that stretch is passing through plan & rolling / hill terrain and also through settlement, it is expected that existing right of way to vary from 15m to 30m. Proposed improvements on NH127B require a right of way of 25-30m for stretch between Phulbari to Selsella & 20-25m for stretch between Selsella to Groigre. 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.

C.5. Pavement Condition

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.

C.6. Main Carriage Way

The existing carriageway width is generally 3.5m to 5.00m. 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.

C.7. Typical Cross Section Details

The **Error! Reference source not found.**showing below is the proposed project length after geometric improvement of the project road.

Table 7: Widening/Improvement Proposal

Sl no	Length(m)	TCS	Section	TCS Details
I	10410	TCS-1	Rural Section	Typical cross section for 2-lane Widening / reconstruction with 2.50m paved shoulder in both sides in rural area
II	15040	TCS-1A	Rural Section	Typical cross section for 2-lane widening / realigment with 2.50m paved shoulder in both sides in rural area. New Construction due to Geometric Improvement.
III	21730	TCS-2	Urban Section	Typical cross section for 2-lane widening / reconstruction with 2.50m paved shoulder in both sides in urban area
IV	820	TCS-2A	Urban Section	Typical cross section for 2-lane widening / realigment with 2.50m paved shoulder in both sides inUrban area. New Construction due to Geometric Improvement
v	16150	TCS - 3	Rural Section	Typical Cross Section For 2-Lane widening / reconstruction with 0.90m paved shoulder in one side hill & one side valley

Sl no	Length(m)	TCS	Section	TCS Details
VI	3065	TCS – 3A	Rural Section	Typical cross section for 2-lane Realignment with 0.90m paved Shoulder in one side hill & one Side valley
VII	11740	TCS – 4	Rural Section	Typical cross section for 2-lane widening / reconstruction with 0.90m paved shoulder in one side Hill & one side valley
VII	2340	TCS – 4	Rural Section	Typical cross section for 2-lane Realignment with 0.90m paved Shoulder in one side hill & one Side valley

C.8. Intersections

The existing project road has a number of junctions mainly with village roads. Junctions have been classified into “Major” and “Minor” junctions according to functional importance and future prospects. At most of “Major” junctions channelized at-grade junction improvement has been proposed. Traffic island and rotary have been provided wherever necessary to channelize flow of traffic and minimize collision points and increase road safety. There are 4 Nos of major intersections present along the project stretch mainly with National highways and State highways along with many minor junctions with other categories of roads. The details of Major junctions are shown in given below.

- Major Junction with SH-02- Three Leg Junction
- Major Junction with SH-46-Three Leg Junction
- Major Junction with SH-11-Three Leg Junction
- Major Junction with Old NH127B-Three Leg Junction

C.9. Details of Service Roads (data is awaited from DPR consultant)

C.10. Major and Minor Bridges

Bridges, culverts form a vital link between the road sections and are basic infrastructure elements in any highway network. Bridges, in India, are categorized as follows:

Major Bridge	Total length exceeding 60 m
Minor Bridge	Total length upto 60 m, but exceeding 6 m
Culverts	C D Works of length upto 6 m.

The existing alignment includes 21 minor bridges and 221 number of cross drainages structures. 2 nos. of existing major bridges have been proposed for reconstruction and one major bridge has been retained. Moreover 19 no. of minor bridges has been proposed in the project road. All existing minor and major bridges proposed for reconstruction / widening / new construction will be as per standards of MoRT&H. Details of major and minor bridges are given below;

Table 8:Details of Minor bridges

Sl no	Proposed Chainage	Span Arrangement	Span/Dia	Type of structure	Type of Work
1	18+015	1	15	Minor Bridge	Reconstruction
2	18+578	1	15	Minor Bridge	Reconstruction
3	22+140	2	25	Minor Bridge	Retained

Sl no	Proposed Chainage	Span Arrangement	Span/Dia	Type of structure	Type of Work
4	24+537	1	10	Minor Bridge	Retained
5	26+025	3	25	Minor Bridge	Retained
6	27+345	2	19	Minor Bridge	Retained
7	28+364	1	25	Minor Bridge	Retained
8	29+329	1	15	Minor Bridge	Reconstruction
9	35+440	2	22.5	Minor Bridge	Retained
10	36+095	1	10.8	Minor Bridge	Retained
11	37+044	2	25	Minor Bridge	New Construction
12	43+845	2	19	Minor Bridge	New Construction
13	44+980	1	20	Minor Bridge	New Construction
14	62+090	1	15	Minor Bridge	Reconstruction
15	62+209	1	15	Minor Bridge	Reconstruction
16	67+252	1	30	Minor Bridge	Reconstruction
17	68+212	1	15	Minor Bridge	Reconstruction
18	79+900	1	35	Minor Bridge	New Construction

Figure 7: image of existing major bridge at chainage 12+400km

Figure 8: image of existing minor bridge at chainage 18+015km

C.11. Culverts

There are 221 nos. of culverts are proposed out of which 122 nos. are Pipe culverts and99 no. is RCC Box culvert/slab culverts. The details of the existing and new proposals are given in Table 9

Table 9: Details of Culverts

Type	PipeCulvert	Slab / BoxCulvert	Total
To be widened	-	-	-
To be reconstructed	83	48	131
New construction	39	51	90
Numbers to be Retained	-	-	-
Numbers to be Abandoned	-	-	-
Total no. of Structures	122	99	221

C.12. Vehicular Underpass/Light Vehicular Underpass

There is no Vehicular Underpass and Light Vehicular Underpasses in the existing project road stretch.

C.13. Road Over Bridges(ROB)and Level Crossing

There is no existing manned railway crossing (LC)/ROB in the existing project road stretch.

C.14. Bypasses

There is1 number of by pass proposed along the project road. The bypass should be taken up to minimize LA and RR in the town portion.

C.15. 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,

The perimetral cut-off walls will also increase the effective depth of foundation in addition to their protective functions.

C.16. Miscellaneous Works

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.

Crash Barriers (CB) - Steel Single W-Beam Metal Crash Barrier shall be installed mainly at major hazard locations. It will also generally be installed on sections of the road (a) where the embankment height is more than 3m (b) bridge approaches and (c) on the outside of curves. These Guardrails shall be installed along the edge of the outside shoulder with an offset of 2.5m from the edge of the pavement of carriageway.

Guard Posts- Guard posts are proposed on embankments of height more than 1.0m, bridge approaches and horizontal curves of radius greater than 170m. The spacing of guard post shall be 2.0m c/c inthese areas. Typical Guard post consists of precast (M20) post of size 200mm x 200mm and aheight of 600mm above ground level. They are encased in M15 cement concrete for a depthof 450mm below ground level. Guard posts are painted with alternate black and whitereflective paint of 150mm wide bands.

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. 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.

D. Traffic Projection

Three homogeneous sections have been identified for traffic study.

The ADT along different sections of the project Highway vary between a minimum of total 810 vehicles (611 PCUs) at Km. 47.200 to a maximum of total 4268 vehicles (3675 PCUs) at Km. 19.500. From survey location Km. 19.500 to survey location Km. 47.200, the traffic levels are highly reducing along the project stretch, as the traffic is diverting towards Singimari at Rajabala junction Km. 38.250. Again, traffic flow levels are increasing along the project stretch by the addition of traffic from Singimari at Mitali
junction Km. 62.750. Based on traffic flow intensity along the project stretch, it can be divided into three homogeneous sections. First homogeneous section is from starting of the project stretch to Rajabala Junction at Km. 38.250, second is from Rajabala junction to Mitali Junction at Km. 62.750 and the third is from Mitali junction to end of the project stretch, i.e., upto Tura.

Table 10: Classified Traffic Volume Count

Vehicle Type	Km. 19.500		Km. 47.200		Km. 67.200	
	To Phulbari	To Nidanpur	To Rajabala	To Selsella	To Tura	To Garobadha
Two Wheelers	1004	1018	311	303	498	558
Auto Rickshaw (Pass & Goods)	830	806	123	108	316	341
Car/Jeep/Van	179	207	70	69	331	396
Taxi	56	64	6	4	45	28
Mini Bus	6	4	8	8	31	19
Standard Bus	24	18	6	8	50	43
LCV	11	14	5	4	21	25
2Axle	19	14	3	3	24	26
3Axle	0	1	0	0	3	4
MAV	1	1	0	0	0	0
Tractor	1	0	0	0	0	0
Tractor	1	0	0	0	0	0

Vehicle Type	Km. 19.500		Km. 47.200		Km. 67.200	
	To Phulbari	To Nidanpur	To Rajabala	To Selsella	To Tura	To Garobadha
Trailer						
Cycle	350	324	6	6	60	35
Cycle Rickshaw	222	219	0	0	0	0
Animal Drawn Vehicles	0	0	0	0	0	0
Hand Cart	1	2	0	0	0	0
Others	0	0	0	1	0	0
Govt. Car/ Jeep/ Van	0	0	0	0	0	0
Govt. Bus	0	0	0	0	0	0
Govt. LCV	0	0	0	0	0	0
Govt. Truck	0	0	0	0	0	0
Tollable Traffic (vehicles)	294	322	98	96	505	541
Tollable Traffic (PCU's)	390	399	123	124	686	686
Total Traffic (vehicles)	2703	2691	538	514	1379	1475
Total Traffic (PCU's))	2349	2320	405	388	1281	1348

Traffic projections from year 2015 to 2045 were collected as presented in Table 11, Table 13 and Table 13.

Table 11: Traffic Projection of Project Road for Km 19+500

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Tract or	Tractor Trailer	Cycle	Cycle Rickshaw	hand Cart	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Stan dard Bus		2 Axle	3 Axle									
2015	1555	1257	297	92	8	31	18	25	1	2	1	1	518	339	1	4146	474	3586
2016	1757	1408	333	103	8	33	20	26	1	2	1	1	528	346	1	4569	526	3917
2017	1968	1563	370	115	8	34	22	27	1	2	1	1	539	353	1	5005	579	4256
2018	2204	1735	410	127	9	35	25	28	1	2	1	1	550	360	1	5490	638	4631
2019	2469	1926	455	141	9	36	28	30	1	2	1	1	561	367	1	6029	703	5047
2020	2765	2138	505	157	9	37	31	31	1	3	1	1	572	374	1	6627	775	5507
2021	3097	2373	561	174	10	39	35	32	1	3	1	1	583	382	1	7293	855	6017
2022	3438	2610	617	191	10	40	39	34	1	3	1	1	595	389	1	7970	934	6532
2023	3816	2871	679	210	10	41	43	35	2	3	1	1	607	397	1	8717	1022	7099
2024	4236	3158	747	231	10	42	48	36	2	3	1	1	619	405	1	9540	1118	7722
2025	4701	3474	821	255	11	43	53	37	2	3	1	1	631	413	1	10448	1224	8407
2026	5219	3822	903	280	11	44	59	39	2	4	1	1	644	422	1	11450	1340	9161
2027	5740	4166	985	305	11	44	64	40	2	4	1	1	657	430	1	12452	1455	9911
2028	6315	4540	1073	333	11	45	71	41	2	4	1	1	670	439	1	13547	1580	10730
2029	6946	4949	1170	363	12	46	78	42	2	4	1	1	683	447	1	14746	1716	11623
2030	7641	5395	1275	395	12	47	86	43	2	4	1	1	697	456	1	16056	1864	12597
2031	8405	5880	1390	431	12	48	94	44	2	4	1	1	711	465	1	17490	2025	13661
2032	9161	6350	1501	465	12	49	102	45	2	4	1	1	725	475	1	18897	2182	14700
2033	9986	6858	1621	502	13	50	111	46	2	5	1	1	740	484	1	20423	2351	15825
2034	10884	7407	1751	543	13	51	121	47	2	5	1	1	755	494	1	22077	2533	17042

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Tractor	Tractor Trailer	Cycle	Cycle Rickshaw	hand Cart	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Standard Bus		2 Axle	3 Axle									
2035	11864	8000	1891	586	13	52	132	48	2	5	1	1	770	504	1	23871	2730	18360
2036	12932	8640	2042	633	13	53	144	49	3	5	1	1	785	514	2	25817	2942	19785
2037	14095	9331	2206	684	14	54	157	50	3	5	2	2	801	524	2	27928	3172	21328
2038	15364	10077	2382	738	14	55	171	51	3	5	2	2	817	535	2	30217	3420	22998
2039	16747	10884	2573	797	14	56	186	53	3	6	2	2	833	545	2	32701	3687	24806
2040	18254	11754	2779	861	14	57	202	54	3	6	2	2	850	556	2	35395	3976	26763
2041	19897	12695	3001	930	15	59	220	55	3	6	2	2	867	567	2	38319	4288	28883
2042	21688	13710	3241	1004	15	60	240	56	3	6	2	2	884	579	2	41491	4626	31178
2043	23639	14807	3500	1085	15	61	261	58	3	6	2	2	902	590	2	44933	4990	33664
2044	25767	15992	3780	1172	16	62	285	59	3	6	2	2	920	602	2	48668	5383	36356
2045	28086	17271	4083	1265	16	63	310	60	3	7	2	2	938	614	2	52722	5807	39272

Table 12: Traffic Projection of Project Road for Km 47+200

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Cycle	Others	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Standard Bus		2 Axle	3 Axle						
2015	448	174	105	7	12	11	7	4	0	0	10	0	778	145	588
2016	507	195	118	8	12	11	8	4	0	0	10	0	873	161	655
2017	567	217	131	9	13	12	8	4	0	0	10	0	971	176	724
2018	636	241	145	9	13	12	9	5	0	0	11	0	1080	193	801
2019	712	267	161	11	13	12	10	5	0	0	11	0	1202	212	887
2020	797	297	179	12	14	13	11	5	0	0	11	0	1338	233	982
2021	893	329	199	13	14	13	12	5	0	0	11	0	1490	256	1088
2022	991	362	218	14	15	13	13	6	0	0	11	0	1644	279	1195
2023	1100	398	240	16	15	14	15	6	0	0	12	0	1815	305	1313
2024	1221	438	264	17	15	14	16	6	0	0	12	0	2004	332	1443
2025	1356	482	291	19	15	14	17	6	0	0	12	0	2213	363	1586
2026	1505	530	320	21	16	15	19	7	0	0	12	0	2444	396	1745
2027	1655	578	348	23	16	15	20	7	0	0	13	0	2675	429	1903
2028	1821	630	380	25	16	15	22	7	0	0	13	0	2929	465	2075
2029	2003	687	414	27	17	15	24	7	0	0	13	0	3207	504	2264
2030	2203	748	451	29	17	16	26	7	0	0	13	0	3512	547	2471
2031	2423	816	492	32	17	16	28	8	0	0	14	0	3846	593	2697
2032	2641	881	531	35	18	16	30	8	0	0	14	0	4174	638	2919
2033	2879	952	574	37	18	17	32	8	0	0	14	0	4531	686	3159
2034	3138	1028	620	40	19	17	34	8	0	0	15	0	4918	738	3419

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Cycle	Others	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Standard Bus		2 Axle	3 Axle						
2035	3421	1110	669	44	19	17	36	9	0	0	15	0	5340	794	3701
2036	3729	1199	723	47	19	18	39	9	0	0	15	0	5797	855	4007
2037	4064	1295	781	51	20	18	42	9	0	0	15	0	6294	920	4339
2038	4430	1398	843	55	20	18	45	9	0	0	16	0	6834	990	4699
2039	4829	1510	910	59	20	19	48	10	0	0	16	0	7421	1066	5090
2040	5263	1631	983	64	21	19	51	10	0	0	16	0	8059	1148	5513
2041	5737	1761	1062	69	21	20	55	10	0	0	17	0	8752	1237	5972
2042	6253	1902	1147	75	22	20	58	11	0	0	17	0	9505	1332	6471
2043	6816	2054	1239	81	22	20	62	11	0	0	17	0	10323	1435	7011
2044	7429	2219	1338	87	23	21	67	11	0	0	18	0	11212	1546	7597
2045	8098	2396	1445	94	23	21	71	12	0	0	18	0	12179	1666	8233

Table 13: Traffic Projection of Project Road for Km 67+200

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Cycle	Animal cart	hand Cart	Others	Govt. Car	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Standard Bus		2 Axle	3 Axle									
2015	780	505	548	57	39	72	36	38	5	0	73	0	0	0	0	2152	795	1994
2016	881	566	614	64	41	75	39	41	5	0	74	0	0	0	0	2399	878	2203
2017	987	628	681	71	42	77	42	43	6	0	76	0	0	0	0	2652	962	2415
2018	1105	697	756	79	43	79	46	45	6	0	77	0	0	0	0	2934	1055	2649
2019	1238	774	839	87	44	82	49	48	7	0	79	0	0	0	0	3247	1157	2909
2020	1386	859	931	97	46	84	53	51	7	0	81	0	0	0	0	3595	1270	3196
2021	1552	953	1034	108	47	87	58	54	8	0	82	0	0	0	0	3982	1394	3514
2022	1723	1048	1137	118	48	89	62	56	8	0	84	0	0	0	0	4374	1518	3831
2023	1913	1153	1251	130	49	90	66	59	9	0	86	0	0	0	0	4806	1654	4180
2024	2123	1269	1376	143	50	92	71	62	9	0	87	0	0	0	0	5282	1803	4563
2025	2357	1395	1514	157	51	94	76	65	10	0	89	0	0	0	0	5807	1966	4985
2026	2616	1535	1665	173	52	96	81	68	10	0	91	0	0	0	0	6387	2145	5448
2027	2877	1673	1815	189	53	98	86	70	11	0	93	0	0	0	0	6965	2322	5907
2028	3165	1824	1978	206	54	100	91	73	11	0	94	0	0	0	0	7597	2513	6408
2029	3482	1988	2156	224	55	102	96	76	12	0	96	0	0	0	0	8288	2722	6953
2030	3830	2167	2350	245	56	104	102	79	12	0	98	0	0	0	0	9043	2948	7548
2031	4213	2362	2562	267	57	106	108	82	13	0	100	0	0	0	0	9870	3195	8197
2032	4592	2551	2767	288	59	108	114	86	13	0	102	0	0	0	0	10679	3434	8832
2033	5005	2755	2988	311	60	110	119	90	14	0	104	0	0	0	0	11556	3692	9519
2034	5456	2975	3227	336	61	113	125	94	15	0	106	0	0	0	0	12507	3970	10261
2035	5947	3213	3485	363	62	115	132	98	15	0	108	0	0	0	0	13538	4270	11063

Year	Two Wheelers	Auto Rickshaw	Car/ Jeep/Van	Taxi	Busses		LCV	Trucks		MCV	Cycle	Animal cart	hand Cart	Others	Govt. Car	Total Traffic volume in Numbers	Total tollable traffic volume in numbers	Total traffic in PCU
					Mini Bus	Standard Bus		2 Axle	3 Axle									
2036	6482	3470	3764	392	63	117	138	103	16	0	111	0	0	0	0	14656	4593	11931
2037	7065	3748	4065	423	65	119	145	107	16	0	113	0	0	0	0	15867	4941	12870
2038	7701	4047	4391	457	66	122	152	112	17	0	115	0	0	0	0	17181	5317	13884
2039	8394	4371	4742	493	67	124	160	118	18	0	117	0	0	0	0	18605	5722	14982
2040	9150	4721	5121	533	69	127	168	123	18	0	120	0	0	0	0	20150	6159	16170
2041	9973	5099	5531	575	70	129	176	129	19	0	122	0	0	0	0	21824	6630	17454
2042	10871	5507	5973	622	71	132	185	135	20	0	125	0	0	0	0	23640	7138	18844
2043	11849	5947	6451	671	73	134	194	141	21	0	127	0	0	0	0	25610	7686	20348
2044	12916	6423	6967	725	74	137	204	148	22	0	130	0	0	0	0	27746	8277	21975
2045	14078	6937	7525	783	76	140	214	155	22	0	132	0	0	0	0	30062	8915	23736

E. Bus Bay

15 Nos of Bus lay byes are proposed as per the recommendations contained in IRC: 80-1981. The typical bus bay consists of deceleration and acceleration lanes of 45m length with stopping lane of 5.0 m wide, 15m long in rural areas. A raised footpath of 2.5m wide is proposed for the safety of waiting passengers. In urban areas, where the frequency of buses stopping is more, the length of the stopping lane has been kept as 30m to accommodate two buses stopping at the same time. Adequate arrangements have also been made to drain off surface water. The locations of bus lay byes will be freezed in consultation of local authority.

Bus Bay with passenger shelter is provided near village area at 15 locations in the project road. The details of Bus Bay locations are given below;

Table 14: Location of projected bus bay

Bus Bay			
Sl.no	Chainage		
	Form	To	Side
1	2000	2200	Both
2	3145	3345	Both
3	10657	10975	Both
4	11775	11985	LHS side
5	11885	12100	Rhs Side
6	15070	18285	Both
7	16110	16323	Both
8	34040	34226	Both
9	45000	45180	Both
10	61755	61815	LHS
11	61815	61875	RHS
12	66650	66705	LHS
13	66705	66760	RHS
14	73100	73160	Both
15	81085	81145	Both

There is no existing truck lay bye on project road. No Truck lay bye is proposed in this project road

F. Utilities Shifting

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.

G. Project Benefits

Transportation/Highway projects are generally intended to improve the economic and social welfare of the people and the locality.
The proposed project would act as the prime artery for the economic flow to this region. It will enhance economic development, provide employment opportunities to locals, strengthen tourist development, ensure road safety and provide better transportation facilities and other facilities such as way side amenities. Vehicle operating cost will also be reduced due to improved road quality.
Overall improvement will be expected in project area in terms of:

- Improvements in the physical infrastructure and road access.
- Improvement in social services due to quicker and safe mode of transport
- Enhanced connectivity between rural & urban population which will benefit the all sections of the society like general population, small-medium-large scale industries, farmers, businessmen etc.
- Reduction in pollution, vehicle maintenance costs, fuel usage due to free flow of traffic
- Employment potential for skilled, semi-skilled and unskilled labour, during construction and operational phases of the project, with specific attention to employment potential of local population as well as necessity for imparting any specialized skills to them to be eligible for such employment in the project
- Over-all development in economy in terms of industry and improved lifestyle
- Minimize road accidents by increasing road widths.
- Minimize the travel time.
- Better connectivity to economic, social and political hubs of Meghalaya.
- Better approach to medical, educational and essential services.
- Faster transportation of perishable goods like fruits, fish, vegetables, and dairy products.
- Better opportunities for transporting, processing and marketing of agricultural products.
- Development of tourism and pilgrimage.
- Opening up of opportunities for new occupations and trade on the route.
- Improved road connectivity helps in better implementation and management of government schemes.

The construction of the project road in the state of Meghalaya will ensure smooth flow of the traffic. Installation of proper road safety system through signage, barricades, and crash barriers will add to be safety to the traffic. Bus bays, truck lay bays, rest areas, ROBs, service roads are proposed in the project, which shall enhance the road safety

H. Natural Resources/Materials

Detailed analysis of the availability of water requirement and construction material such as selected soil, hard rock, fine aggregates and coarse aggregates was carried out as part of detailed engineering design. During the investigations borrow areas and quarries for earth, sand & aggregates were identified. Details of each type of material source are given below:

Stone Aggregates/Stone Quarries: Potential approved stone quarries for extraction of aggregates and stone exists at the nearby locations within 40 kms.

Sand: The beds of the river Brahmaputra flowing near to the proposed road have medium to fine sand in sufficient quantities with a lead of 290 Kms.

Moorum & Earth: The good quality laterite moorum will be collected from nearby locality with a

lead of 20 kms. Barren lands and agricultural land, where the owners are planning to lower the levels of the land for making it irrigated or develop to a pond/fishery pond will be used for borrow area. The area around and along the proposed project was surveyed for the selection of borrow areas. The survey revealed that adequate materials are available in the borrow areas.

Fly Ash: Fly ash should be used, if available within 300 kms approach of the project as per MoEF & CC fly ash notification. Few sources of fly ash available within 300 kms of project road and will be used as per the requirement and suitability.

Table 15: **Leads for Various Materials (data is awaited from DPR consultant)**

1	Sand (Fine)	Shillong	292
2	Lime		
3	Moorum/ Rubbish		
4	Stone Metal		
5	Stone Boulder		
6	Stone Chips, Aggregate		
7	Coarse Sand		
8	Cement		
9	Steel		
10	Tar, Bitumen		
11	Bitumen Emulsion		
12	Structural Steel		

I. Cost Estimation

The estimated cost for widening and strengthening into 4 laning with paved shoulder with all structure, road furniture in all respect is Rs. 1487.70 Crores. The package cost wise breakup is as follow:

SUMMARY OF COST			
Sr. No.	**Particulars**	**Amount (In Cr.)**	**% of Cost**
1	Bill No. 1: Site clearance and Dismantling	3,26,16,256	0.427
2	Bill No. 2: Earth Work	1,11,45,60,614	14.604
3	Bill No. 3: Grannular Sub Base Courses and Base Courses (Non-Bituminous)	1,31,59,06,718	17.242
4	Bill No. 4: Bituminous Courses /Rigid Pavement	98,06,39,666	12.849
5	Bill No. 5: Culverts	67,70,70,440	8.872
6	Bill No. 6: Drainage & Protective Works		
	A.) Longitudinal Drains	47,47,42,741	6.221
	B.) RRM Retaining wall and Parapet wall	1,26,92,46,630	16.631
	C.) Stone Masonry Breast wall and Hydroseeding Protection	46,63,81,326	6.111
	D.) Composite RE Wall	0	0.000

7	Bill No. 7: Traffic signs, Road markings and other road appurtunences	20,54,67,689	2.692
8	Bill No. 8: Bridges	88,96,48,839	11.657
9	Bill No. 8A: Repair & Reh.	41,97,344	0.055
10	Bill No. 9: VUP/PUP	0	0.000
11	Bill No. 10: RE Wall Cost	0	0.000
12	Bill No. 11: Toll Plaza	16,85,26,700	2.208
13	Bill No. 12: Environmental Plan	3,27,83,266	0.430
	Civil Cost (A)	**7,63,17,88,228**	100.00
	GST @12% On Civil Cost	**91,58,14,587**	
	Total Civil Cost (B)	**8,54,76,02,816**	
	Contingenies @ 2.8 % of Civil Cost	21,36,90,070	
	Supervision Charges @ 3% of Civil Cost	22,89,53,647	
	Agency Charges @ 3% of Civil Cost	22,89,53,647	
	Escalation Charges @ 2.5% after first year of Civil Cost	19,07,94,706	
	Maintenance @2.5% for 5 years	19,07,94,706	
	Forest Clearance	1,50,00,000	

A.

4. ANALYSIS OF ALTERNATIVE

A. Introduction (Comparison with the zero option)

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. 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 Nidanpur – Rongram 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 Meghalaya in order to achieve all-round development of its economy and progress of its people.

B. Alternative analysis

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.
- **Environment:** Lost Forest landExpected Pollution.

C. 'Without Project' Scenario

In the case of 'without project' scenario the existing road carriageway is considered 'as is'. Considering the present traffic volume and potential for growth in near future, the capacity of the present road is insufficient for handling expected traffic volume and calls in for immediate improvements. The poor road conditions, population growth, increase in traffic volumes and the economic development along the project corridor would continue to occur and will exacerbate the present situation. The existing unsafe conditions and the adverse environmental consequences, in terms of impact on ambient air and noise along the roads, would continue to worsen in the absence of the proposed improvements.

Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development.

D. 'With Project' Scenario

Alternative Alignment Option Study for Bypass

The overview of the three alternatives along with features of the alternative plan is described in the following tables and figures.

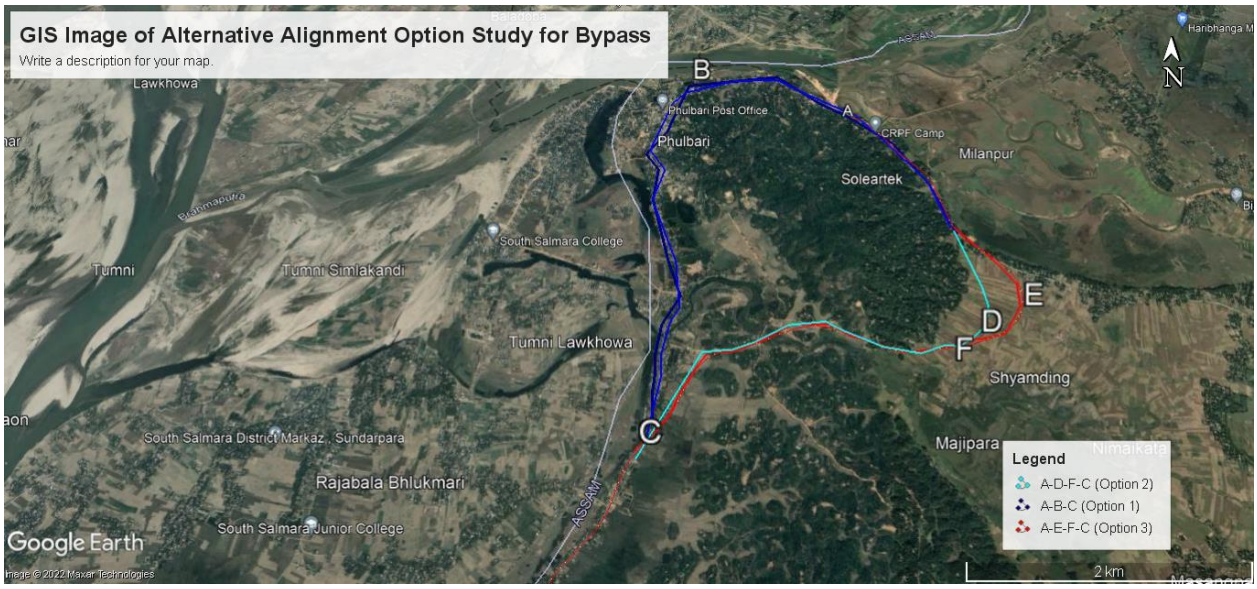


Figure 9: GIS Image of Alternative Alignment Option Study for Bypass

Options	Symbol	Node	Length (km)
Option 1 A-B-C		Follow Existing alignment with improvement	6.52
Option 2 A-D-F-C		With Bypass	4.28
Option 3 A-E-F-C		With Bypass	4.68

Table 16: Analysis of Alternatives

1	**Design Speed**	30-40 Kmph	80 Kmph	80-100 Kmph	**80-100 Kmph**
2	**Total Length**	6.52 km	6.52 km	4.28 km	**4.68**
3	**Land Acquisition (ha) (Of which the non-forest government land)**	No land acquisition	Total affected land 12.02 ha	Total affected land 13.5 ha	**Total affected land 13.7 ha**
4	**Description of alignment**	Project road does not follow IRC: SP: 73-2007 and Ministry of Road Transport and Highways (MoRTH) Guidelines	Project road widening will follow IRC: SP: 73-2007 and Ministry of Road Transport and Highways (MoRTH) Guidelines	Project road widening will follow IRC: SP: 73-2007 and Ministry of Road Transport and Highways (MoRTH) Guidelines	**Project road widening will follow IRC: SP: 73-2007 and Ministry of Road Transport and Highways (MoRTH) Guidelines**
5	**Environment-lost Forest land (ha) and number of lost trees (Of which the number of trees of private owners)**	No forest land diversion No felling of trees	No forest land diversion Approximately 129 trees wil be felled.	No forest land diversion Approximately 25 trees wil be felled	**No forest land diversion** **Approximately 25 trees wil be felled**
6	**Environment-Expected Pollution**	With passage of time operational traffic volume will increase due to increase in population. Therefore, no project will lead to deterioration in road condition as well as air and noise pollution.	This alignment primarily follows existing road and passes through existing habitation area. Hence, widening and strengthening along this alignment would lead to more exposure to local people in terms of air and noise pollution due to higher traffic volume during operational phase	Most of the landuse along this proposed bypass is agriculutural in nature and population density along this alignment is comparatively lesser than Option 1. So. It will cause lesser effect on local people interms of exposure to air and noise pollution during operational phase.	**Most of the landuse along this proposed bypass is agricultural in nature and population density along this alignment is comparatively lesser than Option 1. So. It will cause lesser effect on local people interms of exposure to air and noise pollution during operational phase.**
7	**Number of affected structures**	Not affected	No of affected Structure (Titleholder or Non - title holder)	No of affected Structure (Titleholder or Non - title holder) 46	**No of affected Structure (Titleholder or Non - title holder)**

			540		**44**
8	**Number of physically displaced persons/families (must-include)**	Not affected	No of physically displaced families (Residential and Residential Cum Commercial)54 of which 231 persons	No of physically displaced families (Residential and Residential Cum Commercial) 17 of which 72 persons	**No of physically displaced families (Residential and Residential Cum Commercial) 16 of which 69 persons**
9	**Number of project affected persons (PAPs)/families (Ifpossible, to collect info)**	Not affected	Project Affected Person (PAP) living within these 1458 Families is 6226 persons	Project Affected Person (PAP) living within these 1101 Families is 4714 persons	**Project Affected Person (PAP) living within these 1099 Families is 4704 persons**
10	**Structures and Protective Works**	NA	Data is awaited from DPR consultant	Data is awaited from DPR consultant	**Data is awaited from DPR consultant**
11	**Geometric Design**	Not Affected	This alignment includes sharp curves and paases through congested areas	This alignment includes sharp curves.	**This alignment is almost straight and has a good geometry.**
12	**Civil Cost (million rupee)**	NA	Data is awaited from DPR consultant	Data is awaited from DPR consultant	**Data is awaited from DPR consultant**
13	**resettlement and rehabilitation & LA Cost (million rupee)**	NA	Data is awaited from DPR consultant	Data is awaited from DPR consultant	**Data is awaited from DPR consultant**
14	**Total Cost Including resettlement and rehabilitation and LA (million rupee)**	No Additional cost	Data is awaited from DPR consultant	Data is awaited from DPR consultant	**Data is awaited from DPR consultant**
15	**Utility Shifting Cost (Million rupee)**	NA	Data is awaited from DPR consultant	Data is awaited from DPR consultant	**Data is awaited from DPR consultant**
16	**Result (selected route)**				✔ **(Initial Assessment)**
17	**Comment**	With passage of time operational traffic volume will increase due to increase in population. Therefore, with increased traffic and deteriorating road condition will lead to traffic blockage resulting in higher fuel consumption as well as air and noise pollution.	The new road will result in smoother traffic movement due to improved surface. This will in turn lead to lesser fuel consumption and lesser air and noise emission. However, improvement on this alignment will result in significant social impact as well as exposure to air and noise pollution due to presence of existing	The new road will result in smoother traffic movement due to improved surface. This will in turn lead to lesser fuel consumption and lesser air and noise emission. Further, the proposed alignment being primarily agricultural in nature will cause lesser exposure to air and noise pollution for thelocal communities. However, the social	**Least environmental and social imapcts compared to other options.**

			communities on both sides.	impact for this alignment is comparatively higher than Option 3	

All the three options were studied in detail to find out the best feasible option with lesser impacts both in terms of environmental and social impacts. As is evident from Table 16, the existing road (Option 1) passes through settlement areas making widening of the existing road more difficult due to social conditions. Also, the local people will be exposed to increased air and noise pollution due to construction works as there existing communities on both sides. Additionally, the improvement of the existing road will result in more number of trees being felled. Social impact of this option is also high. Thus, Option 1 is not a viable option

Between Options 2 and 3, Option 3 is considered as this option has the least environmental and social impact among the two. Though, most of the landuse along the proposed bypass of both Option 2 and Option 3 is agricultural in nature and population density along the alignment is comparatively lesser than Option 1. Thus, it will cause lesser effect on local people interms of exposure to air and noise pollution during operational phase. But the social impact of Option 2 is higher than option 3.

Therefore, considering both environmental and social impacts **Option 3** has been chosen.

The ‘with project scenario’ is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the widening to two lanes of the existing single lane stretch as envisaged in the project objectives. The scenario is economically viable and will improve the existing conditions. It, would thereby, contribute to the development goals envisaged by the Government of Meghalaya and India, and enhance the growth potential of the area.

To avoid the large-scale acquisition of land and properties, the project envisages the two-laning of the highway within the existing ROW, but for critical locations like where toll plaza and other amenities have been proposed.

In spite of the various development benefits likely to accrue due to the project, as is the case of every road development project, the project would be accompanied by certain impacts on the natural, social and environmental components. The potential impacts on the various environmental components can be avoided through good environmental practices. Wherever avoidance of negative impact has not been possible, appropriate mitigation and enhancement actions will be worked out to effectively offset the environmental damages inflicted due to the project. A detailed Resettlement and Rehabilitation (R&R) Action Plan is also being worked out to improve the well-being and livelihood of the people to be impacted. Comparative assessments of the “with and without” project scenarios are presented in the following table.

Table 17: "With and Without" Project Scenarios - A Comparative Assessment

Component	"With" Project Scenario	'Without" Project Scenario
Highway Geometrics	Divided two lanes carriageway with geometric improvements	Existing single lane carriageway with poor geometrics
Design Speed	80-100 Kmph (in hill section 50 Kmph)	50-60 Kmph in rural Sections, 30-40 Kmph in Urban Sections
Congestion in Settlements	Segregation of local and through traffic by the provision of service roads or realignment will greatly relieve congestion.	Congestion In urban areas due to mixing of local, pedestrian and through traffic.
Felling of road side trees	Felling of both old and young trees. Old and weak trees near the road edge shall	No felling of trees. The old trees may become a safety hazard to the road users

Component	"With" Project Scenario	'Without" Project Scenario
	be a road hazard and shall be felled. Double the number of new young and healthy trees to be planted in compensation.	with passage of time.
Road Safety Measures	Provision of proper road markings, zebra crossings, service roads, crash barriers and improvement of geometry to reduce accidents.	Accident incidents shall rise with an increased traffic volume.
Environmental Quality	Provision of service lane in the settlements area improves environmental quality within the project areas due to lowered pollution levels and relieving of congestion. Besides an aggressive tree plantation and provision of enhancement features shall not only provide aesthetics but also improve the quality of air	Poor due to congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion.
Drainage	Will be improved due to reconstruction of culverts / bridges with adequate hydraulics.	These issues remain unaddressed without the project
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate.
Wayside Facilities	Wayside facilities proposed at several locations, where necessary like rest areas, with appropriate facilities for recreation, hotels, highway patrol pump, highway public telephones etc.	Not of adequate standards, quality and number
Environmental Enhancement	Enhancement of community and cultural properties and also water front in an aesthetic manner.	No enhancement measures involved.
Development	Higher potential for development due to improvement in access and consequent increase in connectivity	Development activities will be greatly hampered by the gross inadequacy of infrastructure.

E. Alignment Selection due to Environmental Considerations

The selection of the alignment / widening options along various sections has been worked out based on continuous interaction between the engineering design team and environmental study teams. Various alignment improvement alternatives for the project road have been analyzed along entire project road considering rural sections, urban sections, forest areas and junctions.

The factors considered for evaluation of alternatives are:

- Flora and fauna likely to be impacted;
- Productive agricultural land likely to be impacted;
- Impacted water resource and surface water bodies;
- Environmental quality to be impacted;
- Land availability;
- Land use along the alignment;
- Residential / Commercial structures Impacted;
- Utilities likely to be impacted;
- Common property resources likely to be impacted;

- Religious structures affected;
- Impact onsensitive, cultural and community properties;
- Impact on air and noise quality

F. Conclusion

The analysis of alternatives for the Nidanpur – Rongram Project alignment indicates that the socio economic and environmental 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 and the unavoidable loses will be compensated as per the applicable R&R guiding principles.

5. ENVIRONMENTAL BASELINE STUDIES

A. Introduction

This chapter describes the baseline environmental conditions in and around the project road sections. It comprises both secondary information and primary information collected through baseline studies, secondary data collection and primary field surveys.

Details of the environmental baseline are required for decision making on project design, implementation and operation from the environmental perspectives. The data has been collected from the primary surveys and secondary sources. It is essential to establish the base line environmental status of the physical, natural and socio-cultural environmental parameters along the project roads and within the project area of influence (10 Kms radious).

The baseline condition describes the state of the existing environment before the onset of the proposed development work. The collection of baseline information of the project area is the most important reference for conducting environmental screening and preliminary EIA study.

The existing baseline conditions have been analyzed based on the secondary data/information collected from published authentic sources and various government agencies. Efforts have been made to collect the latest information both at regional as well as local level. The proposed road passes through West Garo Hills district in the state of Meghalaya. The existing baseline data and analysis around the project road covering both districts are presented in the following sections.

A.1. Study Area

The project road corridor Nidanpur – Rongram is currently a single lane/ Intermediate Road. The road starts from Nidanpur (Near Fakirganj) and ends at Rongram (Near Tura), covering a distance of 81.200 km. Some part of the road stretch passes through plain land and flood prone area, hilly terrain and community forest areas.

The project road sectionspass through Nidanpur, Phulbari, Rajabala, Selsella & Babadamgare and Groigreen route to Tura.Map of the study area is shown in Figure 10.

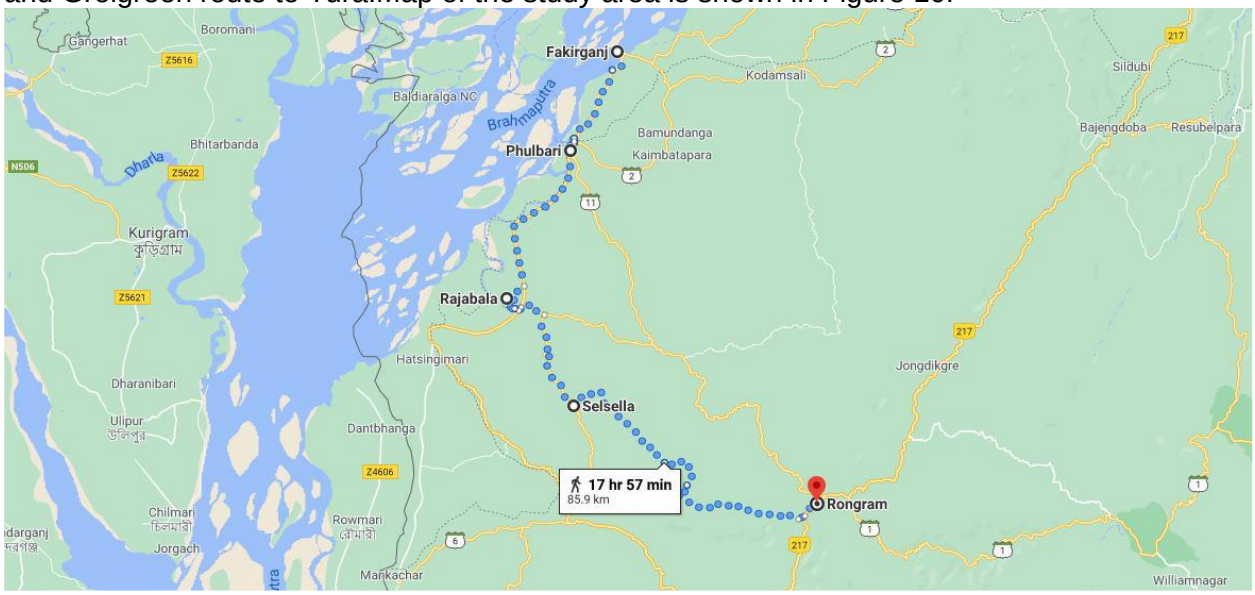


Figure 10: Map of Study Area

The area of direct influence is confined in a linear fashion along the corridor, where the construction activities take place. The area of direct influence of 500 m on either side of PRoW has been considered. Secondary data have been collected within 10 km aerial distances specifically mentioned at Para 9(iii) of Form I of EIA Notification 2006.

- **Baseline Environment**

Baseline environmental conditions about all facet of environment viz. physical, biological and socioeconomic have been established using both primary and secondary sources. Efforts have been made to collect the latest information's both at regional as well as local level especially along the project corridor. This will help to predict likely changes in the environment due to the project and will serve as performance indicators for various components.The profile presented below comprises of the following:

Physical Environment	Meteorology, Geology, Topography, Soil characteristics, Air quality, Surface and sub-surface water quality
Biological Environment	Aquatic, Biotic and marine flora, fauna and mammals.
Land Environment	Land use, Soil composition

B. Physical Environment

B.1. Topography

The West Garo Hills district is situated between 25° 13' N and 26° 1' N Latitudes and 89° 50' E and 90° 27' E Longitudes. The district has hills and plains including a large number of rivers and streams in a criss cross manner. The district portrays a hilly as well as rugged landscape. Due to hilly topographical condition of the district, most of the settlements are situated along Assam and Bangladesh borders (District Census Handbook, West Garo Hills, 2011). The West Garo Hills has three important mountain ranges in the districts of Garo Hills namely, Tura and Arbella ranges lying parallel in the central and eastern part respectively of the district and in the Ranggira range lies in the western part. The Tura range is about 50 kms in length. The mountain peaks located in this range are Tura Peak, Nengminjok Peak, Chitmang Peak, Nokrek Peak and Meminram Peak. The highest peak is the Nokrek (1412 m.) which lies 13 kms south-east of Tura.

- **Project Influence Area**: The terrain on this stretch is broadly divided into three parts, section one from Ch 0+000 toCh 38+000 (38.0 km) as mostly plains, second section from Ch 38+000 to 55+000 (27.0km) as mostly plains and rolling both whereas last section from Ch 55+000 to Ch 82+232 ismostly rolling and hill section. Alignment at the start is passing through the plains adjoining Brahmaputra River and terminates at Groigre in Tura city situated on the foot hills of Turapeak. Elevation varies from about 95 ft to 985 ft above MSL.

B.2. Climate and Meteorology

The climate of Meghalaya is influenced by elevation as well as distribution of physical relief. Based on the weather condition, Meghalaya is characterized by four distinct seasons which are-rainy season from May to early October, cool season from early October to November, cold season from December to February and warm season from March to April (ENVIS centre on eco–tourism, Department of Science & Technology, Sikkim, 2011). The district has a tropical type of climate and is largely controlled by South-West monsoon including seasonal winds. The climate of the district is relatively lower in altitude to the rest of the state and experiences a fairly high temperature for most portion of the year (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India). The climatic condition often varies within the district due to the considerable variations in altitude but mostly it is hot as well as humid during summer and in winter, it is pleasantly warm borders. In this district, summer months are from April to August,

the monsoon months from June to August and winter months are from October to February (District Census Handbook, West Garo Hills, 2011).

B.3. Rainfall

The monsoon season in the district is during June to August with moderate intensity during March-April as well as September-October. The highest rainfall recorded during 2011 is 821.50 mm in July and 1328.20 mm in August in Tura town. In summer, there is a heavy rainfall which controls the temperature and makes the atmosphere very humid. The district is largely controlled by South-West monsoon (District Census Handbook, West Garo Hills, 2011). The average rainfall is 3300 mm of which mostly occur during the monsoon with winter being practically dry (West Garo Hills, State of Meghalaya, 2020). From Figure 12, it is observed that in the last few years from 2009, May 2019 has the maximum average rainfall in a year which was 1481.6 mm along with the 31 rainfall days in Tura.

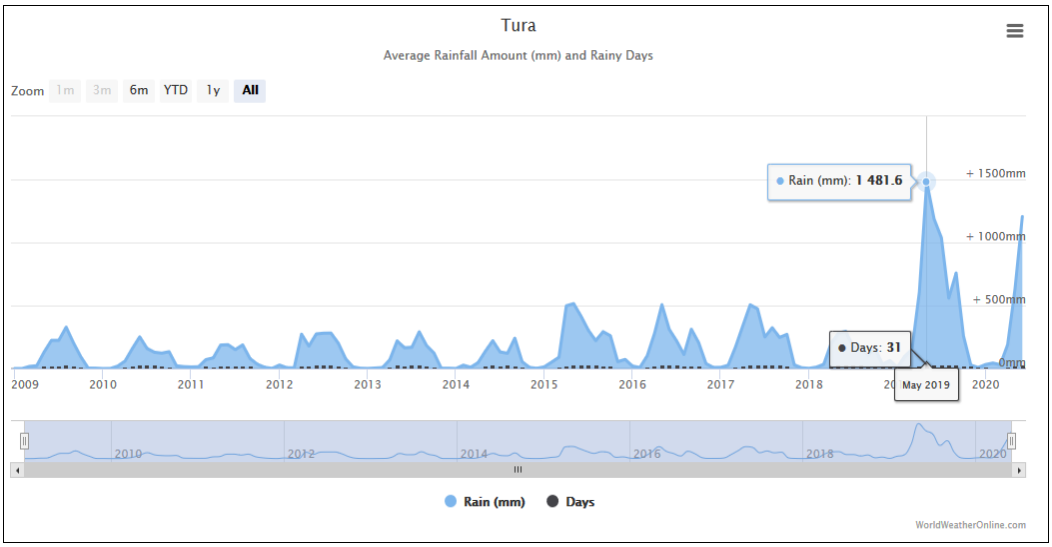


Figure 11: Graphical representation showing the annual trends of rainfall in mmand rainfall days of last few years in Tura, West Garo Hill District (Source**:** https://www.worldweatheronline.com/lang/en-in/tura-weather-averages/meghalaya/in.aspx**)**

B.4. Temperature

The average temperature in West Garo Hills district ranges from minimum 19℃ to maximum 30℃ throughout the year.In summer season which are hot and dry, the temperature ranges from 22°C to 30°C whereas in winter the climate is cool with cool breeze and the temperature ranges from 10°C to 22°C. The hottest months are May-August and coldest are December-February. (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India). In winter, the Tura Peak gets frosted whereas in summer the temperature may rise as high as 38° C specially in low lying places of the district(District Census Handbook, West Garo Hills, 2011)**.** From Figure 29, in Tura it is observed that the average annual temperature of 2019 is the highest and maximum temperature of 2014 is the highest since last few years.

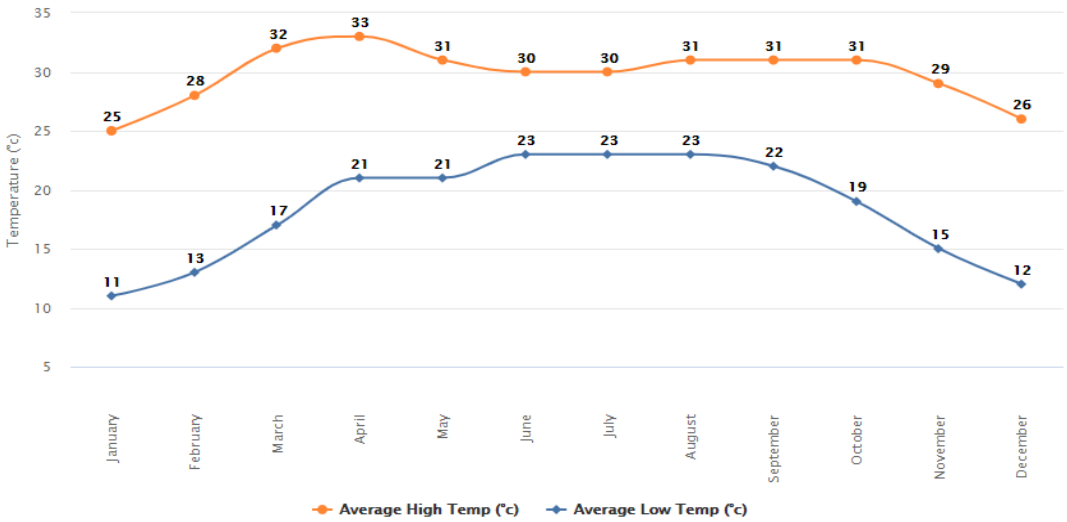


Figure 12:Graphical representation showing the annual trends of temperature in ℃ of last few years in**Tura, West Garo Hill District** (Source:https://www.worldweatheronline.com/lang/en-in/tura-weather-averages/meghalaya/in.aspx)

B.5. Relative Humidity:

The district is highly humid during the summer season and is controlled by the south west monsoon and seasonal winds. The average humidity is high in the winter months and post monsoon period with maximum of 78% to minimum of 67% (District Census Handbook, West Garo Hills, 2011).Figure 11 shows the relative humidity percentage is very high in the Tura region**.**

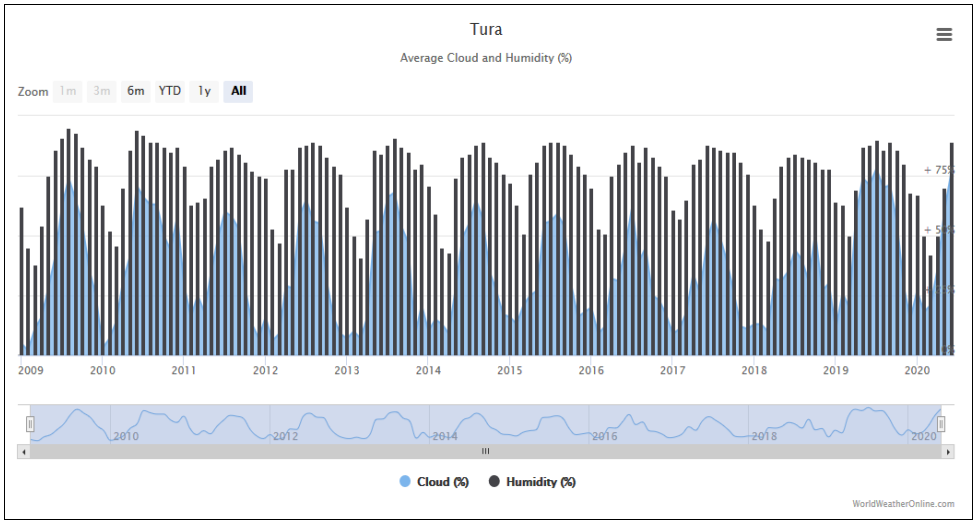


Figure 13: Graphical representation showing the annual trends of relative humidity in %of last fewyearsin Tura, West garo hill district(Source:https://www.worldweatheronline.com/lang/en-in/tura-weather-averages/meghalaya/in.aspx**)**

B.6. Wind Speed:

The average hourly wind speed in this district experiences mild seasonal variation throughout the year along with seasonal winds. The windier part of the year lasts for about 6.0 months ranging between late February to late August. The calmer part of the year lasts for about 6.0 months ranging between late August to February (From Figure 12, it is observed that the

average wind gust of the district lies in the range of 6 to 16 kmph and average wind lies in the range of 4 to 8 kmph; it is also seen that the average wind gust in July 2019 was the highest (15.8 kmph). The predominant average hourly wind direction varies throughout the year. The wind is most often from the west from end of January to end of March; from the south from end of March to early October; and from north from mid October to end of January. In Figure 13, the windrose diagram for Tura shows the hours per year the wind blows from the indicated direction and it is seen that the wind mostly blows towards the north east.

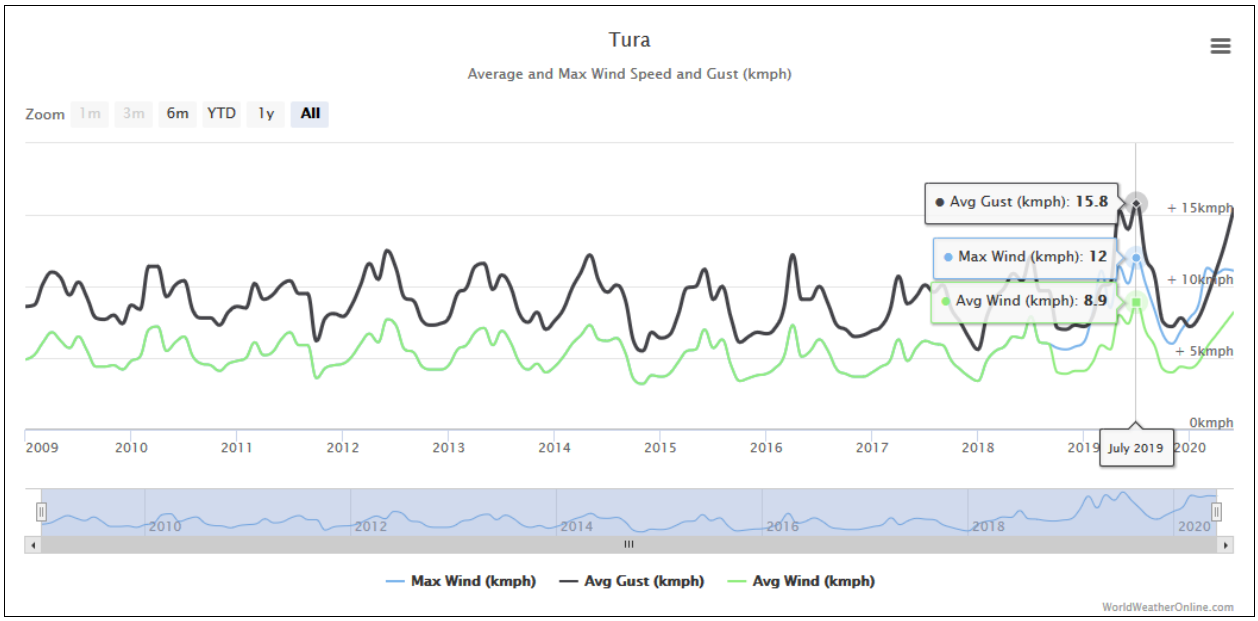


Figure 14: **Graphical representation showing the annual trends of wind speed and gust in kmph** of last few years in**Tura, West garo hill district**(Source**:** https://www.worldweatheronline.com/lang/en-in/tura-weather-averages/meghalaya/in.aspx**)**

Figure 15: Windrose diagram showing the wind directionin Tura, West garo hill district(https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/tura_india_1254046)

The predominant average hourly wind direction in this district varies throughout the year. The wind is often from the south in mid early May to late September; from the east in late late Septemberto early May.In **Error! Reference source not found.**, thewindrose diagram for Tura shows the hours per year the wind blows from the indicated direction and it is seen that the wind mostly blows towards the north east.

B.7. Geology:

The district comprises of hills and plains. The North-West region is situated in the north- western part of the district which presents a dissected as well as rugged hilly land surface mostly composed of gneissic rocks along with old inliers Sela group of rock. The northern belt of this region comprises of recent alluvium with an exception of a narrow belt in the South which is covered by laterite soils. Other rocks of Jaintia series and Disang series are found in patches. Thi region has irregular landscape whose elevation is 100-800 m from the mean sea level it is a plain area along the Brahmaputra valley. The South-West region is situated in the north-eastern part which forms the watershed of almost all rivers present in the region. The Southern part of this is dissected to plain which at the end merges with the plain in Bangladesh. The region is composed of rocks like gneiss, Jaintia series, Disang series, Surma series, Dihing series, Duptila series, Baghmara formation, Barail series and Simsang formation and has laterite as well as red and yellow soil. The central part has the rocks of Surma series and Brahmaputra formation, Tipam series and Chengapara formation as well as Barail series (District Census Handbook, West Garo Hills, 2011). The minerals found in the district are coal, limestone, phosphorite, lithomargic clay, fireclay, gypsum, glass sand, kaolin, quartzite, sillimanite, granites, feldspar, banded hematite-quartzite and Dolerites (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India).

B.8. **Seismicity**:

The Meghalaya falls in a region of high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state falls in Zone V (Figure 16) because of the active fault planes underneath formed because of the convergence of three plate tectonic plates namely, India Plate, Eurasian Plate as well as Burma Plate. Regions of this state have experienced seismic activity more than M6.0 including an M8.1 in 1897 (Amateur Seismic Centre, Pune, 2020). Therefore, the district is under seismic Zone V.

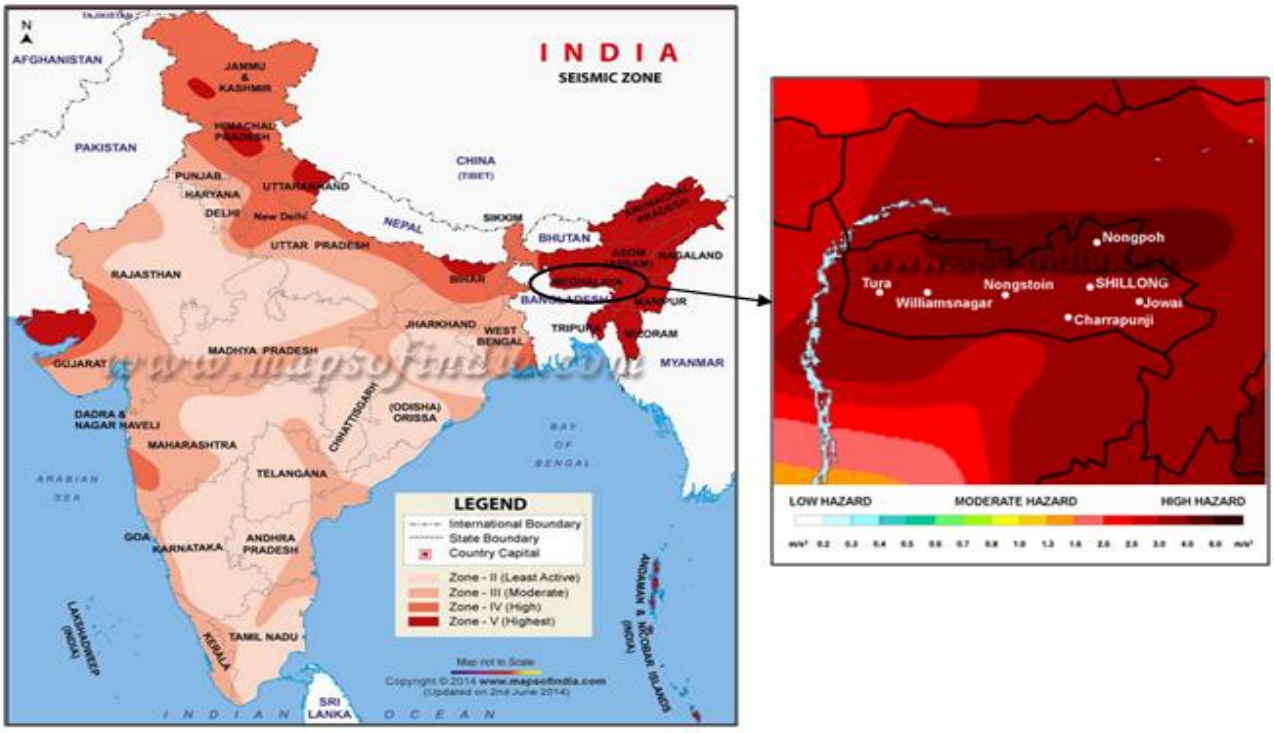


Figure 16: Seismic zone map of India and Meghalaya (Source: https://www.mapsofindia.com/maps/india/seismiczone.htm**)**

From the above map it is clear that the project road comes under zone V, which is susceptible to major earthquakes.

B.9. Land Use

Land use refers to, `man's activities and the various uses which are carried on land'. Land cover refers to, `natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformations. The term's land use and land cover being closely related are inter-changeable, because the former is generally inferred based on the cover and on the contextual evidence.

➢ Along the Project Road

The project study area is dominated by Mixed Forest (38.55 %) while crop land is 24.80% which shows that farming is very prevalent in the study area. Plantation is covered in 9.16 % of the study area while urban and rural settlement is 1.24%. Most of the area along the project road is flood prone. Some images of land use have been shown inFigure 17. The detailed land use and land cover map is shown inFigure 6.

Table 18: Land Use Classification of Study Area

S. No.	LULC Classes	Area (in %)
1	Settlements	1.24
2	Evergreen Broad leaf	0.62
3	Deciduous Broadleaf	1.09
4	Mixed Forest	38.55
5	Grassland	0.52

6	Shrubland	3.84
7	Water Bodies	20.18
8	Cropland	24.80
9	Plantation	9.16
	TOTAL	100.00

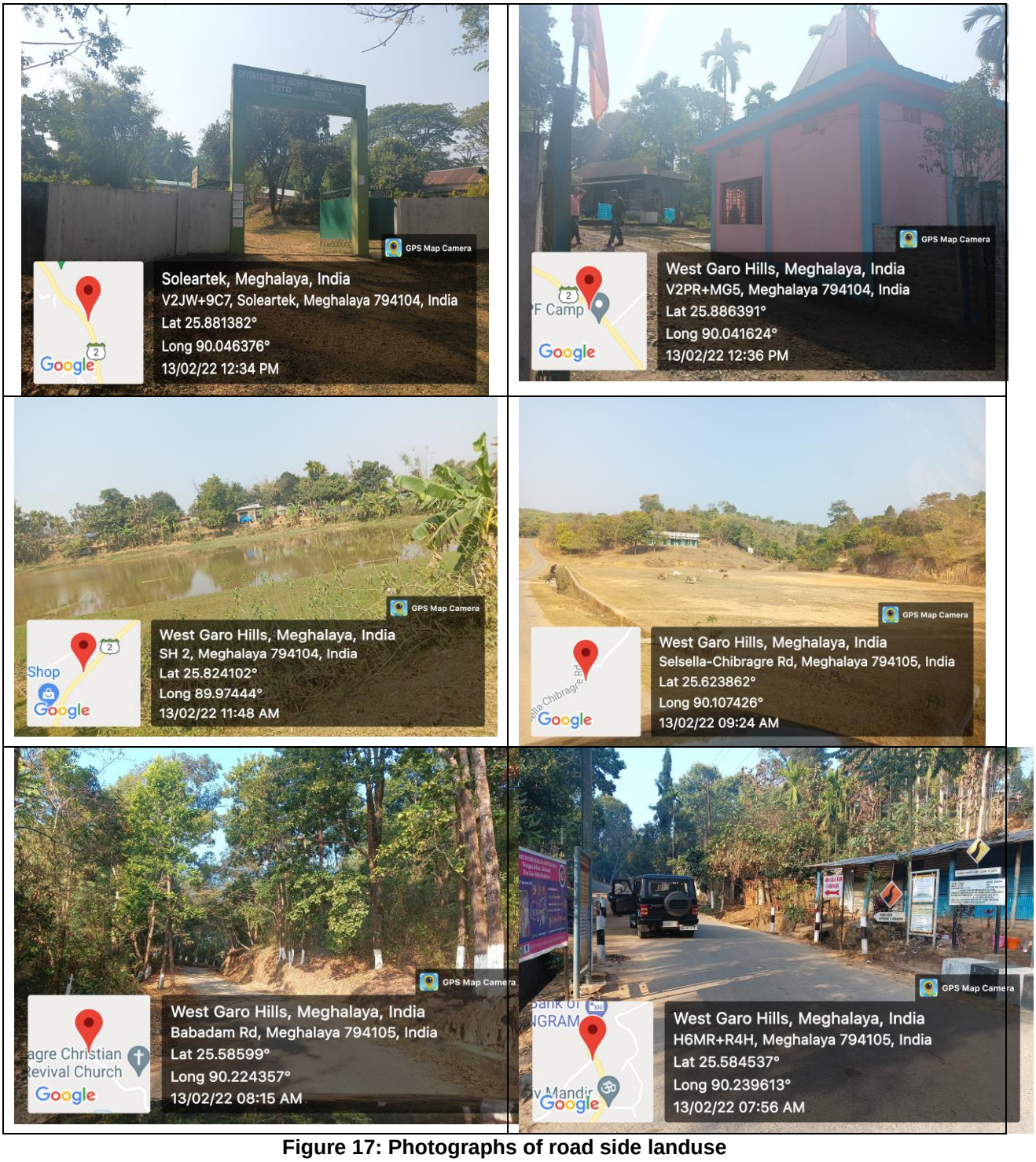


Figure 17: Photographs of road side landuse

B.10. Elevation

B 10. Elevation

The elevation of the project road and project influence area has been presented inFigure 18. 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.

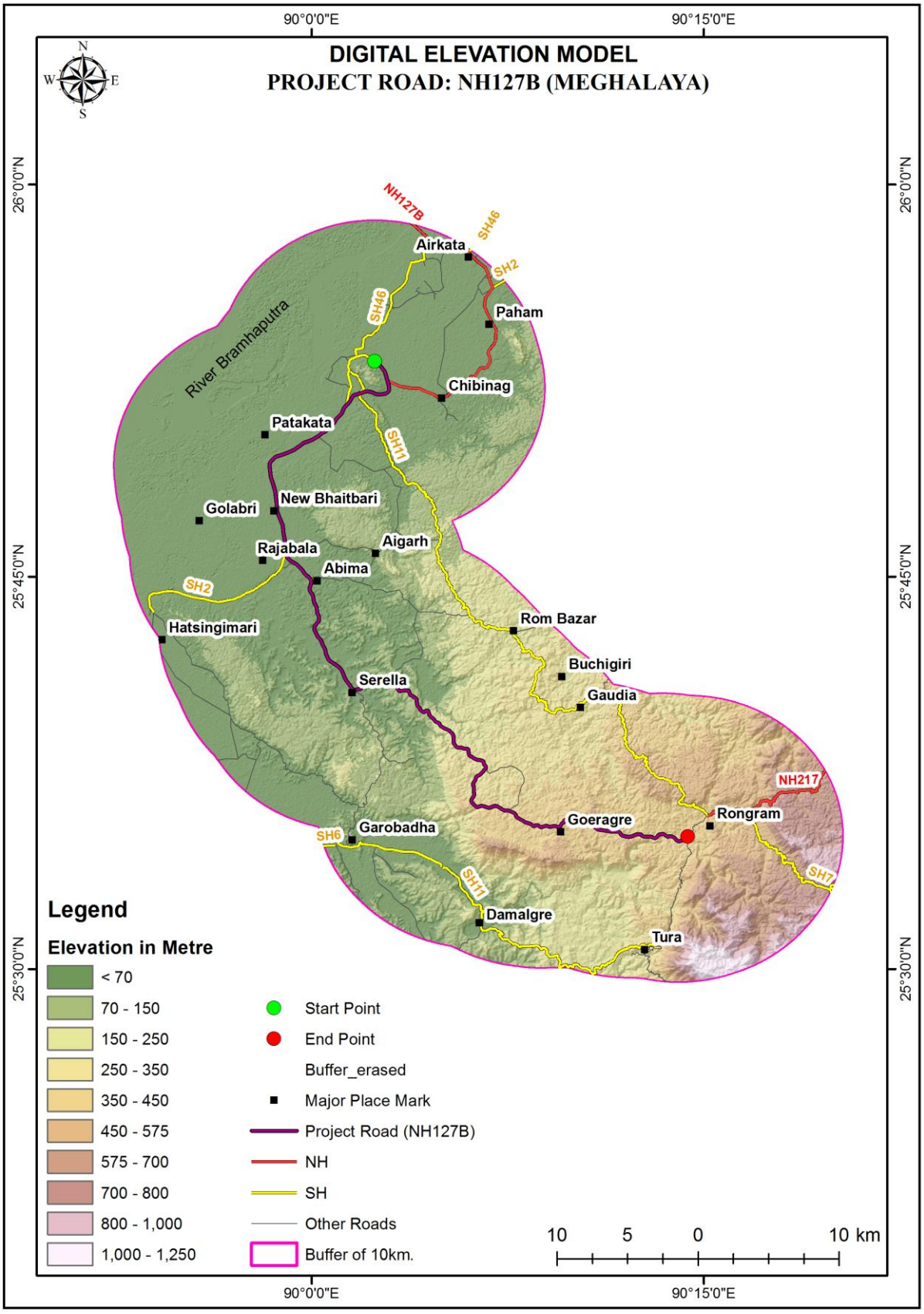


Figure 18: Elevation Map of the Project Road and Project Influence Area

B.11. Soil

West Garo Hills *district:*Major Soils (common names like red sandy loam deep soils (etc.,) - Red and lateritic sandy loam soils. Soil of West Garo hills district, Meghalaya mainly fall under five physiography:

Sl. No	Physiography	Area	Percentage
1	Hill top / Ridge	2933 ha	0.80
2	Hill side slope	292427 ha	79.53
3	Foot hill	1034 ha	0.28
4	Hillock / Hummock	32476 ha	8.83
5	Alluvium plain / Flood plain	37278 ha	10.14

Soils of the area are taxonomically classified into four orders i.e. Alfisols, Entisols, Inceptisols and ultisol.

- **Soil Quality**

To understand the soil characteristics of the study area, 3 locations in the study area were selected for soil sampling. The soil sampling locations are shown inFigure 19.

Table 19: Soil sampling location details

Location Area	Chainage	Latitude	Longitude	Distance from Alignment
Near Katmail Eidga Math (SSM1)	7+100 Km	25°50'52.962" N	90°0'51.7572"E	30m
Near Selsella CHC (SSM 2)	27+500 Km	25°41'51.2376" N	90°0'47.6892"E	15m
Babadam Playground (SSM 3)	48+900 Km	25°36'0.882" N	90°7'35.8176"E	50m

Figure 19: Soil sampling stations along the project road

The analysis results of soil quality are presented inTable 20.

Table 20: Physio-Chemical Analysis of soil quality

Sl. No.	Parameters	Unit	Soil Sample -1	Soil Sample -2	Soil Sample -3	Minimum BDL value
1	Soil Texture	-	Loam	Loam	Sandy Loam	-
2	Soil Colour		Whitish Brown	Whitish Brown	Whitish Brown	-
3	pH Value at 25°C	-	7.94	8.24	7.98	1.0
4	Conductivity at 25°C	µS/cm	634	684	745	1.0
5	Moisture	% by mass	13.2	11.5	14.2	1.0
6	Bulk Density	gm/cc	1.39	1.31	1.41	0.5
7	Water Holding Capacity	Inches/foot	1.24	1.18	1.14	0.5
8	Nitrogen as N	mg/Kg	21.4	22.1	21.4	2.0
9	Phosphorus	mg/Kg	2.28	3.12	3.6	0.5
10	Potassium (as K)	mg/Kg	48.9	74.1	51.4	1.0
11	Calcium as Ca	mg/Kg	40.2	38.2	41.2	1.0
12	Nitrate as NO3	mg/Kg	681	74.2	75	1.0
13	Sulphate as SO4	mg/Kg	14.1	11.5	12.1	1.0
14	Chloride	mg/Kg	3.5	2.8	2.4	0.5
15	Organic Carbon	% by mass	5.2	4.9	4.5	0.5
16	Organic Matter	% by mass	4.5	4.2	3.6	0.5

Sl. No.	Parameters	Unit	Soil Sample -1	Soil Sample -2	Soil Sample -3	Minimum BDL value
17	Total Soluble Solids	mg/Kg	12.5	11.6	10.2	1.0
A	Sand	% by mass	31.2	28.4	37.1	1.0
B	Silt	% by mass	32.4	39.5	22.1	1.0
C	Clay	% by mass	36.4	32.1	40.8	1.0

Soil texture of Babadam Playground is sandy loam, whereas the soil texture of Near Katmail Eidga Math and Near Selsella CHC is loam. The soil samples were alkaline, pH value at 25°C ranges between 7.94 to 8.24. The moisture content is medium. Bulk density in all locations varies from 1.31 to 1.41. The electrical conductivity is in the range of 634– 745 µs/cm. Based on above analysis, it can be inferred that all locations have moderate leaching potential and thus in case of any hydrocarbon/ chemical spill, there would be potential for groundwater contamination.

B.12. Water Resource and Hydrology

Water resources of the study area are classified into the following categories:

(i) Surface Water Resource: River, Nallah, Ponds, etc.
(ii) Ground Water Resources: Accumulation of water in deeper strata of ground.
The only source of recharging for surface water and ground water is from the atmospheric precipitation, which is in the form of rainfall.

➢ Surface Water Resource:

There is 1 river and few other water bodies (i.e., ponds, lakes etc along the project road). List of ponds along the project road are given in Table 21: Ponds along the project road. Satellite image of water bodies along the project road is shown inFigure 20. Detailed Road strip plan is attached in Annexure 8.

Table 21: Ponds along the project road

Sl no	Chainage	Side	Distance the form road
1	10+100	LHS	10m
2	10+200	LHS	10m
3	11+500	LHS	10m
4	16+100	RHS	7.5M
5	17+700	LHS	8M
6	22+400	RHS	10M
7	38+100	LHS	12M
8	44+700	RHS	5M
9	46+100	LHS	50M
10	48+900	LHS	30M
11	54+400	LHS	25M
12	54+800	RHS	2M
13	55+600	RHS	5M

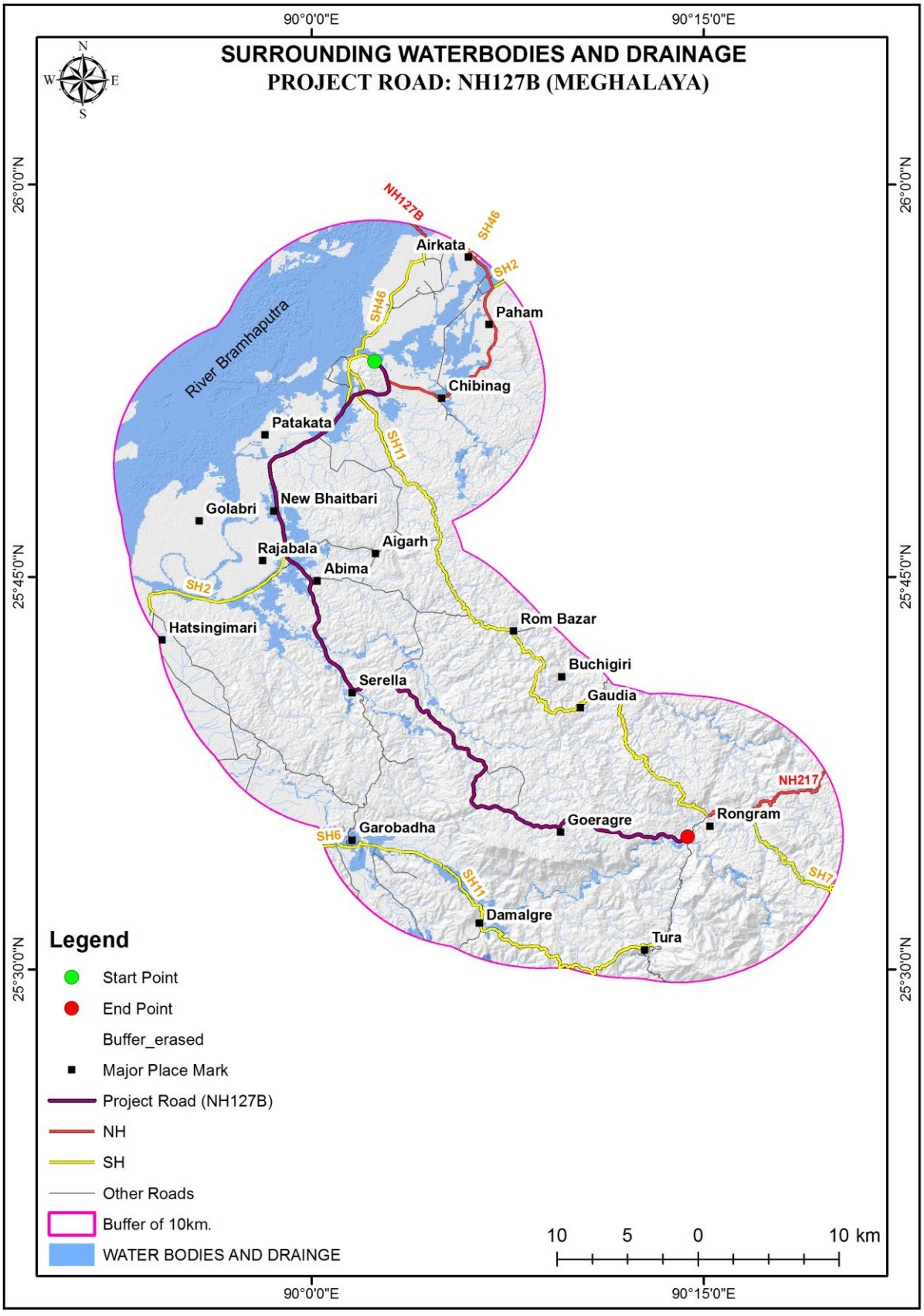


Figure 20: Drainage Network of Project Study Area

Some photographs of road side ponds and rivers are shown in Figure 21.

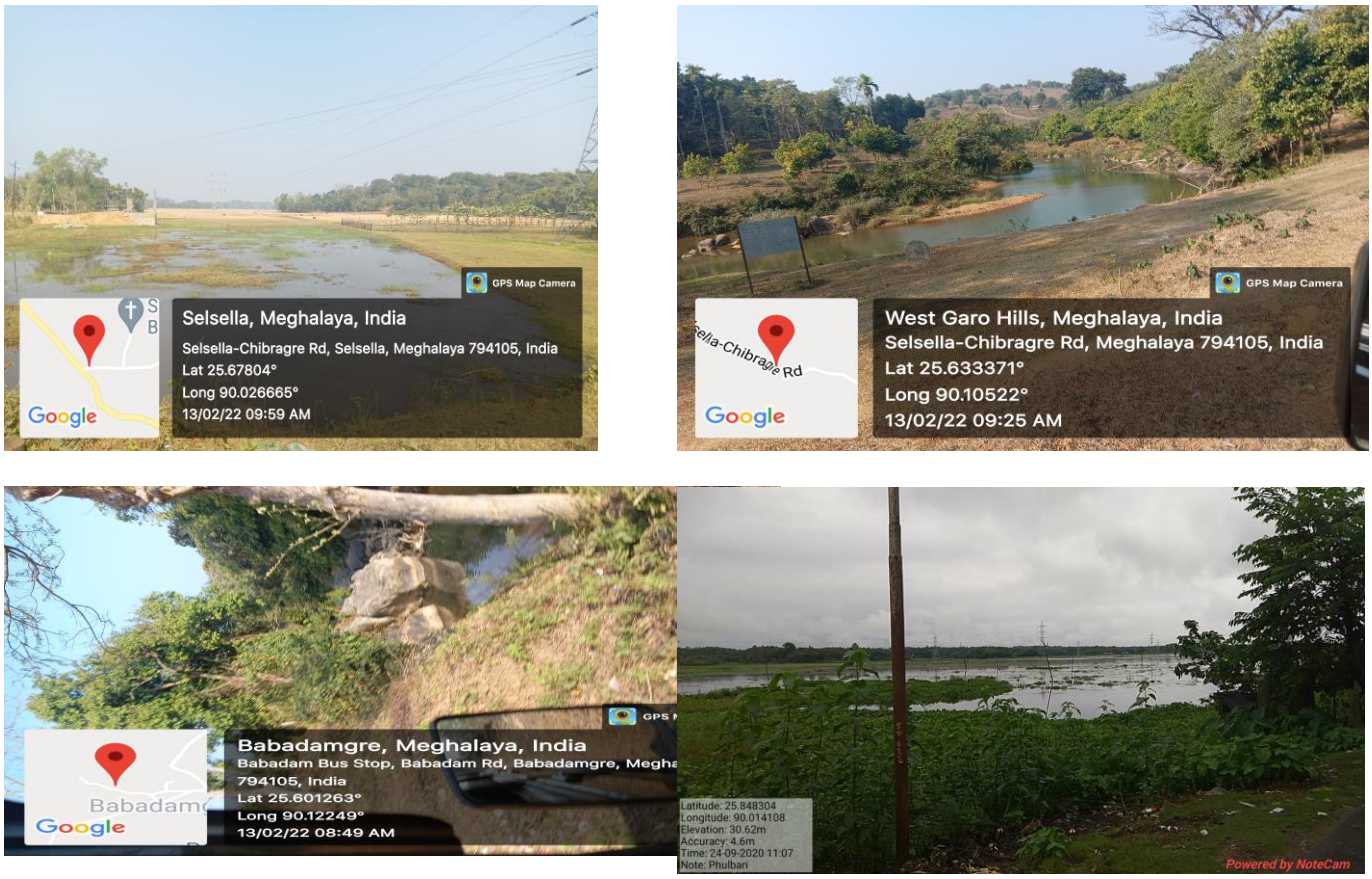


Figure 21: photographs of few surface water bodies along the project road

➢ Ground Water Resource

The Tura range form watersheds in this district from which the rivers flow towards Bangladesh plains in the south and towards the Brahmaputra valley in north and west. The important rivers of the north region are Kalu, Ringgi and Didak. The important rivers of the south region are Bhogai, Dareng etc. The Tura range is also the source of the Simsang (Someswari) which is one of the major rivers of Meghalaya and its valley is the most important feature in the South Garo Hills (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India). Ground water occurs in the pore spaces of the unconsolidated alluvial sediments in the zone of saturation. The near surface sediments are predominantly sandy clays and clays grading into sediments which have varied proportions of sand and clays. These sediments occur as inter layered sequence and pockets. Kankar is mainly found in clay in the form of lenses and layers as well as interspersed. These mixed sediments occur down to 20 m and support large number of dug wells. The depth of dug wells range between 6 to 20 m. Below the top 4 to 10 m silty clays and clays, there occurs the sand formations which form a part of aquifer system. This aquifer is largely unconfined to semi-confined and supports a large number of cavity/shallow tube wells.

➢ Hydrogeology:

The hydrogeological framework of the district is mainly controlled by distribution of rainfall, geological setting and movement of ground water through inter-connect weak planes because of joints, fissures as well as faults, primary and secondary porosities of the Geological formation. Hydrogeologically, the district is divided into three units which are consolidated, semi-

consolidated and unconsolidated formations. In the deeper aquifer of the older alluvium, medium/heavy duty tube wells ranging in depth from 82 to 93 m and tap 18–36 m of granular zone yielding 55 – 110 m3 per hour for draw down ranging up to 9 m. On the other hand, in the Younger alluvial areas, there is no deep tube well. However, the low duty small diameter (8 cm) shallow tube wells constructed in the similar younger alluvium range in depth from 25 to 30 m tapping 8 – 10 m granular zones and yield about 25 – 40 m3 per hour for a draw down up to 8 m (Rongram Rongrenggre Darugre Road -Environment Report, PWD, Govt. of Meghalaya, 2020).

B.13. Water Quality

➢ Surface Water

Surface water includes drainage channels (eg. rivers, streams, and canals) and stagnant water bodies (eg. lakes, ponds, tanks and other impounded water bodies). A highway project can significantly alter the hydrological setting of the project area by acting as an impediment to the natural drainage system of the region. It is, therefore, essential that all surface water resources and their characteristics be identified and examined along the project road.
To understand the surface water characteristics of the study area, 4 locations in the study area were selected for surface water sampling. The sampling locations are shown in Figure 22.

Table 22: Sampling location details of Surface Water

Location Area	Chainage	Latitude	Longitude	Distance from Alignment
Nimaikata (SWM 1)	5+000 Km	25°51’52.2” N	90°1’27.0552” E	200 m
Near Bhoralgaon (SWM 2)	15+200 Km	25°47'45.39"N	89°58'40.17"E	50m
Near Balnangiri (SWM 3)	43+850 Km	25°37’26.868” N	90°6’28.9476” E	200m
Rongram Chi (SWM 4)	60+900 Km	25°34’59.6568” N	90°13’47.1684” E	300m

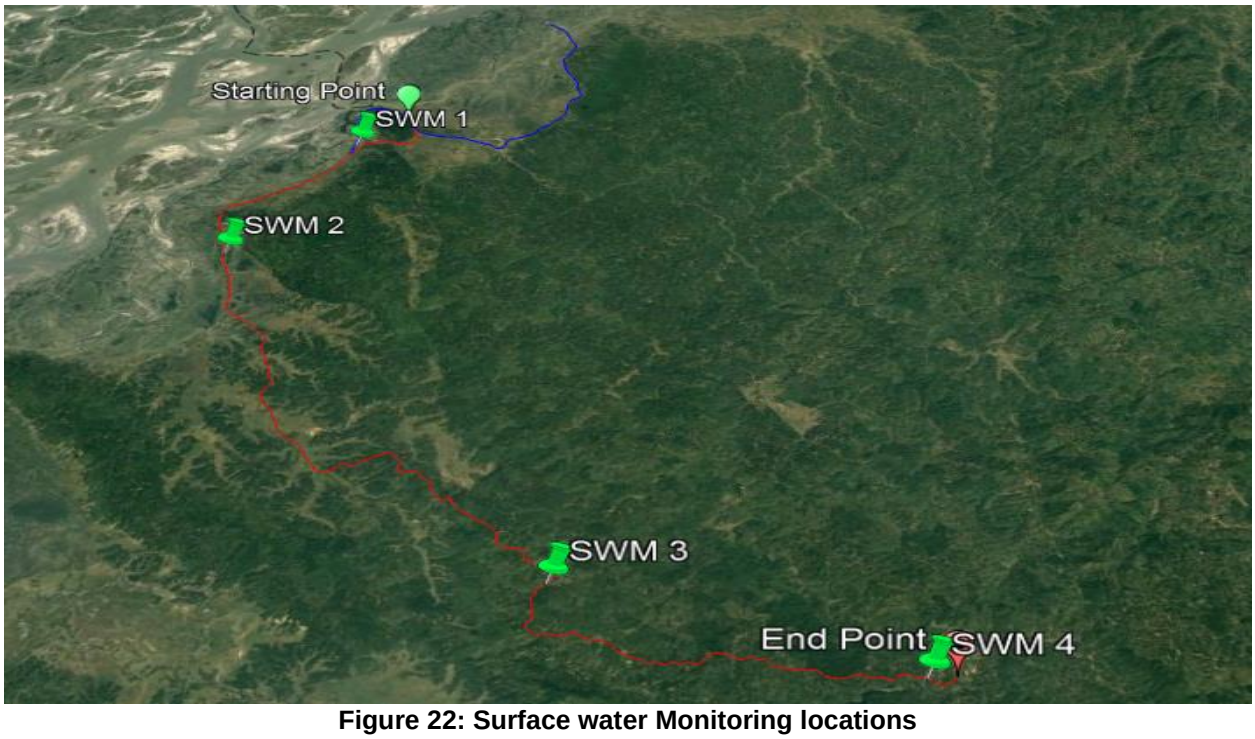


Figure 22: Surface water Monitoring locations

Analytical results of surface water quality along the project road are shown in Table 23;

Table 23: Analytical result of surface water quality along the project road

S. No.	Parameter(s)	Nimaikata	Bhoralgaon	Balnangiri	Rongram Chi	Acceptable Limit	Permissible Limit	Minimum BDL value	WHO Guideline Value (4th Edition)
1	pH Value at 25°C	7.46	7.67	7.08	7.55	6.5 – 8.5	No Relaxation	1.0	6.5-8.0
2	Conductivity at 25°C, µS/cm	422	324	384	401	-	-	1.0	-
3	Total Dissolve Solids, mg/l	274	211	250	261	500 Max	2000 Max	5.0	1000
4	Turbidity, mg/l	14	12	19	16			1.0	5
5	Calcium (as Ca),mg/l	49.2	35.8	41.5	44.5	75 Max	200 Max	0.2	75
6	Magnesium (as Mg) , mg/l	12.4	11.2	16.4	17.2	30 Max	100 Max	0.2	50
7	Sodium (as Na) ,mg/l	6.4	5.4	6.5	4.8	-	-	0.2	200
8	Potassium (as K) ,mg/l	4.2	3.2	4.1	4.1	-	-	0.2	20
9	Total Alkalinity (as $CaCO_3$) ,mg/l	212	158	184	186.2	200 Max	600 Max	2.0	-
10	Sulphate (as SO_4) ,mg/l	18.4	11.5	12.5	24.1	200 Max	400 Max	2.0	250
11	Chloride (as Cl),mg/l	9.8	7.8	8.8	7.4	250 Max	1000 Max	1.0	250
12	Nitrate (as NO_3) ,mg/l	2.1	2.2	2.6	2.8	45 Max	No Relaxation	1.0	50
13	* Fluoride as F, mg/l	0.05	0.05	0.1	0.12			0.05	1.5
14	Sodium Absorption Ratio (SAR)	1.15	1.11	1.21	0.86			-	-
15	Iron (as Fe),mg/l	0.09	0.08	0.14	0.17	0.3 Max	No Relaxation	0.1	0.3
16	* Dissolve Phosphate (as PO_4) ,mg/l	0.24	0.36	0.41	0.22	-	-	0.05	-
17	Total Hardness (as $CaCO_3$) ,mg/l	173	135	171	189	200 Max	600 Max	5.0	500
18	Biochemical Oxygen Demand, mg/l	6.4	4.2	4.5	5.8	-	-	1.0	-
19	Dissolve Oxygen, mg/l	5.4	6.2	6.1	5.3	-	-	0.2	-
20	Chemical Oxygen Demand, mg/l	18	16	14	20	-	-	2	-
21	* Phenolic compound (as C_6H_5OH), mg/l	BDL	BDL	BDL	BDL			0.003	-
22	* Lead (as Pb), mg/l	BDL	BDL	BDL	BDL	0.01	No Relaxation	0.01	0.01

S. No.	Parameter(s)	Nimaikata	Bhoralgaon	Balnangiri	Rongram Chi	Acceptable Limit	Permissible Limit	Minimum BDL value	WHO Guideline Value (4th Edition)
23	* Nickel (as Ni), mg/l	BDL	BDL	BDL	BDL	0.02	No Relaxation	0.01	0.07
24	* Copper (as Cu), mg/l	BDL	BDL	BDL	BDL	0.05	1.5	0.01	2.0
25	* Zinc (as Zn), mg/l	1.6	1.8	1.8	1.6	5	15	0.01	3-5
26	* Cadmium (as Cd), mg/l	BDL	BDL	BDL	BDL	0.003	No Relaxation	0.001	0.003
27	* Arsenic (as As), mg/l	BDL	BDL	BDL	BDL	0.01	0.05	0.01	0.01
28	* Manganese (as Mn), mg/l	BDL	BDL	BDL	BDL			0.1	1-5
29	*Boron (as B), mg/l	0.05	0.04	0.08	BDL			0.05	2.4
30	* HexaChromium (as Cr^{6+}, mg/l	BDL	BDL	BDL	BDL			0.01	0.05
31	Faecal Coliform MPN/100 ml	56	67	77	86			-	-

From the above monitoring result, it can be concluded that, the pH value varies from 7.08 to 7.66. Whereas BOD and DO values are almost close in all locations and COD value ranges between 16-20. CPCB and MOEF&CC has categorized the surface water in 5 different categories namely A, B, C, D and E **(**Ref: http://cpcb.nic.in/water-quality-criteria/) as presented in Table 24.

Table 24: Categorisation of surface water by CPCB and MOEF&CC

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 to 8.5 Electrical Conductivity at 25C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2mg/l

As per the categorization the surface water along the project road can be classified as Category D.

➢ Ground Water

Groundwater quality is a concern during road construction to establish baseline quality, ground water samples were drawn from 3 locations along the project road and analyzed as per IS 10500. The locations of ground water sampling are shown inFigure 23.

Table 25: Sampling location details of Ground Water

Location Area	Chainage	Latitude	Longitude	Distance from Alignment
Near Bypass (GWM 1)	00+100Km	25°52'49.74"N	90° 2'46.18"E	61m
Near Babadam (GWM 2)	48+700 Km	25°36'5.0652" N	90°7'31.7496"E	40m
Near Endpoint (GWM 3)	62+000 Km	25°35'2.2416" N	90°14'22.9812"E	50m

Figure 23: Ground water sampling locations along the project road

Analytical results of ground water quality along project road alignment are shown inTable 26.

Table 26: Analytical results of Ground water quality along the project road

Sl no.	Parameter(s)	Near Bypass	Near Babadam	Near Endpoint	Acceptable Limit	Permissible Limit	Minimum BDL value	WHO Guideline Value (4th Edition)
1	Colour, Hazen units	< 1	< 1	< 1	5 Max	15 Max	2.0	5.0
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	-	Unobjectionable
3	Temperature, °C	19.2	18.7	20.2	-	-	1.0	12-25
4	pH Value at 25°C	7.64	7.14	7.33	6.5 – 8.5	No Relaxation	1.0	6.5-8.0
5	Conductivity at 25°C, µS/cm	621	432	456	-	-	1.0	-
6	Total Dissolve Solids, mg/l	404	281	224	500 Max	2000 Max	5.0	1000
7	Turbidity, mg/l	<1	<1	<1	1	5	0.5	5
8	Calcium (as Ca),mg/l	47.2	38.2	24.1	75 Max	200 Max	0.2	75
9	Magnesium (as Mg) , mg/l	35.2	19.4	16.5	30 Max	100 Max	0.2	50
10	Sodium (as Na) ,mg/l	14.2	13.2	11.2	-	-	0.2	200
11	Potassium (as K) ,mg/l	8.1	7.5	5.4	-	-	0.2	20
12	Total Alkalinity (as $CaCO_3$) ,mg/l	245	188	156	200 Max	600 Max	2.0	-
13	Sulphate (as SO_4) ,mg/l	64.1	24.1	18.4	200 Max	400 Max	2.0	250
14	Chloride (as Cl),mg/l	19.4	13.5	12.4	250 Max	1000 Max	1.0	250
15	Nitrate (as NO_3) ,mg/l	6.5	5.5	3.8	45 Max	No Relaxation	1.0	50
16	*Fluoride as F, mg/l	0.07	0.05	0.05	1.0	1.5	0.05	1.5
17	Iron (as Fe),mg/l	0.27	0.06	0.08	0.3 Max	No Relaxation	0.10	0.3
18	*Dissolve Phosphate (as PO4) ,mg/l	0.19	0.10	0.16	-	-	0.05	-
19	Total Hardness (as CaCO3) ,mg/l	262	175	128	200 Max	600 Max	5.0	500
20	Phenolic compound (as C_6H_5OH), mg/l	BDL	BDL	BDL	0.001 Max	0.002 Max	0.001	-
21	*Lead (as Pb), mg/l	BDL	BDL	BDL	0.01 Max	No Relaxation	0.01	0.01
22	*Nickel (as Ni), mg/l	BDL	BDL	BDL	0.02 Max	No Relaxation	0.01	0.07
23	*Copper (as Cu), mg/l	BDL	BDL	BDL	0.05 Max	1.5 Max	0.01	2.0

Sl no.	Parameter(s)	Near Bypass	Near Babadam	Near Endpoint	Acceptable Limit	Permissible Limit	Minimum BDL value	WHO Guideline Value (4th Edition)
24	*Zinc (as Zn), mg/l	1.6	1.0	1.1	5 Max	15 Max	0.1	3-5
25	*Cadmium (as Cd), mg/l	BDL	BDL	BDL	0.003	No Relaxation	0.002	0.003
26	*Arsenic (as As), mg/l	BDL	BDL	BDL	0.01 Max	0.05 Max	0.01	0.01
27	*Aluminium (as Al), mg/l	BDL	BDL	BDL	0.03 Max	0.2 Max	0.01	-
28	Boron (as B), mg/l	0.06	0.08	0.04	0.5 Max	1.0 Max	0.1	2.4
29	Total Chromium (as Cr), mg/l	BDL	BDL	BDL	0.05 Max	No Relaxation	0.05	0.05
30	E. Coli, (MPN/100ml)	Absent	Absent	Absent	Shall not be detected in 100ml sample		-	-
31	Total Coliform, (MPN/100ml)	Absent	Absent	Absent	Shall not be detected in 100ml sample		-	-

Analysis results when compared with potable IS:10500 norms indicates that all parameters are within the permissible limit and maybe used as drinking water. Indian standard specification drinking water specification: II 10500:1991 is attached in annexure 5.

➢ Bottom Sediment

Sediments form a natural buffer and filter system and often play an important role in the storage and release of nutrients in the aquatic ecosystems. During the last two centuries, heavy metals released by human activities have superimposed new pattern of metal distribution on those which are naturally occurring. In rivers the predominant source of bottom sediments is land runoff. Impoundments and estuaries are often characterized by heavy siltation from tributary streams. The bottom sediment sample were collected at the major bridge at ch. 0+300km from redundant part of river, Ch 1+500km, Ch. 12+400km.

Table 27: Bottom sediment result

			Location-1	**Location-2**	**Location-3**	
1	pH Value at 25°C	ITL/W&W/SOP/02	7.47	7.94	7.91	1.0
2	Organic Carbon, %	ITL/W&W/SOP/07	7.51	5.84	6.64	1.0
3	Organic Matter, %	ITL/W&W/SOP/07	7.36	6.81	7.81	1.0
4	Total Nitrogen, mg/g	ITL/W&W/SOP/08	4.08	4.14	4.64	0.5
5	Phosphate (Available), mg/g	ITL/W&W/SOP/09	0.12	0.10	0.16	0.05
6	Potassium, mg/g	ITL/W&W/SOP/10	17.2	16.5	18.9	1.0
7	Chloride as Cl, mg/g	ITL/W&W/SOP/11	34.2	32.2	35.7	2.0
8	Sodium as Na, mg/g	ITL/W&W/SOP/13	27.6	27.4	28.6	1.0
9	Copper as Cu, mg/g	ITL/W&W/SOP/15	0.015	0.012	0.015	0.2
10	Zinc as Zn, mg/g	ITL/W&W/SOP/12	0.031	0.028	0.038	0.2
11	Lead as Pb, mg/g	ITL/W&W/SOP/16	0.020	0.017	0.024	0.2
12	Nickel as Ni, mg/g	ITL/W&W/SOP/18	0.028	0.029	0.034	0.2

From the above baseline monitoring it can be conclude that, organic carbon percentage varies from 5.84 to 7.51. The total nitrogen level varies between 4.08 to 4.64.

B.14. Ambient Air Environment

Air pollution is caused due to both natural and manmade processes. The main source of air pollution is human induced/manmade, which includes industrialization and its by products, burning of timber, heat and light, rapid urbanization, vehicular pollution, plastics, burning of polymers and processing of various materials emitting obnoxious gases, generation of smoke, dust and fine respirable particles due to construction activity and rapid burning etc. Vehicular emission is major source of air pollution now-a-day. Presently some patches of study area are in the locality of heavy traffic movement particularly at congested places i.e at major market areas, which may impact the ambient air quality of the area. During construction stage of the project, temporary air pollution arises due to the movement of construction vehicles, operation of plants & machineries, dust emission due to excavation and demolition etc. The air quality parameters considered for the construction phase includes PM_{10}, $PM_{2.5}$, Nitrogen Oxides (NOx) Sulphur Di-oxide (SO_2), and Carbon monoxide (CO).

Table 28: Ambient Air Quality Standard

Particulate Matter (Size less than 10µm) or PM10, µg/m3	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	100
Particulate Matter (Size less than 2.5µm) or PM2.5 , µg/m3	PM 2.5 APM 550 Fine Particle Sampler (Gravimetric method)		60
Sulphur Dioxide (SO2), µg/m3	Improved West and Gaeke Method	IS-5182 (Part-II)	80
Nitrogen Dioxide (NO2), µg/m3	Jacob and Hochheiser	IS-5182 (Part-IV)	80
Carbon Monoxide (CO), mg/m3	Non – dispersive Infrared (NDIR) Spectroscopy	IS-5182 (Part-IV)	4

- **Along the Project Road**

Ambient air quality monitoring has been conducted at 6 locations along the project road alignments. The air sampling locations is shown in **Error! Reference source not found.**. SPM and RPM have been determined gravimetrically and as specified in IS 5182 (Part 23): 2006.The concentration of NO_x has been estimated using IS 5182 Part 2:2001 method and SO_x has been estimated by IS 5182 Part 6:2006 method. CO was measured as per EPA Method 13. Sampling duration for SO_2, NO_x, PM2.5 and PM10 was 24 hourly as per NAAQS Standards requirements and CO sampling duration was 1 Hr.

The monitoring stations had been distributed throughout the project road so as to get a representative baseline of any variation in land use as well as road geometrics and traffic conditions across the project road. The purpose is also to establish a benchmark, which can form the reference for monitoring in the construction and operation period. GOI ambient air quality standard is given in annexure 3.

Table 29: Sampling location details of Ambient Air Quality

Location Area	Chainage	Latitude	Longitude	Distance from Alignment
Starting Point (AAQM 1)	0+000 Km	25°52’14.42” N	90°03’38.38” E	8m
New Bhaitbari (AAQM 2)	15+800 Km	25°47’27.00” N	89°58’41.81” E	16m
Sibukolgre (AAQM 3)	31+500 Km	25°40’50.09” N	90°02’18.48” E	16m
Babadam UP (AAQM 4)	48+600 Km	25°36’03.91” N	90°07’26.75” E	16m
Chibra Songma Local Baptist Church (AAQM 5)	58+300 Km	25°35’09.05” N	90°12’27.29” E	15m
End Point (AAQM 6)	61+900 Km	25°35’04.50” N	90°14’24.95” E	15m

Figure 24: Air quality monitoring stations along the project road

Table 30: Analysis of ambient air quality monitoringalong the project road

	S.N.	Date of sampling	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	CO (mg/m3)
Location –Near Starting Point Bypass (AAQM 1)							
Week 1	1	01/03/2021 to 02/03/2021	82.4	43.2	10.2	14.5	BDL
	2	05/03/2021 to 06/03/2021	85.4	42.9	9.4	16.2	BDL
Week2	3	08/03/2021 to 09/03/2021	81.4	41.8	8.9	13.5	BDL
	4	11/03/2021 to 12/03/2021	86.5	42.5	11.2	16.5	BDL
Week3	5	14/03/2021 to 15/03/2021	82.4	43.2	10.8	14.5	BDL
	6	17/03/2021 to 18/03/2021	80.9	42.5	9.2	13.6	BDL
Week4	7	20/03/2021 to 21/03/2021	88.2	43.5	11.2	16.5	BDL
	8	23/03/2021 to 24/03/2021	83.2	41.8	10.1	13.5	BDL
		Minimum	80.9	41.8	8.9	13.5	-
		Maximum	88.2	43.5	11.2	16.5	-
		Average	83.8	42.675	10.125	14.85	-
WHO Air quality guideline 2005, Guidance			**50**	**25**	**40****	**20**	**-**

	S.N.	Date of sampling	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	CO (mg/m3)
Value							
NAAQMS Standard			**100**	**60**	**80**	**80**	**2**
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**
Location – New Bhaitbari (AAQM 2)							
Week 1	1	02/03/2021 to 03/03/2021	78.9	42.5	9.8	12.4	BDL
	2	06/03/2021 to 07/03/2021	81.2	45.2	10.2	13.5	BDL
Week2	3	09/03/2021 to 10/03/2021	84.2	39.4	10.1	14.5	BDL
	4	12/03/2021 to 13/03/2021	78.5	38.7	9.8	12.5	BDL
Week3	5	15/03/2021 to 16/03/2021	81.2	41.6	9.4	13.5	BDL
	6	18/03/2021 to 19/03/2021	84.2	42.5	10.4	15.2	BDL
Week4	7	21/03/2021 to 22/03/2021	80.1	42.1	9.6	12.9	BDL
	8	24/03/2021 to 25/03/2021	82.5	41.5	9.7	13.5	BDL
		Minimum	78.5	38.7	9.4	12.4	-
		Maximum	84.2	45.2	10.4	15.2	-
		Average	81.35	41.69	9.88	13.5	-
WHO Air quality guideline 2005, Guidance Value			**50**	**25**	**40****	**20**	**-**
NAAQMS Standard			**100**	**60**	**80**	**80**	**2**
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**
Location - Sibukolgre (AAQM 3)							
Week 1	1	02/03/2021 to 03/03/2021	66.8	34.8	6.8	10.1	BDL
	2	06/03/2021 to 07/03/2021	71.2	38.9	8.1	13.2	BDL
Week2	3	09/03/2021 to 10/03/2021	69.2	37.7	6.9	11.1	BDL
	4	12/03/2021 to 13/03/2021	71.2	38.7	7.2	12.2	BDL
Week3	5	15/03/2021 to 16/03/2021	67.8	34.8	6.5	11.2	BDL
	6	18/03/2021 to 19/03/2021	68.4	37.6	6.8	10.2	BDL
Week4	7	21/03/2021 to 22/03/2021	76.5	38.4	8.9	12.4	BDL
	8	24/03/2021 to 25/03/2021	72.4	38.7	8.4	11.4	BDL
		Minimum	66.8	34.8	6.5	10.1	-
		Maximum	76.5	38.9	8.9	13.2	-
		Average	70.44	37.45	7.45	11.48	-
WHO Air quality guideline 2005, Guidance Value			**50**	**25**	**40****	**20**	**-**

	S.N.	Date of sampling	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	CO (mg/m3)
NAAQMS Standard.			**100**	**60**	**80**	**80**	**2**
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**
Location - Babadam UP (AAQM 4)							
Week 1	1	02/03/2021 to 03/03/2021	78.1	37.8	10.1	13.8	BDL
	2	06/03/2021 to 07/03/2021	77.5	38.4	9.9	13.5	BDL
Week2	3	09/03/2021 to 10/03/2021	78.5	38.4	9.6	13.5	BDL
	4	12/03/2021 to 13/03/2021	81.2	39.8	10.1	14	BDL
Week3	5	15/03/2021 to 16/03/2021	79.4	40.1	10.2	14.2	BDL
	6	18/03/2021 to 19/03/2021	80.1	39.4	9.6	13.5	BDL
Week4	7	21/03/2021 to 22/03/2021	76.5	41.2	9.4	12.5	BDL
	8	24/03/2021 to 25/03/2021	77.8	41.2	9.2	13.4	BDL
		Minimum	76.5	37.8	9.2	12.5	-
		Maximum	81.2	41.2	10.2	14.2	-
		Average	78.64	39.54	9.76	13.55	-
WHO Air quality guideline 2005, Guidance Value			**50**	**25**	**40****	**20**	**-**
NAAQMS Standard.			**100**	**60**	**80**	**80**	**2**
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**
Location - Near Chibra Songma Local Baptist Church (AAQM 5)							
Week 1	1	03/03/2021 to 04/03/2021	77.4	41.2	9.5	13.5	BDL
	2	07/03/2021 to 08/03/2021	78.5	40.5	9.4	13.6	BDL
Week2	3	10/03/2021 to 11/03/2021	74.2	39.4	8.9	12.9	BDL
	4	13/03/2021 to 14/03/2021	79.4	38.4	10.2	14.5	BDL
Week3	5	16/03/2021 to 17/03/2021	75.2	38.6	8.9	12.8	BDL
	6	19/03/2021 to 20/03/2021	76.4	38.4	8.8	13.1	BDL
Week4	7	22/03/2021 to 23/03/2021	76.8	40.1	9.2	12.8	BDL
	8	25/03/2021 to 26/03/2021	78.9	38.7	10.1	14.5	BDL
		Minimum	74.2	38.4	8.8	12.8	-
		Maximum	79.4	41.2	10.2	14.5	-
		Average	77.10	39.41	9.38	13.46	-
WHO Air quality guideline 2005, Guidance Value			**50**	**25**	**40****	**20**	**-**
NAAQMS Standard.			**100**	**60**	**80**	**80**	**2**

	S.N.	Date of sampling	PM10 (µg/m3)	PM2.5 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	CO (mg/m3)
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**
Location - Near End Point (AAQM 6)							
Week 1	1	03/03/2021 to 04/03/2021	81.2	41.2	10.2	14.5	BDL
	2	07/03/2021 to 08/03/2021	87.5	43.2	11.2	14.5	BDL
Week2	3	10/03/2021 to 11/03/2021	84.5	41.7	10.8	13.8	BDL
	4	13/03/2021 to 14/03/2021	79.8	39.4	11.2	15.2	BDL
Week3	5	16/03/2021 to 17/03/2021	78.8	39.2	9.9	13.5	BDL
	6	19/03/2021 to 20/03/2021	77.4	38.9	8.7	13.5	BDL
Week4	7	22/03/2021 to 23/03/2021	79.2	38.4	10.2	14.3	BDL
	8	25/03/2021 to 26/03/2021	80.4	39.2	9.4	13.5	BDL
		Minimum	77.4	38.4	8.7	13.5	-
		Maximum	87.5	43.2	11.2	15.2	-
		Average	81.10	40.15	10.20	14.10	-
WHO Air quality guideline 2005, Guidance Value			**50**	**25**	**40****	**20**	**-**
NAAQMS Standard.			**100**	**60**	**80**	**80**	**2**
Minimum BDL value			**25**	**10**	**5**	**5**	**1.14**

** Annual Mean

All monitoring was conducted between 1st March, 2021 to 31st March, 2021.

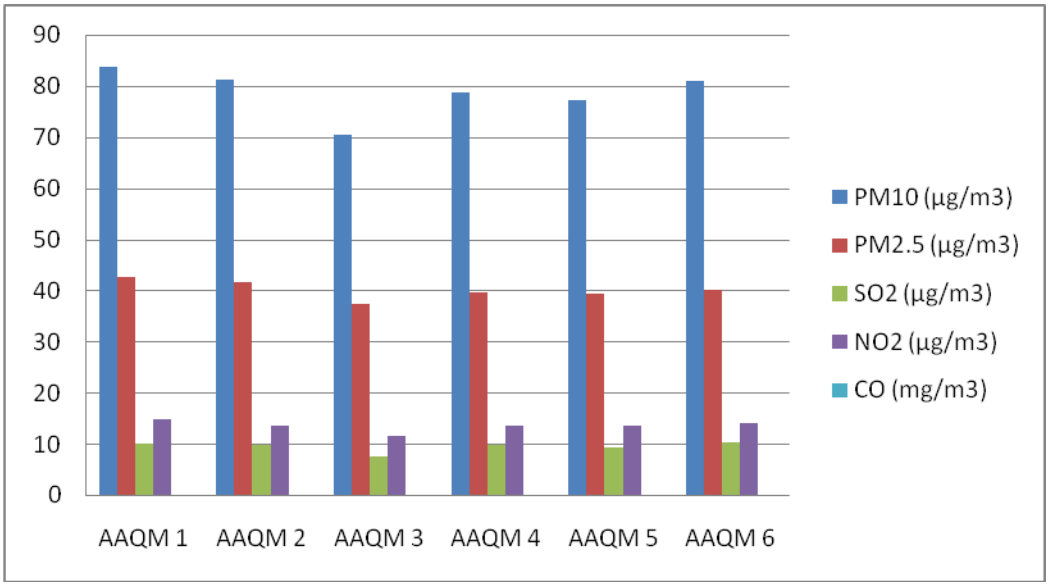


Figure 25: Average values of air pollutants in all locations (March 2021)

➢ **Air monitoring baseline analysis**

The PM_{10} concentrations in the all locations were found below the NAAQMS standard value (100ug/m^3) current monitoring (i.e., month of March, 2021).

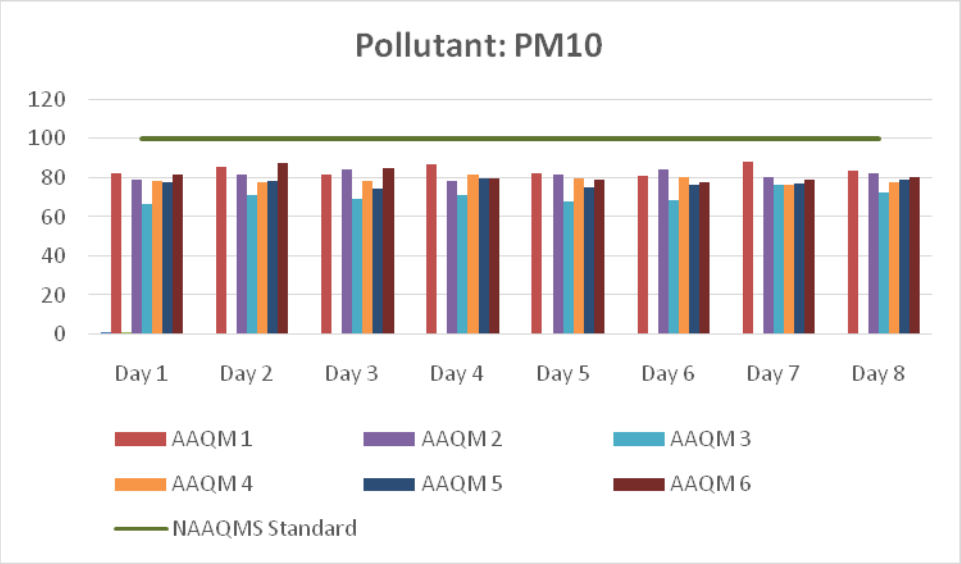


Figure 26: PM_{10} values in all locations along with NAAQMS standard

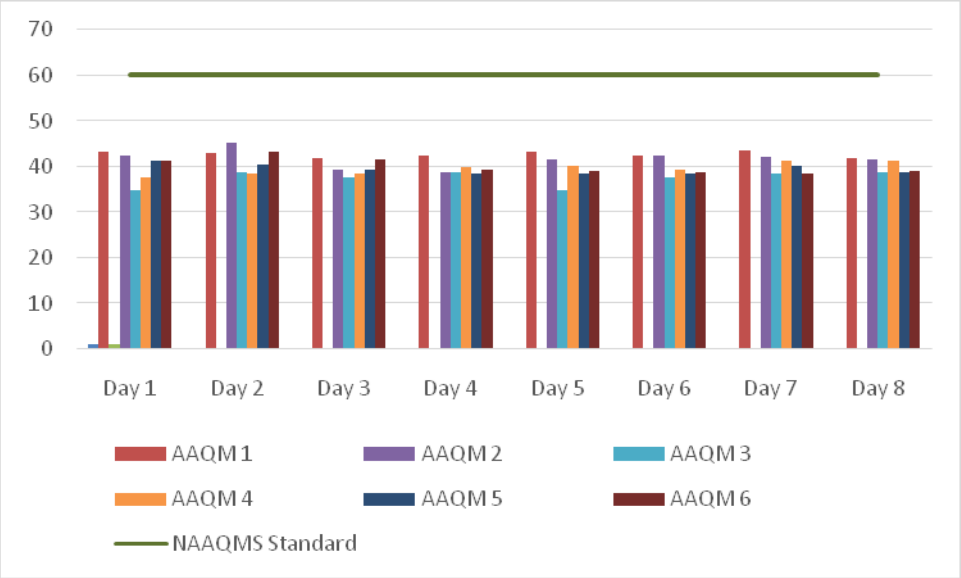


Figure 27: $PM_{2.5}$ values in all locations along with NAAQMS standard

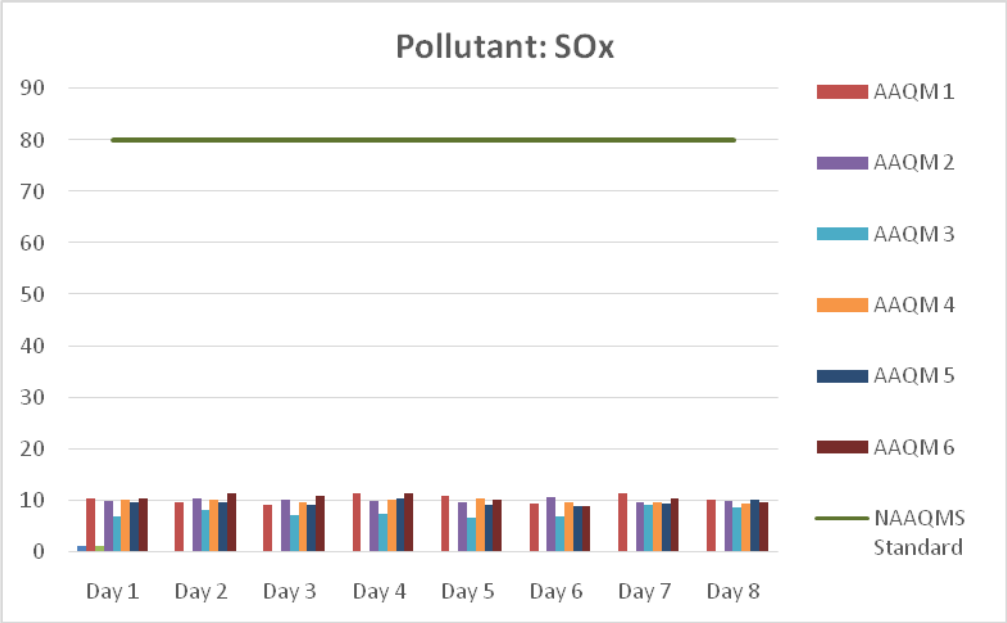


Figure 28: SOx values in all locations along with NAAQMS standard

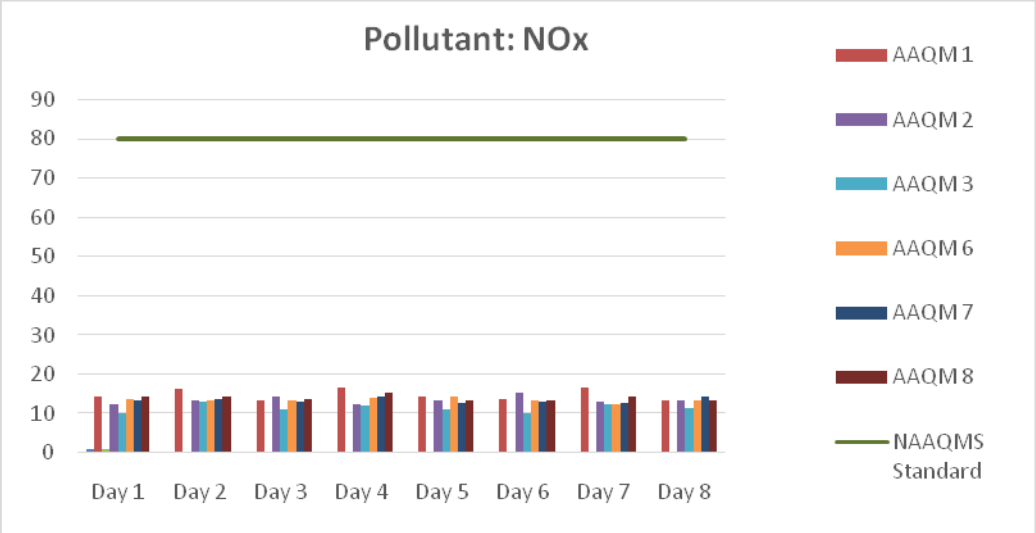


Figure 29: NOx values in all locations along with NAAQMS standard

The analysis shows that measured PM_{10} and $PM_{2.5}$ concentrations are mostly below the NAAQS standard in all 6 locations. The SO_x and NO_x values along the project road are also within the NAAQS standard.

B.15. Noise Environment

Noise attributed to roads 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. High noise levels are a concern for sensitive receptors i.e., hospitals, educational institutions, etc. Silence zone is defined as an area up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority.

The Central Pollution Control Board (CPCB) has specified ambient noise levels for different land uses for day and night times as presented in **Error! Reference source not found.**and Annexure 4.

Importance was given to the timing of exposure and areas designated as sensitive.

Table 31: National Ambient Noise Level Standards

Area Code	Category	Limits in Decibels (dB A)	
		Day time	Night tme
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

Source: Central Pollution Control Board, New Delhi

Note:

1) Day-time: 6 AM to 10 P.M., Night-time: 10 PM to 6 AM;
2) Silence zone is an area up to 100 m around premises as hospitals, educational institutions and courts.

Locations for noise monitoring along the project road were identified based on the criteria same as those used for air monitoring but the relative importance of each criterion carries a weightage in arriving at the final set of locations. In case of noise monitoring locations, sensitive land use such as schools, hospitals and religious places gains more importance due to ill effects of noise. The noise levels were monitored with Integrated Noise Level Meter.
Locations of noise monitoring is shown in **Error! Reference source not found.**.

Table 32: Sampling location details of Noise

Location Area	Chainage	Latitude	Longitude	Category
Starting Point Bypass (NM 1)	0+000 Km	25°52’14.42” N	90°03’38.38” E	Commercial
New Bhaitbari (NM 2)	15+800 Km	25°47’27.00”N	89°58’41.81” E	Residential
Sibukolgre (NM 3)	31+500 Km	25°40’50.09” N	90°02’18.48” E	Sensitive
Babadam UP (NM 4)	48+600 Km	25°36’03.91” N	90°07’26.75” E	Resi + Rural Area
Chibra Songma Local Baptist Church (NM 5)	58+300 Km	25°35’09.05” N	90°12’27.29” E	Residential
End Point (NM 6)	61+900 Km	25°35’04.50” N	90°14’24.95” E	Commercial

All monitoring was conducted between 1st March, 2021 to 31st March, 2021

Figure 30: Noise monitoring locations along the project road

Table 33: Analysis of noise monitoringin all locations

	Starting Point Bypass (NM 1)		**New Bhaitbari (NM 2)**		**Sibukolgre (NM 3)**		**Babadam UP (NM 4)**		**Chibra Songma Local Baptist Church (NM 5)**		**End Point (NM 6)**	
Classification	**Commercial**		**Residential**		**Sensitive**		**Resi + Rural Area**		**Residential**		**Commercial**	
Date	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
Maximum	58.2	51.8	52.6	56.2	51.9	52.1	54.2	52.9	53.7	51.4	56.2	56.2
Minimum	38.7	36.8	37.1	37.2	34.5	34.8	37.1	37.3	37.1	37.0	40.2	37.9
Leqday	51.3	49.4	49.8	50.9	49.4	49.4	48.9	50.8	49.7	48.7	52.6	51.8
Leqnight	39.7	38.7	38.7	39.6	37.6	36.6	37.2	39.6	39.3	38.4	41.5	40.7
Leq	50.8	49.2	49.5	50.5	48.9	48.6	48.4	50.4	49.5	48.6	52.3	51.5
STANDARD	**Day – 65**	**Night - 55**	**Day – 55**	**Night – 45**	**Day - 50**	**Night - 40**	**Day - 55**	**Night - 45**	**Day - 55**	**Night - 45**	**Day - 65**	**Night - 55**

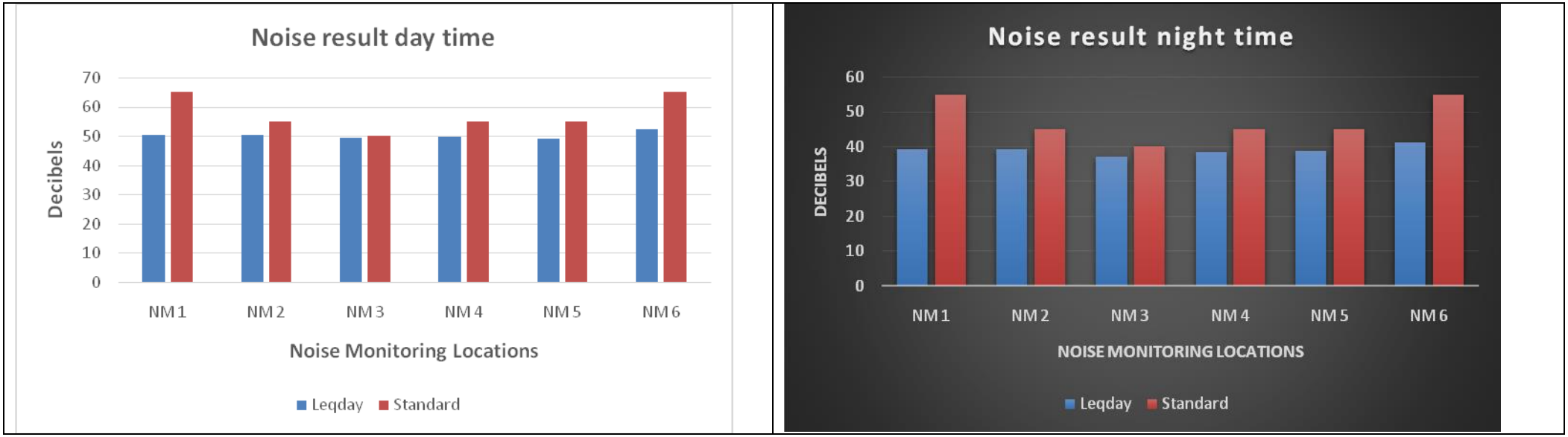


Figure 31: Noise monitoring results in day and night time along the project road

- **WHO Guidelines for Community Noise:**

Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	**-** **-**
Dwelling, indoors **Inside bedrooms**	Speech intelligibility and moderate annoyance, daytime and evening Sleep disturbance, night-time	35 30	16 8	 **45**
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	**60**
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	**-**
Pre-school Bedrooms, indoors	Sleep disturbance	30	sleeping -time	**45**
School, playground outdoor	Annoyance (external source)	55	during play	**-**
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	**40** **-**
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial, shopping and traffic areas, indoors and Outdoors	Hearing impairment	70	24	**110**
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	**110**
Public addresses, indoors and outdoors	Hearing impairment	85	1	**110**
Music through headphones/ Earphones	Hearing impairment (free-field value)	85 #4	1	**110**
Impulse sounds from **toys, fireworks and firearms**	Hearing impairment (adults) Hearing impairment (children)	- -	- -	**140#2** **120#2**
Outdoors in parkland and conservation areas	**Disruption of tranquillity**	**#3**		

#1: as low as possible;

#2: peak sound pressure (not LAmax, fast), measured 100 mm from the ear;

#3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low;
#4: under headphones, adapted to free-field values

An analysis of the results indicates that the day & night time noise levels in all six locations were mostly within the permissible limit.

C. Biological Environment

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.

Ecological resources are among the most important resources impacted by the road/infrastructure projects. The detailed baseline study of the ecological resources is essential to estimate the magnitude of potential impacts and to avoid or mitigate any loss caused by the proposed project. In this section baseline details of the flora and fauna are presented.

➢ Biodiversity of Meghalaya

Meghalaya is one of the main constituents of “Seven Sister” and is predominantly a land of hills and valley. Due to its vast natural beauty and grace, it has been also named as ‘Scotland of the East’. Till 1970 Meghalaya was part of undivided Assam, with Shillong as its capital. On January 21, 1972, Meghalaya was created by combining the hill regions of Garo, Khasi, and Jaintia to form a separate state, housing a Legislative Assembly of its own. Geographical location of the state is between 89^{o} 45’ to 92^{o} 48’ and 25^{o} 02’ to 26^{o} 05’. The total geographical area of the state is 22, 429 Sq Km, extending 300 km west to east and 100 km from north to south. The state comprises 11 districts, namely South Garo Hills, South West Garo Hills, West Garo Hills, East Garo Hills, North Garo Hills, West Khasi Hills, East Khasi Hills, South Khasi Hill, Ri bhoi, West Jaintia Hills and East Jaintia Hills. It is bounded on the north by Goalpara, Kamrup, Karbi Anglong and Nagaon districts, east by Cachar and North Cachar Hills districts of Assam and west and on the south by Rangpur division and Mymensingh divisions of Bangladesh. The altitude ranges from 50 – 1950 m (Talukdar et al. 2004). The highest peak is Shillong Peak. The state has population of about 29.67 lakhs with a density of 132-persons/ km2. The sex ratio is 989 females: 1000 males and the total literacy rate is 74.43%; male 75.59% and female 72.89 %; urban 90.79% rural 69.92 % (Census of India, 2011).

The main tribes in Meghalaya are the Khasis, the Garos, and the Jaintias. Each tribe has its own culture, traditions, dress, and language. The majority of the population and the major tribal groups in Meghalaya follow a matrilineal system where lineage and inheritance are traced through women. All the three major ethnic tribal groups, namely, the Khasis, Jaintias and the Garos also have their own traditional political institutions that have existed for hundreds of years.

The major rivers of the state are Ganol, Ringgi, Krishnai, Manda, Darong, Bhogai, simsang, Dareng, Umkhri, Umtrew, Umiam, Kopili, Kynshiang,Shella, Umngot, Myntdu, Lubha, etc. One of the marked features of River Kynshi in West Khasi Hills is the formation of River Island called Nongkhnum. Nongkhnum is not only India’s but Asia’s second largest river island.

The three geographical sub-regions of Meghalaya, viz., Khasi, Garo and Jaintia hills are among the wettest regions of the world, with clouds persisting in various areas nearly throughout the year.

Meghalaya falls under the Indo-Myanmar Bioddiversity Hotspot zone. Meghalaya, is one of the biodiversity rich states of India in terms of diversity of both flora and fauna due to its unique geographical position at the meeting point of Indo-Malayan and Eastern Himalayan bio-geographical regions. Thus, it shares biodiversity elements including flora and fauna from both the regions. Meghalaya also shares rich species diversity containing species from Indo-China and rest of India. The diverse landscape of the state also supports a large array of forest types and species. The flora of Meghalaya comprises about 3,128 species of flowering plants of which a large number of species are endemic. Meghalaya harbours a rich diversity of orchids (Family: Orchidaceae), of which nearly 110 genera and 439 taxa are reported from the state. However, many authors believe that Meghalaya may have more species of orchids and many are still to be discovered (Kakati 1986). Meghalaya is also considered as center of origin for a number of crop plants like rice, and Citrus based on the large number of wild relatives found in the state.

The faunal diversity of Meghalaya constitutes a total of 5538 species recorded so far, of a total 89,451 species known from India. Nearly 35 % of Indian Mammals and 50 % of the birds are represented in the state (. Invertebrates are represented by 2114 genera and 4580 species, of which 3624 species are insects. Among invertebrates, the porifera is the smallest group represented by only one genus and one species. Meghalaya has 139 species of Mammals, 659 species of Birds, 107 species of Reptiles, 55 species of Amphibia and 152 species of Fishes. Of these, 35 species of Mammals are endangered, vulnerable or insufficiently known. Similarly, 10 species of birds and 9 species of reptiles are either endangered or vulnerable. Along with the species diversity, the State has a significant percentage of endemic elements.

Government of Meghalaya, India through PWD Roads National Highways has decided to take up the development of various National Highway corridors across Meghalaya for the augmentation of capacity for safe and efficient movement of traffic by widening and strengthening to standard 2 lanes with paved shoulders. The new National Highway 127B is one such corridor.The new National Highway 127B (Meghalaya) starts from Phulbari in Assam-Meghalaya border and connecting to Rongram near Tura (Meghalaya). Project road traverses through Phulbari, Rajabala, Selsella & Babadamgare and Groigre enroute to Rongram. Alignment from Selsella to Goiragre is a new alignment consisting of existing village road on either end and both end and cart track. . This road passes through the only one district namely West Garo Hills of Meghalaya.

	No. of Genera	No. of Species
Vertebrates		
Mammalia	83	139
Aves	232	659
Reptilia	51	107
Amphibia	11	55
Pisces	74	152
Invertebrates	2114	4580
Bryozoa	3	5
Arthropoda	1825	3901
Annelida	25	49
Mollusca	67	223
Nematoda	49	77
Rotifera	30	111
Platyhelminthes	56	83
Medusae	2	2
Porifera	1	1
Protozoa	56	128

C.1. Flora of West Garo Hill District

Dense tropical mixed forest along with a small patch of temperate forest is found in this district. The district is rich in unique flora and it is considered to be the original home of the *Citrus* (District Census Handbook, West Garo Hills, 2011). The vegetation of the hills is categorized into flora of tropical and sub-tropical zones on the basis of altitude. The vegetation of tropical zone vegetation covers evergreen, semi-evergreen and deciduous forests, grasslands and bamboo thickets including riparian forests and swamps. The forests mainly have *Shorea robusta* and *Tectona grandis.* The tallest trees are *Schima wallichii, Aesculus assamica, Aporusa wallichii, Terminalia belirilia belirica, Engelhardtia spicata, Bridelia retusa, Lagerstroemia parviflora, Gmelina arborea*, *Cryptocarya andersonii, Talauma hodgsonii,* etc.; and the lower canopy is formed by *Miliusa velutina, Engelhardtia spicata, Hibiscus macrocarpus, Zizyphus rugosa, Helicia robusta and Ficus prostrata* etc. A few palms species like *Areca, Pinanga, Caryota* and *Didymosperma* are also found. *The Shrubby species are Capparis zeylanica, Mimosa himalayayana, Acacia Concinna, Garcinia lancifolia, Bauhinia acuminata, Mussaenda Roxburghii, Solanum Kurzii, Eupatorium Modiflorum,* and *Phlogacanthus tubiflorus etc.* In a few areas, trees like Dysolobium *grande, Paederia scanders, Solena heterophylla, Mucuna bracteata, Fissistigma wallichii* and *Aristolocjia saccata* are prominent. In most of the open moist localities as well as near water sources, herbs such as *Dictyospermum, Aneilema Scaberrimum, Aneilema Scaberrimum*, *Coix* sp., *Burmania* sp., *Cyprus* spp., *Anemone* spp., *Burmania* Sp., *Coiictyospermum, Oxalis corniculate* and *Ericcaulon* are present. *Alpinia, Amomum, Hedychium, Colocasia, Costus* are found in the evergreen forests along with epiphytic orchids. The epiphytic creepers such as *Rhaphidophora* spp., *Hoya* spp., etc. along with stem parasites of Loranthaceae as well as total root parasite *Cuscuta reflexa* are also found in this district. Ferns as well as fern-allies, mosses and liverworts etc. are found on old tree trunks or stones near water sources including shady places. Because of excessive 'Jhum' practice most of the forests got cleared and secondary monoculture forests of *Shorea robusta* were established (West Garo Hills, State of Meghalaya, 2020). The sub-tropical forest is restricted in Tura Peak, Nokrek Peak etc. These are generally evergreen forests along with few segments of deciduous forests. The upper canopy is contributed by *Betula culindristachvs, Kavea floribunda, Castanopsis hystrix, Garonia affinis, Cyathocalvx martabanicus, Dryntes lancifolia, Talauma rabaniania, Taluma phellocarna, Pasania xylocarpa,Fiscus* spp. and *Aldina cordifolia, Machilus gamblei, M. Villosa, Milletia orainii, Sterculia villosa, Garuga pinnata, Carnicia paniculata, Eriobotrya benghalensis, Emblica offinialis, Ebretia acuminata, Quercus semiserrata, Sageraea juarina, Symolocus ferruginea, Betula alnoid*es with *Litsea* spp. etc. forms the middle canopy of trees. The lowest canopy consists of *Aglata roxburghii, Antidesma bunius, Mitrephora tomentosa, Styrax serrulatim, Breynia patens, Pasania spicata, Premna multiflora. Entada phaseoloides, Spatholobus roxburghii, Conophalus suaveolens, Dalbergia stipulacea* and *Vitis latifolia* etc. stretch from one tree to another in the forests. The branches of old tree trunks are mainly moss-laden thus fully covered by few epiphytic orchids. Ferns, liverworts as well as mosses are also predominant in this part (West Garo Hills, State of Meghalaya, 2020). Nearest forest area along the project road are given in Table 34.

Table 34: Ecologically/ culturally significant area along the project road

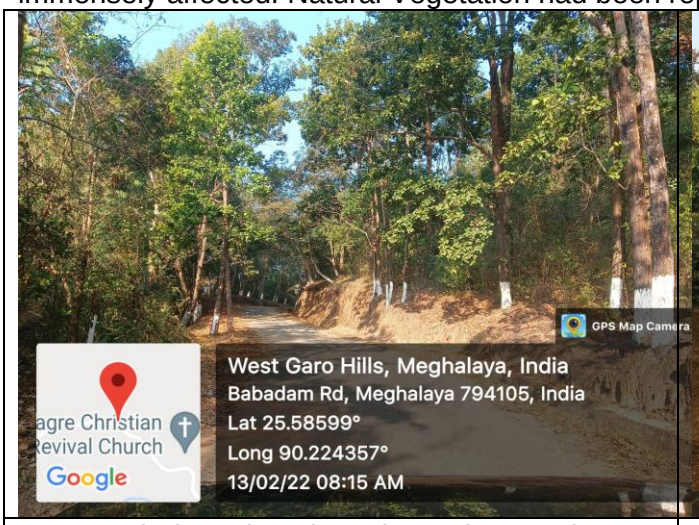
Ecologically/Culturally significant feature	Closest Site/Remarks
Wildlife Sanctuary	No WLS is in close vicinity
National Park	Nearest National Park is Nokrek which is about 10 km
Ramsar Site	No Ramsar Site is present in Meghalaya
Biodiversity Heritage Site	No biodiversity Heritages sites are located in in close vicinity

Ecologically/Culturally significant feature	Closest Site/Remarks
Biosphere Reserve	Nearest National Park is Nokrek which is about 7 km from the nearest ROW
Important Bird Area	Nearest National Park is Nokrek which is about 10 km
Wildlife Corridor	No wildlife corridor is mentioned or documented
Elephant Corridor	The Nearest and only elephant corridor present in the West Garo Hill is the Ranggira – Nokrek which is about 8 km from the ROW
Tiger Reserve	Meghalaya Doesn't have any Tiger Rerserve
Reserve Forest	1. Dibru Hills RF: The Project site passing through the boundary of the Dibru Hillas RF, but there is no diversion of Forest lands for the project, the expansion of road is being done on the non forested lands. 2. Tura Peak RF: The distance from the Tura peak RF is more than 10 km,
Elephant Reserve	Nokrek and Balpakram National Park forms the core area (400 Km^2) of the Elephant Reserve and majority of the part of the Elephant Reserve is situated in East Garo and South Garo Hill Districts.
Community Forests	No Community Forests sites are located in in close vicinity
Sacred Groove	No Sacred Grove sites are located in in close vicinity
Archeological Sites	None
Unprotected / Non Classified Forest	Yes
Major River	None
Fish Sanctuary	No declared Fish sanctuary lying in close vicinity of the project site
Surface water bodies	Yes. Small ponds mostly used for fishery.

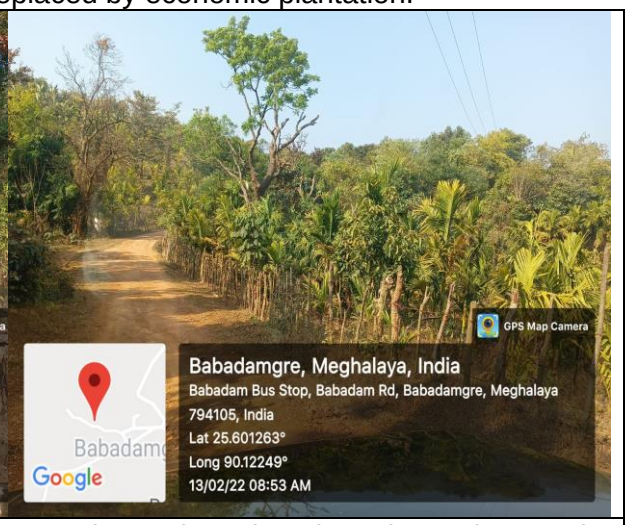
- **Vegetation Along the Project Road:**

Vegetation around 10 km and 15 km buffer of the study area mostly comprises of large/ medium/ small trees bushy shrubs and annuals perennial or biennials herbs. No scheduled species as per Wildlife Protetion Act, 1972 had been described from the project site nor any species listed under Endangered or Vulnerable as per IUCN status had been described from the project site. The tropical vegetation covers areas upto an elevation of about 1000. As the project road , covers both the hilly and flood planins of West Garo hills district, diversity of vegetation is quite high around 10 km and 15 km buffer of the study area.The majority of the forests viz. Dilma, Dhima, Chimabangsi, Rajasimla Ildek, Darugre, Rongrenggre, Songsak, Siju, Rewak, Emangre, baghmara, Phulbari, Rongmatchokgre, Rongchugre, Singimari etc. fall in this zone. It embraces evergreen, semi-evergreen and deciduous forests, bamboo thickets and grasslands including riparian forests and swamps. These forests mainly consist of Shorea robusta and in certain area Tectona grandis has also been introduced. Between Chainage 53+000 to 60+000, few patches of natural vegetation of Sal (Shorea robusta) had been observed. But due to large scale Cashew, Areca Nut plantation

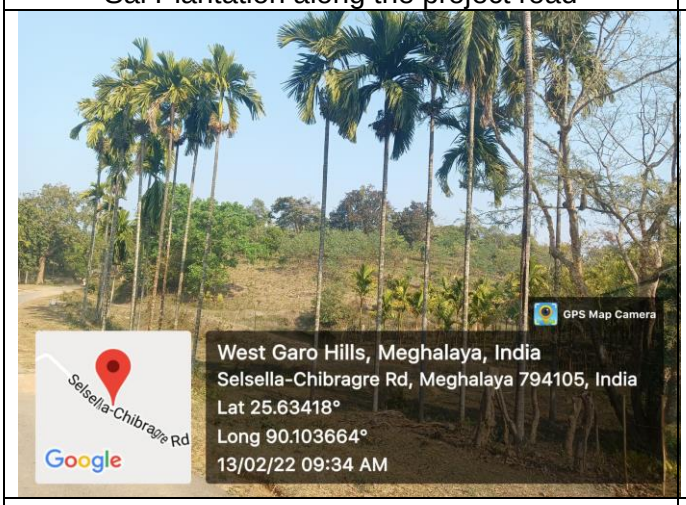
and jhum cultivation by the local community the natural vegetation in the study area has been immensely affected. Natural Vegetation had been replaced by economic plantation.



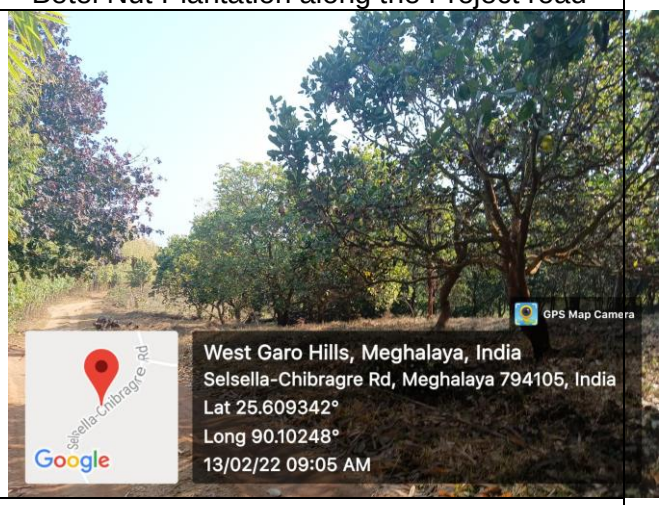
Sal Plantation along the project road



Betel Nut Plantation along the Project road



Betel Nut Plantation along the Project road



Cashews Plantation along the Project Road

Figure 32: Plantation observed along the Project Road

- **Economic Plantation:**

Since time immemorial, Areca nut has been grown in Meghalaya as an important commercial crop. All along the study area large scale areca nut orchard had been seen.

Cashew is one of the most important cash crops in the west garo hills and West Garo Hills District has an area of 4899 ha. under cashew nut with an estimated annual production of about 12603 Metric tonnes of raw cashew nut (2012-13). The Selsella CD block is one of the important cashew growing area in west garo Hills and the project road passes through this block mainly. Very isolated efforts are made by farmers of West Garo Hills under Selsella Development Block for area expansion through planting recommended variety of cashew. The average area of cashew orchard per family is 1 acre. 5% farmers in the West Garo Hills were found to undertake intercropping with pineapples.

Small scale rubber plantation is also observed in some pockets between chainage 37+000 to 60+000.It could be noted that, majority of these plantation has replaced natural plantation in the study area.

➢ Mammal of study area:

Though the state of Meghalaya recorded presence of about 139 different species of mammals, but mmmalian Diversity is not high in the project site as the area doesn't have any dense forest cover or protected areas within direct influence zone of project site. Due to large scale Cashew, Areca Nut plantation and jhum cultivation by the local community the natural vegetation in the study area has immensely affected the wildlife population of the study area. Traditional hunting practices by tribal community was also one of the major causes of depletion of wildlife in hilly region of West Garo hills. Presently only minor wildlife is being reported from the study area. In the report, wildlife around 10 km and 15 km buffer of the study area is being tabulated.It should be noted that the mighty Brahmaputra, Norkrek National Park and Dibru Hill RF falls within 15 km buffer of the study area. Gangetic Dolphin is only found in the waters of Brahmaputra which donot fall under direct influence zone of the project site.

➢ Nokrek National Park-

Nokrek National Park is located in the Garo Hills of Meghalaya state, covering parts of three districts,i.e., East Garo Hills, West Garo Hills, and South Garo Hills. Nokrek was declared as a national park in 1986, while the final notification was issued in 1997. The area has been acquired by outright purchase of land from the local communities by the Government of Meghalaya. Though this park covers an area of 47.48 km^2, most places in the NP are less than 5 km in width. The park plays a significant role in conservation of regional biodiversity typical of the Garo Hills hence, the area surrounding the National Park has been declared as the Nokrek Biodiversity Reserve (UNESCO 1988). The forest habitat mainly consists of Tropical Evergreen, Moist Deciduous, Tropical Semi-evergreen, Sub tropical Evergreen forests and Riverine forests. The National Park is one of the least disturbed forest tracts of Sub-Himalayan range. The park is home to a variety of animals, birds and pheasants, beside some rare and endemic flora. Important animals found here are Indian Elephant, Hoolock Gibbons, Capped Langur, Stump Tailed Macaque, Clouded Leopard, Leopard, Gaur, Sambar, Barking Deer, Himalayan Black Bear, Sloth Bear. Many species of birds can also be spotted here and the national park is considered to be an important bird area and an ideal spot for bird watchers. Citrus indica which is mother of all citrus fruit in the world is endemic to this place and the locals call it by name memangnarang ('orange of the spirits').

Important Birds of Nokrek NP:

About 150 bird species have been recorded from Nokrek NP, in a survey of the avifauna. Nokrek national park is a designated IBA (Important Bird Area). As per IBA, some of the threatened birds of the national park are-

White-rumped Vulture	Gyps bengalensis	Critically Endangered (CR)
Slender-billed Vulture	Gyps tenuirostris	Critically Endangered (CR)
Yellow-breasted Bunting	Emberiza aureola	Endangered (EN)
Lesser Adjutant	Leptoptilos javanicus	Vulnerable (VU)
River Lapwing	Vanellus duvaucelii	Near Threatened (NT)
Oriental Darter	Anhinga melanogaster	Near Threatened (NT)
Lesser Fish-eagle	Ichthyophaga humilis	Near Threatened (NT)
Great Pied Hornbill	Buceros bicornis	Near Threatened (NT)
Red-breasted Parakeet	Psittacula alexandri	Near Threatened (NT)

Mammals:

The fauna of the NP include many threatened and endangered species of mammals. Nokrek is famed for its diversity of large and small cats, ranging from Tiger (Panthera tigris), Leopard (P. pardus), Clouded Leopard (Neofelis nebulosa), Golden Cat (Catopuma temmincki), to Leopard Cat (Prionailurus bengalensis). The main Canids are Golden Jackal (Canis aureus) and Wild Dog (Cuon

alpinus). The Asiatic Black Bear (Ursus thibetanus) is another large carnivore. However, in recent years there have been no sightings of tiger inside the park. The local communities in Nokrek Biosphere Reserve have also not reported any signs of tiger. Other important species reported from Nokrek NP include Red Panda (Ailurus fulgens) and Binturong (Arctictis binturong), slow loris (Nycticebus bengalensis), pig-tailed macaque (Macaca leonina), stump-tailed macaque (Macaca arctoides), rhesus macaque (Macaca mulatta), capped langur (Trachypithecus pileatus), and western hoolock gibbon (Hoolock hoolock). Some threatened mammalian fauna of the Nokrek NP is listed below:

1	*Panthera tigris*	Tiger	EN
2	*Neofelis nebulosa*	Clouded leopard	VU
3	*Panthera pardus*	Leopard	LC
4	*Pardofelis marmorata*	Marbled cat	NT
5	*Catopuma temmincki*	Golden Cat	NT
6	*Ailurus fulgens*	Red Panda	EN
7	*Arctonyx collaris*	Hog badger	VU
8	*Rusa unicolor*	Sambar	VU
9	*Elephas maximus*	Asian Elephant	EN
10	*Macaca assamensis*	Assamese macaque	VU
11	*Macaca leonina*	Pigtailed macaque	VU
12	*Trachypithecus pileatus*	Capped langur	VU
13	*Hoolock hoolock*	Western Hoolock gibbon	EN
14	*Nycticebus bengalensis*	Bengal slow loris	VU
15	*Macaca arctoides*	stump-tailed macaque	NT
16	*Ratufa bicolor*	Malayan giant squirrel	NT
17	*Bos gaurus*	Gaur	VU
18	*Ursus thibetanus*	Asiatic black bear	VU
19	*Melursus ursinus*	Sloth bear	VU
20	*Helarctos malayanus*	sun bear	VU
21	*Capricornis thar*	Himalayan serow	NT

Herpetofauna:

The herpetofauna diversity of Nokrek National Park is also very high. Different species of Snakes, Turtles, Lizards and Amphibian had been documented from the National Park area. Some important threatened species are-

Scientific Name	**Common Name / Local Name**	**IUCN status**
Snakes		
Typhlops jerdoni	Jerdon Blind Snake / Chipu Chikgil	NT
Amphiesma stolatum	Striped Keelback Snake/ Samrok	NT
Chrysopelea ornate	Ornate Flying Snake/Phultok	NT
Oligodon dorsalis	Red-tailed Kukri Snake / Chipu Kime-gitchak	VU
Psammodynastes pulverulentus	Common Mock Viper/Rete	VU
Rhabdophis himalayanus	Himalayan Keelback Snake / Wamikglo	NT
Rhabdophis subminiatus	Red-necked Keelback/ Tilang ba Gitok gitchak	VU

Sibynophis collaris	Collared Black-headed Snake / Sko-Gisim	NT
Xenochrophis sanctijohannis	St.John's Keelback /Chipu-Gipok	NT
Oligodon nikhili	Nikhil's Kukri Snake /Bisgre Chipu	CR
Python molurus	Burmese python / Chipu-Nokma	NT
Lizards		
Calotes emma	Spiny-headed Lizard /Gara Sko-busugnang	NT
Calotes maria	Gray's Forest Lizard /Gara Tangsek	NT
Calotes calotes	Common green ForestLizard / Gara Tangsek	NT
Japalura planidorsata	Flat-backed Mountain/Lizard/ Gara Janggil pelgap	VU
Ptyctolaemus gularis	Blue-throated lizard/ Gara Gitokblu	EN
Cyrtodactylus khasiensis	Khasi Hills Bent-toed Gecko /Benchidik Ja. gongge	VU
Eutrophis multifasciata	Many lined Skink/ Andlewak Ritingbang	NT
Varanus bengalensis	Bengal Monitor lizard/ Mappu Dalgap	VU
Varanus salvator	Water Monitor / Mappu	VU
Turtles and Tortoise		
Pangshura sylhetensis	Assam roofed turtle	EN
Cyclemys gemeli	Asian leaf turtle	DD
Amphibians		
Occidozyga borealis	Northern trickle Frog /Bengblok Chonteng	VU
Philautus garo	Garo Hills Bush Frog/Bengbrek Jaksima	VU

Fish:
Due to presence of numerous river and streams, the fish diversity of the Nokrek National Park is quite high. Simsang River, which originates from Norkrek Peak, is an important river system of Nokrek NP. Some scheduled fishes of the Nokrek Park are-

Botia rostrate	Gangetic Loach	VU
Tor putitora	Golden Mahsheer	EN
Labeo pangusia		NT
Neolissocheilus hexagonolepis	Copper Mahsheer	NT
Ompok pabda	Butter catfish	NT
Wallago attu	wallago catfish	NT
Anguilla bengalensis	Indian mottled eel	NT
Bagarius sp	Goonch/ Giant devil catfish	NT
Ailia coila	Kajoli	NT

- **Relevance of Nokrek National Park with regards to NH-127B (Meghalaya Section)**

Nokrek National Park though formally notified in 1997 but till date the declaration for eco-sensitive zone (ESZ) around this important national park has not been completed. A draft notification for declaration of ESZ around this NP was issued in 2015 which was suppressed and re-drafted in 2018.

However, the approval is still pending. The proposed road alignment for NH127B from Fakirganj to Rongram (near Tura) is more than 5 km away from the ESZ boundary notified in the last draft notification (published in 2018).

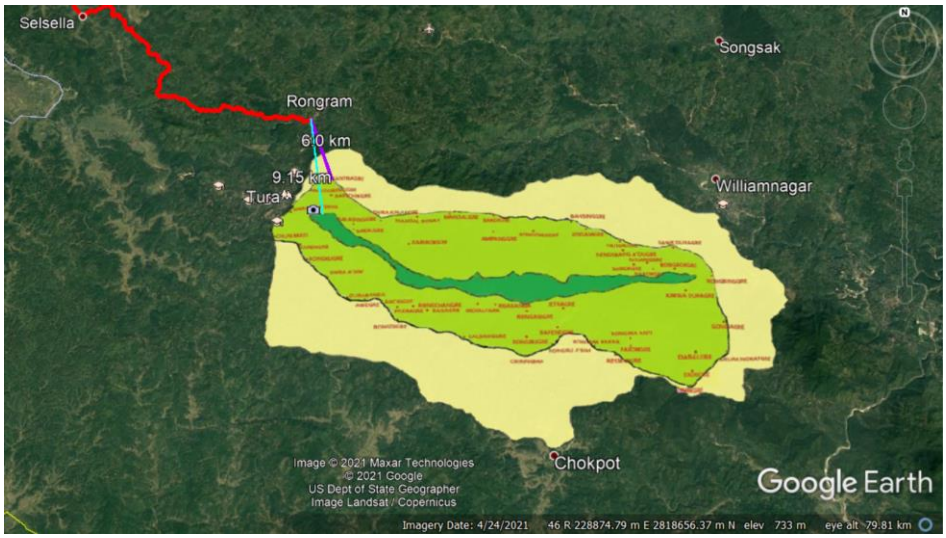


Figure 33: Distance of Nokrek National Park from the project road

➢ Vegetation Along the Project Road:

Vegetation around 10 km and 15 km buffer of the study area mostly comprises of large/ medium/ small trees bushy shrubs and annuals perennial or biennials herbs. No scheduled species as per Wildlife Protetion Act, 1972 had been described from the project site nor any species listed under Endangered or Vulnerable as per IUCN status had been described from the project site. The tropical vegetation covers areas upto an elevation of about 1000. The majority of the forests viz. Dilma, Dhima, Chimabangsi, Rajasimla Ildek, Darugre, Rongrenggre, Songsak, Siju, Rewak, Emangre, baghmara, Phulbari, Rongmatchokgre, Rongchugre, Singimari etc. fall in this zone. It embraces evergreen, semi-evergreen and deciduous forests, bamboo thickets and grasslands including riparian forests and swamps. These forests mainly consist of *Shorea robusta* and in certain area *Tectona grandis* has also been introduced.

Table 35: Plant Biodiversity in the Study Area[5]

(A) ANGIOSPERMS				
Acacia pennata	Mimosaceae	Herb	Common	LC
Ageratum conyzoides	Asteraceae	Herb	Very Common	NA
Albizzia procera	Mimosaceae	Tree	Rare	NA
Anthocephalus chinensis	Rubiaceae	Tree	Common	NA
Artocarpus integrifolia	Moraceae	Small Tree	Common	NA
Arundinella nepalensis	Poaceae	Herb	Common	NA
Arundo donax	Poaceae	Herb	Common	LC

[5]Reference:
1. https://avibase.bsc-eoc.org/avibase.jsp
2. http://asbb.gov.in/

Asparagus racemosus	Liliaceae	Herb	Rare	NA
Bauhinia acuminata	Caesalpiniaceae	Small Tree	Common	LC
Bombax ceiba	Bambacaceae	Tree	Very Common	NA
Cardamine impatiens	Brassicaceae	Herb	Common	NA
Cassia fistula	Caesalpiniaceae	Small Tree	Common	NA
Cassia tora	Caesalpiniaceae	Shrub	Common	NA
Chrysopogon fulvus	Poaceae	Herb	Common	NA
Cissampelos pariera	Manispermaceae	Herb	Rare	NANIC
Commelina bengalensis	Commelinaceae	Herb	Very Common	NANIC
Cyperus rotundus	Cyperaceae	Herb	Abundant	NANIC
Dendrocalamus hamiltonii	Poaceae	Herb	Common	NA
Dioscorea bulbifera	Dioscoreaceae	Climber	Common	NA
Erythrina variegata	Papilionaceae	Small Tree	Rare	NA
Eucalyptus tereticornis*	Myrtaceae	Tree	Rare	NA
Euphorbia emodi	Euphorbiaceae	Herb	Common	LC
E. hirta	Euphorbiaceae	Herb	Common	NA
Ficus hispida	Moraceae	Tree	Common	NA
Galium sp.	Rubiaceae	Herb	Common	NA
Gmelina arborea	Verbenaceae	Tree	Common	NA
Imperata cylindrica	Poaceae	Herb	Common	LC
Ipomoea aquatica	Convolvulaceae	Herb	Common	NA
I. cairica	Convolvulaceae	Creeper	Very common	NA
Justicia adhatoda	Acanthaceae	Shrub	Common	NA
Lagerstroemia sp	Lytharaceae	Tree	Rare	NA
Lathyrus aphaca	Fabaceae	Herb	Common	NA
Lemna minor	Lemnaceae	Herb	Common	LC
Lepidium virginicum	Brassicaceae	Herb	Common	NA
Litsea glutinosa	Lauraceae	Tree	Rare	NA
Mallotus philippensis	Euphorbiaceae	Small Tree	Common	NA
Mimosa pudica	Mimosaceae	Herb	Rare	NA
Phragmites karka	Poaceae	Herb	Common	LC
Phyllanthus emblica	Euphorbiaceae	Tree	Common	NA
Poa annua	Poaceae	Herb	Common	LC
Potamogeton pectinatus	Potomogetonaceae	Herb	Common	LC

Pycrius spp.	Cyperaceae	Herb	Abundant	NA
Ranunculus arvensis	Ranunculaceae	Herb	Common	NA
Saccharum spontaneum	Poaceae	Herb	Abundant	LC
Sapium baccatum	Euphorbiaceae	Tree	Common	NA
Scripus spp.	Cyperaceae	Herb	Common	NA
Shorea robusta	Dipterocarpaceae	tree	Rare	NA
Smilex zylanica	Smilaceae	Climber	Rare	LR
Solanum erianthum	Solanaceae	Herb	Common	NANIC
Sonchus spp.	Asteraceae	Herb	Common	NA
Stellaria media	Caryophylaceae	Herb	Common	NA
Syzygium cumini	Myrtaceae	Tree	Common	NA
Tectona grandis*	Verbenaceae	Tree	Common	NA
Thysanolaena maxima	Poaceae	Herb	Common	NA
Tinospora cordifolia	Manispermaceae	Climber	Rare	NA
Toona ciliata	Meliaceae	Tree	Common	NA
Trewia nudiflora	Euphorbiaceae	Tree	Rare	LR
Vitex peduncularis	Verbenaceae	Tree	Rare	NA
Zizyphus mauritiana	Rhamnaceae	Tall Shrub	Abundant	NANIC
(B) FERNS AND FERN ALLIES				
Adiantum caudatum	Adiantaceae	Herb	Common	NA
Equisetum diffusum	Equisetaceae	Herb	Common	NA
Marselia minuta	Marseliaceae	Herb	Common	NANIC
Pteris biaurita	Pterideae	Herb	Rare	NA
Seleginella helferi	**Selaginellaceae**	**Herb**	**Common**	NANIC

Abbreviations:VU=Vulnerable,NA=NotassessedbutpresentinthecatalogueofLife,NANIC=NotassessedandnotpresentinthecatalogueofLife, LC =Least concern, LR =Lowrisk

C.2. Fauna of West Garo Hill District:

The terrestrial fauna of this district are Hoolock gibbon, Assamese macaque, Slow loris, Golden langur, Capped langur, Common monkey, Tiger, Leopard, Leopard cat, Clouded leopard, Golden cat, Marbled cat, Jungle cat, Large Indian civet, Masked Palm civet, Binturong, Indian Grey mongoose,

Indian fox, Himalayan Black bear, Yellow-Bellied weasel, Madras Tree shrew, Yellow Throated marten, Yellow-Bellied weasel, Madras Tree shrew, Indian flying squirrel, Malayan Giant squirrel, Bandicoot rat, Lesser Bamboo rat, Rufous-tailed hare, Indian elephant, Sambar, Indian Wild boar, Different Species of Bats etc. Avifaunal species present are White-crested Laughing Thrush, Indian black baza , Cockoo-shrike, Green Barbet, Chloropsis, Barred jungle owlet, Red jungle-fowl, Green Himalayan Barbet, Scarlet Minivet, Jungle myna, Black-headed Oriole, White–capped Redstart, Magpie Robin, Yellow Bulbul, Thick-billed green pigeon, Hill Myna, Red headed trogon, Pied Myna, Grey-headed Sibia, Indian three-toed forest kingfisher, Brown Fish Owl, Bee-Eaters, Serpent Eagle, Slaty-headed Scimitar Babbler as well as various species of Parrots, Hornbills, Nightjars, Egrets, Swallow-Shrikes, etc. Reptile fauna include several varieties of lizards, snakes. Different species of lizards, geckos and skinks including *Cnemaspis Jerdoni, Cytodac Tylus Khasiensis, Calotes Emma, C. Maria, C. Versicolor, Cosymbotus Platyrus, Gekko Gecko, Japalura Planidorsata, Hemidactylus Brooki, H. Frenatus* etc. Red necked Keelback are important poisonous species including Indian Cobra and Vipers (West Garo Hills, State of Meghalaya, 2020).

- **Fauna in Study Area:**

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. But withing 10 km and 15 km Buffer area of the project site presence of Gangetic Dolphins had been reported from the Brahmaputra River, but the proposed project would not have any impact as the Gangetic Dolphins is not coming under direct influence zone.

- **Mammal of study area:**

Though the state of Meghalaya recorded presence of about 139 different species of mammals, but mammalian diversity is not high in the project site as the area doesn't have any dense forest cover. Only minor mammals are seen. Gangetic Dolphin is only found in the waters of Brahmaputra which donot fall under direct influence zone of the project site.

Table 36: List of Mammals along the project road

Order	***Common Name***	***Scientific Name***	***Local Availability***	***IUCN Status***	***WPA Status***
Artiodactyla	Gangetic Dolphin	*Platanista gangetica*	Common	EN	I
Primates	Monkey	*Macaca mulatta*	Common	LC	II
Primates	Assamese macaque	*Macaca assamensis*	Rare	NT	II
Primates	Capped Langur	Presbytis pileatus	Rare	EN	I
Primates	Pig Tailed Macaque	*Macaca leonine*	Rare	VU	II
Pholidota	Chinese pangolin	*Manis pentadactyla*	Very Rare	CR	I
Proboscidea	Asian Elephant	*Elephas maximus*	Seasonal	EN	I
Artiodactyla	Wild Boar	*Sus scrofa*	Common	LC	III
Artiodactyla	Barking Deer	*Muntiacus muntjak*	Common	LC	II
Artiodactyla	Gaur/Indian Bison	*Bos gaurus*	Very Rare	VU	I
Carnivora	Jackal	*Canis aureus*	Rare	LC	II
Carnivora	Bengal Fox	*Vulpes bengalensis*	Rare	LC	II
Carnivora	Jungle Cat	*Felis chaus*	Rare	LC	II
Carnivora	Common Palm Civet	*Paradoxurus hermaphroditus*	Common	LC	II
Carnivora	Large Indian civet	*Viverra zibetha*	Rare	LC	II

Carnivora	Small Indian civet	*Viverra indica*	Rare	LC	II
Carnivora	Asiatic Black Bear	*Ursus thibetanus*	Very Rare	VU	I
Carnivora	Indian Grey mongoose	*Herpestes edwarsdii*	Common	LC	IV
Lagomorpha	Black-Naped Hare	*Lepus nigricollis*	Common	LC	IV
Chiroptera	Flying Fox	*Pteropus giganteus*	Common	LC	V
Eulipotyphla	The Asian House Shrew	*Suncus murinus*	Common	LC	V
Rodentia	Himalayan Porcupine	*Hystrix brachyura*	Common	LC	II
Rodentia	The red giant flying squirrel	*Petaurista petaurista*	Rare	LC	II
Rodentia	Hoary-Bellied Squirrel	*Callosciurus pygerythrus*	Common	LC	V
Rodentia	The House Mouse	*Mus musculus*	Common	LC	V
Rodentia	Bandicoot Rat	*Bandicota bengalensis*	Common	LC	IV

- **Herpetofauna of study area:**

Herpetofauna includes Reptiles and amphibian animals of a particular area. Major reptiles include snakes, lizards, turtles and tortoises. Turtles and Tortoise are found mostly in Brahmaputra river system and large water bodies which are not in direct influence zone of project site. Snakes, lizards are common in the project site as the area being a predominantly agriculture zone. Few snakes are also venomous such as Banded Krait, Monocled Cobra, Spectacled Cobra and Red Necked Keelback.

Table 37: Snakes and lizards along the project road

Order	***Common Name***	***Scientific Name***	***Local availability***	***IUCN Status***	***WPA Status***
Snakes and lizards					
Agamidae	Garden Lizard	*Calotes versicolor*	Common	LC	IV
Gekkonidae	Brooke's house gecko	*Hemidactylus brooki*	Common	LC	IV
Gekkonidae	Tokay Gecko	*Gekko gecko*	Rare	LC	IV
Gekkonidae	Indian House Gecko	*Hemidactylus sp*	Common	LC	IV
Scincidae	Common Skink	*Eutropis carinata*	Common	LC	IV
Scincidae	Indian Forest Skink	*Sphenomorphus indicus*	Commom	NE	~
Varanidae	Common Indian Monitor	*Varanus bengalensis*	Common	LC	I
Pythonidae	Burmese Python	*Python bivittatus*	Common	VU	I
Typhlopidae	Brahminy blind snake	*Indotyphlops braminus*	Common	LC	IV
Colubridae	Common Wolf Snake	*Lycodon aulicus*	Common	LC	IV
Colubridae	Copper-Headed Trinket Snake	*Coelognathus radiatus*	Common	LC	IV
Colubridae	Indian Rat Snake	*Ptyas mucosa*	Common	LC	IV
Colubridae	Checkered Keelback	*Fowlea piscator*	Common	LC	IV
Colubridae	Indo-Chinese Rat snake	*Ptyas korros*	Common	LC	IV
Colubridae	Green cat snake	*Boiga cyanea*	Common	LC	IV
Colubridae	Common cat snake	*Boiga gokool*	Common	LC	IV
Colubridae	Gray cat snake	*Boiga siamensis*	Common	LC	IV
Colubridae	Ornate flying snake, flying snake	*Chrysopelea ornata*	Common	LC	IV
Elapidae	Banded Krait	*Bungarus fasciatus*	Common	LC	IV
Elapidae	King cobra	*Ophiophagus hannah*	Rare	VU	I

Order	*Common Name*	*Scientific Name*	*Local availability*	*IUCN Status*	*WPA Status*
Elapidae	Northeastern hill krait	*Bungarus bungaroides*	rare	LC	IV
Elapidae	Greater black krait	*Bungarus niger*	Rare	LC	IV
Colubridae	Spectacled Cobra	*Naja naja*	Rare	LC	II
Colubridae	Monocled Cobra	*Naja kaouthia*	Common	LC	II
Colubridae	Red Necked Keelback Snake	*Rhabdophis subminiatus*	Common	LC	IV
Colubridae	Vine Snake	*Ahaetulla Sp*	Common	LC	IV
Colubridae	Ornate Flying Snake	*Chrysopelea ornata*	Common	LC	IV
Colubridae	Painted Bronzeback Tree Snake	*Dedrelaphis pictus*	Common	LC	IV
Turtles and Tortoises					
Testudines	Indian Tent Turtle	*Pangshura tentoria*	Rare	LC	~
Testudines	The Assam Leaf Turtle	*Cyclemys gemeli*	Rare	~	~
Testudines	Tricarinate Turtle	*Melanochelys tricarinata*	Rare	EN	I
Testudines	Indian Flap-Shelled Turtle	*Lissemys punctata andersonii*	Rare	LC	I
Testudines	Narrow-Headed Softshell Turtle	*Chitra indica*	Rare	EN	IV
Testudines	Indian Peacock Soft-Shell Turtle	*Nilssonia hurum*	Rare	VU	I
Testudines	Gangetic Soft-Shell Turtle	*Nilssonia gangeticus*	Rare	VU	I
Testudines	Yellow Tortoise	*Indotestudo elongata*	Rare	EN	IV
Amphibians					
Bufonidae	Common Asian Toad	*Duttaphrynus melanostictus*	Common	LC	~
Bufonidae	Himalayan Toad	*Duttaphrynus himalayanus*	Common	LC	~
Rhacophoridae	Terai Tree Frog	*Polypedates teraiensis*	Common	LC	~
Rhacophoridae	Common Tree Frog	*Polypedates leucomystax*	Common	LC	~
Rhacophoridae	Assam Tree Frog	*Polypedates assamensis*	Common	LC	~
Dicroglossidae	Indian Bull Frog	*Hoplobatrachus tigerinus*	Common	LC	IV
Dicroglossidae	Indian Skipping Frog	*Euphylctis cyanophlyctis*	Common	LC	IV
Microhylidae	Ornate Narrow Mouth Frog	*Microhyla ornata*	Common	LC	~
Microhylidae	Ballon Frog	*Uperodon globulosus*	Common	LC	~
LC= Least Concern, EN= Endangered,NT= Near Threatened, VU= Vulnerable					

➢ Common Birds of study area:

Due to presence of numerous fish rich water bodies and mighty Brahmaputra River, agricultural fields, different types of vegetation the area is home to numerous bird species. Brahmaputra River which is falling under 10 km zone of the project site, act as winter migration habitat for many species. There are reports of rare sightings of White Rumped Vulture from the area but no nesting sites had been reported in close vicinity of the project's direct influence zone.

Table 38: Name of the common birds in study area

Order	*Common Name*	*Scientific name*	*Local Avaiability*	*IUCN Status*	*WPA Status*
ANSERIFORMES	Lesser Whistling Duck	*Dendrocygna javanica*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Common Shelduck	*Tadorna tadorna*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Ruddy Shelduck	*Tadorna ferruginea*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Red-Crested Pochard	*Netta rufina*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Tufted Duck	*Aythya fuligula*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Garganey	*Spatula querquedula*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Northern Shoveler	*Spatula clypeata*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Gadwall	*Mareca strepera*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Eurasian Wigeon	*Mareca penelope*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Indian Spot-Billed Duck	*Anas poecilorhyncha*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Mallard	*Anas platyrhynchos*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Northern Pintail	*Anas acuta*	Rare, Winter visitor	LC	IV
ANSERIFORMES	Common Teal	*Anas crecca*	Rare, Winter visitor	LC	IV
PHOENICOPTERIFORMES	Little Grebe	*Tachybaptus ruficollis*	Rare, Winter visitor	LC	IV
COLUMBIFORMES	Rock Dove	*Columba livia*	Common	LC	IV
COLUMBIFORMES	Oriental Turtle Dove	*Streptopelia orientalis*	Common	LC	IV
COLUMBIFORMES	Yellow-Footed Green-Pigeon	*Treron phoenicoptera*	Common	LC	IV
COLUMBIFORMES	Spotted Dove	*Streptopelia chinensis*	Common	LC	IV
COLUMBIFORMES	Red Collared Dove	*Streptopelia tranquebarica*	Common	LC	IV
COLUMBIFORMES	Emerald Dove	*Chalcophaps indica*	Rare		
CAPRIMULGIFORMES	Common Swift	*Apus apus*	Common	LC	IV
CAPRIMULGIFORMES	large-tailed	*Caprimulgus*	Rare	LC	IV

Order	***Common Name***	***Scientific name***	***Local Avaiability***	***IUCN Status***	***WPA Status***
	nightjar	*macrurus*			
CUCULIFORMES	Greater Coucal	*Centropus sinensis*	Rare	LC	IV
CUCULIFORMES	Indian Cuckoo	*Cuculus micropterus*	Common	LC	IV
CUCULIFORMES	Asian Koel	*Eudynamys scolopaceus*	Common	LC	IV
GALLIFORMES	Red Jungle Fowl	*Gallus gallus*	Common	LC	IV
GALLIFORMES	Kalij Pheasant	*Lophura leucomelanos*	Rare	LC	IV
GRUIFORMES	White-Breasted Waterhen	*Amaurornis phoenicurus*	Common	LC	IV
GRUIFORMES	Purple Swamp Hen	*Porphyrio porphyrio*	Rare	LC	IV
GRUIFORMES	Common Coot	*Fulica atra*	Winter visitor	LC	IV
PELECANIFORMES	Lesser Adjutant	*Leptoptilos javanicus*	Winter Visitor	VU	IV
PELECANIFORMES	Asian Openbill	*Anastomus oscitans*	Common	LC	IV
PELECANIFORMES	Indian Pond Heron	*Ardeola grayii*	Common	LC	IV
PELECANIFORMES	Cattle Egret	*Bubulcus ibis*	Common	LC	IV
PELECANIFORMES	Great Egret	*Ardea alba*	Common	LC	IV
PELECANIFORMES	Intermediate Egret	*Ardea intermedia*	Common	LC	IV
PELECANIFORMES	Little Egret	*Egretta garzetta*	Common	LC	IV
PELECANIFORMES	Little Cormorant	*Microcarbo niger*	Common	LC	IV
CHARADRIIFORMES	Northern Lapwing	*Vanellus vanellus*	Rare, Winter visitor	NT	IV
CHARADRIIFORMES	Grey-Headed Lapwing	*Vanellus cinereus*	Rare, Winter visitor	NT	IV
CHARADRIIFORMES	Red-Wattled Lapwing	*Vanellus indicus*	Rare, Winter visitor	LC	IV
CHARADRIIFORMES	River Lapwing	*Vanellus duvaucelii*	Rare, Winter visitor	LC	IV
CHARADRIIFORMES	Pheasant-Tailed Jacana	*Hydrophasianus chirurgus*	Rare	LC	IV
CHARADRIIFORMES	Bronze-Winged Jacana	*Metopidius indicu*	Common	LC	IV
CHARADRIIFORMES	Common Sandpiper	*Actitis hypoleucos*	Rare	LC	IV
CHARADRIIFORMES	Common Greenshank	*Tringa nebularia*	Rare	LC	IV
CHARADRIIFORMES	Marsh Sandpiper	*Tringa stagnatilis*	Rare	LC	IV
CHARADRIIFORMES	Common Snipe	*Gallinago gallinago*	Rare	LC	IV
CHARADRIIFORMES	Black-Headed Gull	*Chroicocephalus ridibundus*	Rare	LC	IV
CHARADRIIFORMES	Whiskered Tern	*Chlidonias*	Rare	LC	IV

Order	***Common Name***	***Scientific name***	***Local Avaiability***	***IUCN Status***	***WPA Status***
		hybrida			
ACCIPITRIFORMES	Black-Winged Kite	*Elanus caeruleus*	Rare	LC	IV
ACCIPITRIFORMES	Himalayan Griffon	*Gyps himalayensis*	Very Rare	EN	IV
ACCIPITRIFORMES	White Rumped Vulture	*Gyps indicus*	Very Rare	CR	I
ACCIPITRIFORMES	Crested Serpent-Eagle	*Spilornis cheela*	Very Rare	LC	IV
ACCIPITRIFORMES	Black Kite	*Milvus migrans*	Very Rare	LC	IV
ACCIPITRIFORMES	Pallas's Fish-Eagle	*Haliaeetus leucoryphus*		EN	IV
ACCIPITRIFORMES	Gray-Headed Fish-Eagle	*Haliaeetus ichthyaetus*	Very Rare	NT	IV
STRIGIFORMES	Barn Owl	*Tyto alba*	Very Rare	LC	IV
STRIGIFORMES	Brown Fish-Owl	*Ketupa zeylonensis*	Very Rare	LC	IV
STRIGIFORMES	Asian Barred Owlet	*Glaucidium cuculoides*	Rare	LC	IV
STRIGIFORMES	Jungle Owlet	*Glaucidium radiatum*	Rare	LC	IV
STRIGIFORMES	Spotted Owlet	*Athene brama*	Rare	LC	IV
BUCEROTIFORMES	Oriental Pied-Hornbill	*Anthracoceros albirostris*	Rare	LC	IV
BUCEROTIFORMES	Common Hoopoe	*Upupa epops*	Common	LC	IV
CORACIIFORMES	Common Kingfisher	*Alcedo atthis*	Common	LC	IV
CORACIIFORMES	White-Throated Kingfisher	*Halcyon smyrnensis*	Common	LC	IV
CORACIIFORMES	Pied Kingfisher	*Ceryle rudis*	Common	LC	IV
CORACIIFORMES	Green Bee-Eater	*Merops orientalis*	Common	LC	IV
CORACIIFORMES	Chestnut-Headed Bee-Eater	*Merops leschenaulti*	Common	LC	IV
CORACIIFORMES	Indian Roller	*Coracias benghalensis*	Common	LC	IV
PICIFORMES	Coppersmith Barbet	*Psilopogon haemacephalus*	Common	LC	IV
PICIFORMES	Blue-Eared Barbet	*Psilopogon duvaucelii*	Common	LC	IV
PICIFORMES	Lineated Barbet	*Psilopogon lineatus*	Common	LC	IV
PICIFORMES	Blue-Throated Barbet	*Psilopogon asiaticus*	Common	LC	IV
PICIFORMES	Common Flame-Backed Woodpecker	*Dinopium javanense*	Common	LC	IV
PICIFORMES	Black-Rumped Flameback	*Dinopium benghalense*	Common	LC	IV
PICIFORMES	Greater	*Chrysocolaptes*	Common	LC	IV

Order	***Common Name***	***Scientific name***	***Local Avaiability***	***IUCN Status***	***WPA Status***
	Flameback	*guttacristatus*			
PSITTACIFORMES	Alexandrine Parakeet	*Psittacula eupatria*	Common	NT	IV
PSITTACIFORMES	Rose-Ringed Parakeet	*Psittacula krameri*	Common	LC	IV
PSITTACIFORMES	Gray-Headed Parakeet	*Psittacula finschii*	Common	NT	IV
PSITTACIFORMES	Blossom-Headed Parakeet	*Psittacula roseata*	Common	NT	IV
PSITTACIFORMES	Red-Breasted Parakeet	*Psittacula alexandri*	Common	NT	IV
PASSERIFORMES	Scarlet Minivet	*Pericrocotus speciosus*	Common	LC	IV
PASSERIFORMES	Black-Hooded Oriole	*Oriolus xanthornus*	Common	LC	IV
PASSERIFORMES	Indian Golden Oriole	*Oriolus kundoo*		LC	IV
PASSERIFORMES	Black-Naped Oriole	*Oriolus chinensis*	Common	LC	IV
PASSERIFORMES	Common Iora	*Aegithina tiphia*	Common	LC	IV
PASSERIFORMES	Black Drongo	*Dicrurus macrocercus*	Common	LC	IV
PASSERIFORMES	Bronzed Drongo	*Dicrurus aneus*	Common	LC	IV
PASSERIFORMES	Ashy Drongo	*Dicrurus leucophaeus*	Common	LC	IV
PASSERIFORMES	Long-Tailed Shrike	*Lanius schach*	Common	LC	IV
PASSERIFORMES	Rufous Treepie	*Dendrocitta vagabunda*	Common	LC	IV
PASSERIFORMES	House Crow	*Corvus splendens*	Common	LC	IV
PASSERIFORMES	Common Tailorbird	*Orthotomus sutorius*	Common	LC	IV
PASSERIFORMES	Paddyfield Warbler	*Acrocephalus agricola*	Common	LC	IV
PASSERIFORMES	Red-vented Bulbul	*Pycnonotus cafer*	Common	LC	IV
PASSERIFORMES	Ashy Bulbul	*Hemixos flavala*	Common	LC	IV
PASSERIFORMES	Red-whiskered Bulbul	*Pycnonotus jacosus*	Common	LC	IV
PASSERIFORMES	Red-whiskered Bulbul	*Pycnonotus jocosus*	Common	LC	IV
PASSERIFORMES	Jungle Babbler	*Turdoides striata*	Common	LC	IV
PASSERIFORMES	Indian White-eye	*Zosterops palpebrosus*	Common	LC	IV
PASSERIFORMES	Asian Pied Starling	*Gracupica contra*	Common	LC	IV
PASSERIFORMES	Common Myna	*Acridotheres tristis*	Common	LC	IV
PASSERIFORMES	Bank Myna	*Acridotheres*	Common	LC	IV

Order	*Common Name*	*Scientific name*	*Local Avaiability*	*IUCN Status*	*WPA Status*
		ginginianus			
PASSERIFORMES	Jungle Myna	*Acridotheres fuscus*	Common	LC	IV
PASSERIFORMES	Great Myna	*Acridotheres grandis*	Common	LC	IV
PASSERIFORMES	Common Hill Myna	*Gracula religiosa*	Common	LC	IV
PASSERIFORMES	House Sparrow	*Passer domesticus*	Common	LC	IV
PASSERIFORMES	Oriental Magpie-Robin	*Copsychus saularis*	Common	LC	IV
PASSERIFORMES	Baya Weaver	*Ploceus philippinus*	Common	LC	IV
PASSERIFORMES	Western Yellow Wagtail	Motacilla flava	Common	LC	IV
PASSERIFORMES	Gray Wagtail	Motacilla cinerea	Rare	LC	IV
PASSERIFORMES	Citrine Wagtail	Motacilla citreola	Rare	LC	IV
PASSERIFORMES	White Wagtail	Motacilla alba	Rare	LC	IV
PASSERIFORMES	Olive-backed Pipit	*Anthus hodgsonii*	Rare	LC	IV
PASSERIFORMES	Rosy Pipit	*Anthus roseatus*	Rare	LC	IV
PASSERIFORMES	Scally Breasted Munia	*Lonchura punctulata*	Rare	LC	IV
PASSERIFORMES	White-backed Munia	*Lonchura striata*	Common		
PASSERIFORMES	Purple Sunbird	*Cinnyris asiaticus*	Common	LC	IV
PASSERIFORMES	Crimson Sunbird	*Aethopyga siparaja*	Common	LC	IV
PASSERIFORMES	Black Redstart	*Phoenicurus ochrurus*	Common	LC	IV
PASSERIFORMES	White-Rumped Shama	*Copsicus malabaricus*	Common	LC	IV
PASSERIFORMES	Blue-throated Flycatcher	*Cyornis ruberculoides*	Common	LC	IV
PASSERIFORMES	Grey Bushchat	*Saxicola jerdoni*	Common	LC	IV
PASSERIFORMES	Orange-Bellied Leafbird	*Chloropsis hardwickii*	Common	LC	IV
PASSERIFORMES	Plain Prinia	*Prinia inornata*	Common	LC	IV

C.3. Forest Area of West Garo Hill District:

The area under forests of this district is 1, 65,508 ha. The types of forest found in the district are Reserved Forests which are under the Forest Department, Village Reserved Forests managed by the Garo Hills Autonomous District Council, National Park, Biosphere Reserves and Private/Community Forests present under 'Nokma' system. Development schemes of several forest produces/trees such as teak, sal, critical area plantation and other plantations are being implemented each and every year by the Forest Department through the budgetary allocations. The Meghalaya Forest Development

Corporation, a state owned Corporation has been set up by the State Govt. to avail of institutional credit linked afforestation schemes. The dept. is also maintaining five nurseries which have a capacity of 90000 to 100000 numbers of seedlings/saplings in the district (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India). According to IFSR 2019, West Garo Hills district records 77.79 percent of the district's geographical area as forested along with a gain of 23.22 sq. km. in forest cover from 2017 report data. In West Garo Hills, under DFO West & South West Garo Hills Territorial Division, Tura, there are two reserved forests namely Dibru Hills R.F. (Area is 15.02 sq. km.) & Tura peak R.F. (Area is 4.19 sq. km.) (Forest Administration, Meghalaya Forest and Environment Department, 2019).

Nokrek Biosphere Reserve extends to three districts which are West Garo Hills, East Garo Hills and South Garo Hills District. It covers an area of 820 sq. kms. Where the core zone is 47.48 Sq.Kms. (having Nokrek National Park), buffer zone is 227.92 Sq.Kms. and transition zone is 544.60 Sq.Kms. It is the First Biosphere Reserve in the North-East India which has been designated for inclusion in the World Network of Biosphere Reserve of Man and the Biosphere Programme, UNESCO on 26-05-2009.

The tribal people residing in this district have customary right over their forest and managed by the District Council. Forest patches are only confined to the banks of rivers and rivulets in the district except in the Tura Peak as well as the Nokrek Peak. Because of excessive Jhum cultivation, road and building constructions including urban expansion etc., many forests of this region are being destroyed which resulted in an irreplaceable loss of the green heritage and also jeopardize ecological stability. The sub tropical vegetation occurs at an elevation of approximately 1200m above the mean sea level which is restricted to Tura Peak, Nokrek Peak, etc. These are mainly evergreen forest with few segments of deciduous forests. The district is rich in forest resources covering an area of 1, 65,508 ha and important species are sal, teak, champa, gamari, khokon, etc. The Tropical Wet Evergreen Forests are distributed in high rainfall areas and near catchments areas. Few deciduous species such as *Careya arborea, Callicarpa arborea* and *Dillenia pentagyna* are found in Tropical Semi-evergreen Forests. The rolling grasslands covering large patches are distributed throughout the district (District Census Handbook, West Garo Hills, 2011).

Sacred forest:

In West Garo hills, there are about 8 recorded sacred groves and none of these sacred groves are present on the proposed alignment. The sacerd forest details are geven in below table.

Sl.no	Name of the Scared Grove of West Garo Hill District	Area in Ha.
1	Angalgiri	20
2	Asigiri	4
3	Damalgiri	50
4	Daronggiri	25
5	Goragiri	25
6	Jelbongpara	20
7	Jhanjipara	7
8	Sadolpara	30

Elephant Corridors:

According to 'Right of Passage: Elephant Corridors of India (2017), five active elephant corridors have been identified in the State of Meghalaya. The only elephant corridor present in the West Garo Hill is the Ranggira – Nokrek which is not located within the proposed project site. The Present status of the Ranggira – Nokrek Elephant corridor as described in the Right of Passage: Elephant Corridors of India (2017), read as follows -

Elephants from Ranggira, Sanchangiri and Galwang village forest area use this corridor to move to Nokrek National Park. Earlier, they moved via Bismagre, Bibragre, Sakalgre and Mandalgre private forests. However, the establishment of human settlements, construction of the North-Eastern Hill

University (NEHU) campus, the Garo Students Union building, a fishery pond, the 2nd Police Battalion campus and other artefacts along the Tura-Rongram road has almost blocked the corridor.

The book also states that, there is very rare movement of elephants through this corridor as majority of the corridor is blocked due to anthropogenic activities and constructions. Beyond Ranggira, there is hardly any elephant movement towards east nor there is any suitable elephant habitat left (pres Comm, with Dr. K Ramkumar , Editor of Right of Passage: Elephant Corridors of India, who died due to Covid in May 2021). There might be very poor possibility of witnessing some elephants in the ROW seasonally, there are no permanent residential elephants in the ROW area and there are no corridors that go through the ROW area. During field survey, locals also confirmed very sparse and very rare visit of elephants in the area.

Tiger:

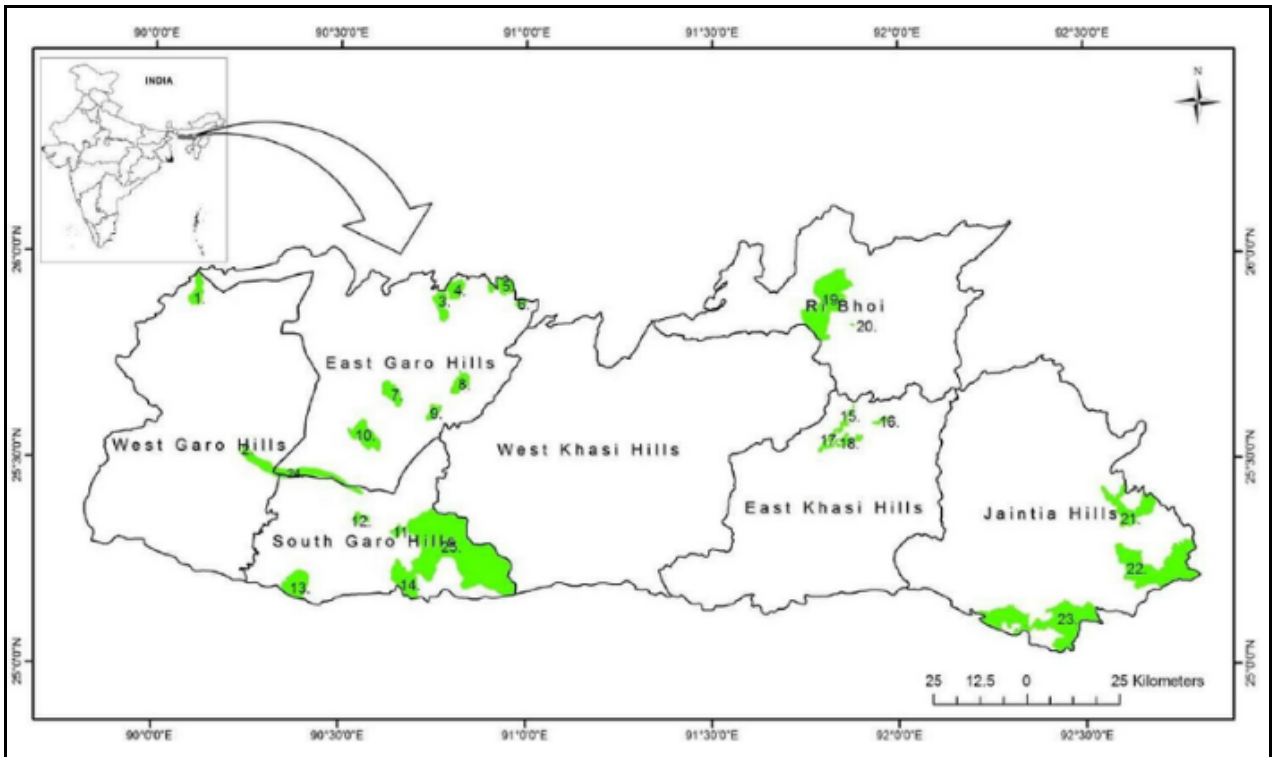
As per latest All India Tiger Estimation, No Tiger presence had been reported from the State of Meghalaya.

Leopard:

No recent sightings had been reported by the State Forest department or local community. Thus, there is very very less possibility of encounter of Leopard from the ROW.

Bears:

Though there are reports of presence bears from Nokrek national Park, but no reports of recent sightings is found from the study area. During interview, the community members were unsure about presence of any bear in their close vicinity. Thus, it implies that, bears are mostly confined to Nokrek only.



Map showing the distribution of National parks (NP), Wildlife sanctuaries (WLS) and Reserved forests (RF) in Meghalaya (1. Dribru hills RF, 2. Tura peak RF, 3. Chima Bangshi RF, 4.Dhima RF, 5. Rajasimla RF, 6. Iidek RF, 7. Songsak RF, 8. Darugiri RF, 9. Dambu RF, 10. Rongrengiri RF, 11. Siju WLS/RF, 12. Emanggiri RF, 13. Angratoli RF, 14. Baghmara WLS/RF, 15. Rait Khawn RF, 16. Shyrwat RF, 17. Upper Shillong RF, 18. Rait Laban RF, 19. Nongkhyllem WLS/ RF, 20. Umsaw RF, 21. Saipung RF, 22. Saipung RF, 23. Narphu RF, 24. Nokrek NP, and 25. Balphakram NP).

Figure: 34 Map showing the distribution of national parks, wildlife sanctuaries and reserve forests of Meghlaya

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- **Profile of project area in Terms of Sensitive Ecological and cultural attributes:**

The table below gives the ecological profile of the project area indicating the critical ecological, Historical and cultural features –

Table 39: Sensitive Ecological profile of the project area

Ecologically/Culturally significant feature	Availability within project area
Wildlife Sanctuary	No
National Park	No
Ramsar Site	No
Biodiversity Heritage Site	No
Biosphere Reserve	No
Important Bird Area	No
Wildlife Corridor	No
Elephant Corridor	No
Tiger Reserve	No
Reserve Forest	No
Elephant Reserve	No(Project side is out of the core area)
Community Forests	No
Sacred Groove	No
Archeological Sites	No
Unprotected / Non Classified Forest	Yes
Major River	No
Fish Sanctuary	No
Surface water bodies	Yes. Small ponds mostly used for fishery.

C.4. Aquatic Ecosystem:

The Tura range form watersheds in the West Garo Hills district from which the rivers flows towards Bangladesh plains in the south as well as the Brahmaputra valley in the north and the west. The

important rivers of the northern part are the Kalu, Ringgi and the Didak. Kalu starts from Tura peak running towards the west through Damalgre, Garobadha and Rangapani before entering Goalpara district including its chief tributaries are Dilni and Rongram rivers. Ringgi starts from Arabela peak running through Ringgegre village and then falling into Jinjiram river. Didak starts from Anogre village running through Garo Hills district before entering Goalpara district. The important rivers of the southern part of the district are the Bhogai and Dareng. Bhogai starts from the southern side of Nokrek Mountains running through Dalu village and entering Mymensingh district in Bangladesh. Dareng is present on the southern side of Nokrek mountain. It runs southwards through Silkigre and then entering into Bangladesh. It has several deep pools such as Bamon, Warima, Rong´ang, etc. where Bamon is the deepest. The Tura range is also the source of the river Simsang (Someswari) which is an important river of Meghalaya starting from Nokrek mountains and running towards the east, passing through Rongrenggre, Williamnagar the headquarters of East Garo Hills district, Nongalbibra, Siju, Rewak and at the end Baghmara the headquarters of South Garo Hills district. The upper corse of this river has huge stones while the lower course has many deep pools and falls such as Mirik, Matma, Jamiseng, Warisik, Bobra, Kan´chru Suk, Goka etc. (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India).

There are 256 wetlands in this district including natural and man-made comprising of 7196 ha area. For open water, the pre monsoon area is 5672 ha and the post monsoon area is 6496 ha. The major wetland types are River/Stream, waterlogged areas, Lakes/Ponds and Ox-bow lakes (National Wetland Atlas: Meghalaya, MoEF, 2009). There are few Fish Seed Farms in the district namely Digrichiring farm and Dalu Demonstration farm in which there are indigenous carps. Turtles and variety of snakes are present.

➢ Common Fishes of study area:

Fish diversity of the West Garo hills is quite high due to presence of numerous water bodies, smalls Strems. As commercial fishery is an important livelihood option in West Garo hills, many different species of fishes are farmed in the region. West Garo Hill District has 5 Fish Sanctuary where endangered species like Golden Mahsheer, Chocolate Mahsheer, Goonch are being protected and conserved. The project site does not have any major river system and fish sanctuary within its limits.

Table40: Name of the common fishes

Order	***Scientific Name***	***Common Name***	***Local Name***	***Local Avaiability***	***IUCN Status***	***Remarks***
Cypriniformes	*Gudusia chapra*	Indian river shad	Na Patchi/Puti	Common	LC	
Cypriniformes	*Danio sp*	Zebra Fish	Na bat	Common	LC	
Cypriniformes	*Puntius Chola*	Barb	Na Patchi/Puti	Common	LC	
Cypriniformes	*Puntius conchonius*		Na Patchi/Puti	Common	LC	
Cypriniformes	*Puntius sophore*		Na Patchi/Puti	Common	LC	
				Common		
Cypriniformes	*Amblypharyngodon mola*	Mola Carplet	Kha Muka	Common	LC	
Cypriniformes	*Botia rostrata*	Gangetic Loach	Kah Syiem(khasi)	No	VU	Ganol River , Simsang river lower course, out side study area
Cypriniformes	*Garra sp*			Common	LC	

Order	*Scientific Name*	*Common Name*	*Local Name*	*Local Avaiability*	*IUCN Status*	*Remarks*
Cypriniformes	*Neolissocheilus hexagonolepis*	Copper Mahsheer	Na rong	NO	NT	Wachi Wari Fish Sanctuary, Simsang River, out side study area
Cypriniformes	*Tor putitora*	GOLDEN Mahsheer	Na gitchak	NO	EN	Wachi Wari Fish Sanctuary, Simsang River, out side study area
Cypriniformes	*Labeo pangusia*		Na wak	NO	NT	Ganol River , lower course, out side study area
Cypriniformes	*Labeo rohita*	Rohu	khabaw	Common	LC	
Cypriniformes	*Catla catla*	catla		Common	LC	
Cypriniformes	*Labeo gonius*	kuria	Kha ski	Common	LC	
Cypriniformes	*Cyprinus carpio*	Common carp		Common	VU	Locally common, farm fish
Cypriniformes	*Chagunius chagunio*			Common	LC	
Cypriniformes	*Esomus danricus*	Indian flying barb	shalynnai	Common	LC	
Cypriniformes	*Raiamas bola*	The trout barb		Common	LC	
Perciformes	*Channa stewartii*	Snakehead	Na Chi	Common	LC	
Perciformes	*Channa gachua*	Snakehead	Na Chi	Common	LC	
Perciformes	*Badis badis*	Chameleon fish	A sinta	Common	LC	
Perciformes	*Chanda nama*	Chanda	Kha snad	Common	LC	
Anabantiformes	*Anabas testudineus*	climbing perch		Common	LC	
Anabantiformes	*Colisa sota*	gourami		Common	LC	
Actinopterygii	*Parambassis ranga*	Glassy perchlet	Kha Snad	Common	LC	
Actinopterygii	*Barilius vagra*	Vagra Baril	Bangbol	Common	LC	
Actinopterygii	*Barilius bendelisis*	Hamilton Baril	Bangbol	Common	LC	
Actinopterygii	*Anguilla bengalensis*	Indian mottled eel	Na nil	NO	NT	Simsang River, outside study area
Siluriformes	*Mystus sp*	Tengra	tengila	Common	LC	
Siluriformes	*Ompok pabo*	Pabo cat	Kha	NO	NT	Brahmaputra

Order	*Scientific Name*	*Common Name*	*Local Name*	*Local Avaiability*	*IUCN Status*	*Remarks*
		fish	babia(khasi)			River
Siluriformes	*Sperata sp*	Aar		Common	LC	
Siluriformes	*Heteropneustes fossilis*	Singi		Common	LC	
Siluriformes	*Wallago attu*	Barali		NO	NT	Brahmaputra River
Siluriformes	*Bagarius sp*	Goonch	Kha khla	No	NT	Songkal Wari, Simsang River, out side study area
Siluriformes	*Clupisoma garua*			Common	LC	
Osteoglossiformes	*Chitala chitala*	Chital		No	NT	Brahmaputra River
Osteoglossiformes	*Notopterus notopterus*	Kanduli	Kha blang	Common	LC	
	LC= Least Concern,NT= Near Threatened, VU= Vulnerable,					

C.5. Comparison with the list of Endangered Species (Iucn Red List)[6]

Gangetic Dolphin	*Platanista gangetica*	Mammals	EN	Predominantly seen in deep waters of Brahmaputra River . Well outside of the direct influce of the ROW
Assamese macaque	*Macaca assamensis*	Mammals	NT	Deep forest dweller, rare sightings reported by villagers
Capped Langur	Presbytis pileatus	Mammals	EN	Deep forest dweller, rare sightings reported by villagers
Pig Tailed Macaque	Macaca leonine	Mammals	VU	Deep forest dweller, rare sightings reported by villagers
Chinese pangolin	*Manis pentadactyla*	Mammals	CR	Very rare
Asian Elephant	*Elephas maximus*	Mammals	EN	Seasonal Presence recorded within the 15 km zone of the project site
Gaur/Indian Bison	*Bos gaurus*	Mammals	VU	Very Rare
Asiatic Black Bear	Ursus thibetanus	Very Rae	VU	Very rare, mostly reported from Nokrek Area
Burmese Python	*Python bivittatus*	Reptile	VU	Locally Common, mostly found in forested areas.
Elapidae	King cobra	*Ophiophagus hannah*	VU	Rarely sighted
Assam Roofed Turtle	Pangshura sylhetensis	Reptile	EN	Rare. Found mostly in river waters of Brahmaputra . Out side of ROW.
Indian Eyed Turtle	Morenia petersi	Reptile	VU	Rare. Found mostly in river waters of Brahmaputra . Outside

[6]Reference: http://www.iucnredlist.org/

				of ROW.
Tricarinate Turtle	Melanochelys tricarinata	Reptile	EN	Rare. Found mostly in forested areas. Outside of ROW
Narrow-Headed Softshell Turtle	Chitra indica	Reptile	EN	Rare. Found mostly in river waters of Brahmaputra . Out side of ROW.
Indian Peacock Soft-Shell Turtle	Nilssonia hurum	Reptile	VU	Rare. Found mostly in river waters of Brahmaputra . Out side of ROW.
Gangetic Soft-Shell Turtle	Nilssonia gangeticus	Reptile	VU	Rare. Found mostly in river waters of Brahmaputra . Out side of ROW.
Crowned River Turtle	Hardella thurjii	Reptile	VU	Rare.Found mostly in river waters of Brahmaputra . Out side of ROW.
Yellow Tortoise	Indotestudo elongata	Reptile	EN	Rare. Found mostly in forested areas. Outside of ROW
Three-Striped Roofed Turtle	Batagur dhongoka	Reptile	EN	Rare. Found mostly in river waters of Brahmaputra . Out side of ROW.
Botia rostrata	Gangetic Loach	Fish	VU	Ganol River , Simsang river lower course, out side study area
Common carp	Cyprinus carpio	Fish	VU	Locally Common. Mostly found in deep river waters or Beels.
Tor putitora	GOLDEN Mahsheer	Fish	EN	Wachi Wari Fish Sanctuary, Simsang River, out side study area
Labeo pangusia		Fish	NT	Ganol River , lower course, out side study area
Silver carp	Hypopthalmychthys molitrix	Fish	NT	Locally Common. Mostly found in deep river waters or Beels. Farm fish
Chital	Chitala chitala	Fish	NT	Locally Common. Mostly found in deep river waters or Beels. Farming is also done.
Neolissocheilus hexagonolepis	Copper Mahsheer	Fish	NT	Wachi Wari Fish Sanctuary, Simsang River, out side study area
Pavo	Ompok pabda	Fish	NT	Locally Common. Mostly found in deep river waters or Beels.
Barali	Wallago attu	Fish	NT	Locally Common. Mostly found in deep river waters or Beels and ponds.
Anguilla bengalensis	Indian mottled eel	Fish	NT	Simsang River, outside study area
Bagarius sp	Goonch	Fish	NT	Songkal Wari, Simsang River, out side study area
Kajoli	Ailia coila	Fish	NT	Locally Common. Mostly found in deep river waters or Beels.
Lesser Adjutant	*Leptoptilos javanicus*	Bird	VU	Migratory. Mostly found near large water bodies(Beels) or River Beds
Northern Lapwing	*Vanellus vanellus*	Bird	NT	Migratory. Mostly found near large water bodies(Beels) or River Beds

Grey-Headed Lapwing	*Vanellus cinereus*	Bird	NT	Migratory. Mostly found near large water bodies(Beels) or River Beds
Himalayan Griffon	*Gyps himalayensis*	Bird	EN	Rare visitor. No nesting sites reported in close vicinity of ROW
White Rumped Vulture	*Gyps indicus*	Bird	CR	Rare visitor. No nesting sites reported in close vicinity of ROW.
Pallas's Fish-Eagle	*Haliaeetus leucoryphus*	Bird	EN	Mostly found near large water bodies (Beels) or River banks. No nesting sites reported in close vicinity of ROW.
Gray-Headed Fish-Eagle	*Haliaeetus ichthyaetus*	Bird	NT	Mostly found near large water bodies (Beels) or River banks. No nesting sites reported in close vicinity of ROW.
Alexandrine Parakeet	*Psittacula eupatria*	Bird	NT	Locally Common.
Gray-Headed Parakeet	*Psittacula finschii*	Bird	NT	Locally Common.
Blossom-Headed Parakeet	*Psittacula roseata*	Bird	NT	Locally Common.
Red-Breasted Parakeet	*Psittacula alexandri*	Bird	NT	Locally Common.
VU = Vulnerable, T = Near Threatened, EN = Endangered, CR = Critically Endangered,				

➢ Seasonal Ecological Variation along the project road

The field study was conducted in the summer season which produces minimum bio diversity in the site. The tree and shrub diversity will remain same in other seasons of the year. In case of herb and grass species, there will be insignificant changes in rest of the year. Similarly in case of the bird species (winter migration) and faunal diversity there will be minor variations. The secondary data is limited to a checklist of species which does not differentiate the availability of bio diversity in different seasons. However, being a linear project the impacts on seasonal variation of bio diversity is very limited and detailed seasonal variation study is unlikely to be required. The team tried to present an overall list of flora and fauna based on records available with forest dept, biodiversity board, district website and mainly with discussion with local community who are best person to provide on ground grass level information.

C.6. Species Diversity Analysis

Plankton are the microscopic organisms that drift on the water currents. Phytoplankton forms the sole base of food chain in aquatic system as they act as energy transducers and convertthe solar energy into chemical energy of food. Zooplankton passes this food energy to the higher trophic levels and thus provides a link between energy producers and the consumers. These organisms are important biological indicators of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes.

Table 41: Species Diversity of Phytoplankton at various Location of River: Redundant part of river atch. (0+300km)

SlNo	**Name of Species**	**No/L**			
		Location 1	**Location 2**	**Location 3**	**Location 4**

1	*Frustulia sp.*	+	+	+	+
2	*Gyrosigma sp.*	+	+	+	+
3	*Navicula sp.*	+	*	*	*
4	*Tabellaria sp.*	*	+	+	+
5	*Gomphonema sp.*	+	+	+	+
6	*Fragilaria sp.*	+	+	+	+
7	*Synedra sp.*	+	+	+	+
8	*Pinnularia sp.*	+	+	+	+
9	*Draparnaldiopsis sp.*	+	+	+	+
10	*Hyalotheca sp.*	*	*	+	*
11	*Spirogyra sp.*	+	+	+	+
12	*Gonatozygon sp.*	+	+	+	+
13	*Ulothrix sp.*	*	+	*	+
14	*Eudorina sp.*	+	+	+	+
15	*Anabaena sp.*	+	+	+	+
16	*Oscillatoria sp.*	+	*	+	+
17	*Spirulina sp.*	+	+	+	+
18	*Nostoc sp.*	+	+	+	*
19	*Mougeotia sp.*	*	+	+	+
20	*Zygnema sp.*	+	*	*	+
21	*Microspora sp.*	+	+	+	*
22	*Triploceras sp.*	+	+	+	+
23	*Eudorina sp.*	+	*	+	+
24	*Ceratium sp.*	*	+	+	+
25	*Glenodinium sp.*	+	+	+	+
26	*Closterium sp.*	+	+	+	+
Total		**20**	**21**	**23**	**22**

* Organism not present

Table 42: Species Diversity of Zooplankton at various Location of River: Redundant part of River at ch. 0+300km

S. No	**Name of Species**	**No/m^3**			
		Location 1	**Location 2**	**Location 3**	**Location 4**
1	*Nauplii sp. larvea*	+	+	+	+
2	*Cyclops sp.*	+	+	+	+
3	*Diaptomus sp.*	+	+	*	+
4	*Mesocyclops sp.*	+	*	+	+
5	*Tropocyclops sp.*	*	+	*	+
6	*Moina sp.*	+	+	+	+
7	*Bosmina sp.*	+	+	+	+
8	*Ceriodaphnia sp.*	+	+	+	+
9	*Daphnia sp.*	+	+	*	+
10	*Monostyla sp.*	+	+	+	+
11	*Brachionus sp.*	*	*	+	+
12	*Keratella sp.*	+	+	+	+
13	*Lepadella sp.*	+	+	*	*
14	*Nauplius sp.*	+	+	+	+
15	*Euchlanis sp.*	*	+	+	+
16	*Paramoecium sp.*	+	+	*	+
17	*Euglena sp.*	+	+	+	+
Total		**14**	**15**	**12**	**16**

* Organism not present

Table 43: Species Diversity of Phytoplankton at various Location of River: Redundant part of river at ch. (1+500km)

S. No	**Name of Species**	**No/L**			
		Location 1	**Location 2**	**Location 3**	**Location 4**
1	*Frustulia sp.*	+	+	+	+
2	*Gyrosigma sp.*	+	+	+	*
3	*Navicula sp.*	+	+	+	+
4	*Tabellaria sp.*	+	+	+	+
5	*Gomphonema sp.*	+	+	+	*

6	*Fragilaria sp.*	+	*	+	+
7	*Synedra sp.*	+	+	+	+
8	*Pinnularia sp.*	+	+	+	*
9	*Draparnaldiopsis sp.*	+	+	*	+
10	*Hyalotheca sp.*	+	+	+	+
11	*Spirogyra sp.*	+	+	+	*
12	*Gonatozygon sp.*	+	+	*	+
13	*Ulothrix sp.*	*	+	+	+
14	*Eudorina sp.*	*	*	+	*
15	*Anabaena sp.*	*	+	+	+
16	*Oscillatoria sp.*	+	+	+	*
17	*Spirulina sp.*	+	+	+	+
18	*Nostoc sp.*	+	+	*	+
19	*Mougeotia sp.*	+	+	+	+
20	*Zygnema sp.*	*	+	+	+
21	*Microspora sp.*	*	+	*	+
22	*Triploceras sp.*	*	*	+	*
23	*Eudorina sp.*	+	+	+	+
24	*Ceratium sp.*	*	+	+	*
25	*Glenodinium sp.*	+	+	+	+
26	*Closterium sp.*	+	+	+	+
Total		**19**	**23**	**22**	**18**

* Organism not present

Table 44: Species Diversity of Zooplankton at various Location of River: Redundant part of River at ch. 1+500km

S. No	**Name of Species**	**No/m^3**			
		Location 1	**Location 2**	**Location 3**	**Location 4**
1	*Nauplii sp. larvea*	+	+	+	+
2	*Cyclops sp.*	+	+	+	*
3	*Diaptomus sp.*	+	+	+	+
4	*Mesocyclops sp.*	+	+	+	*
5	*Tropocyclops sp.*	+	+	+	+
6	*Moina sp.*	+	*	+	*
7	*Bosmina sp.*	*	*	*	+
8	*Ceriodaphnia sp.*	+	+	+	+
9	*Daphnia sp.*	+	+	+	*
10	*Monostyla sp.*	+	*	+	+
11	*Brachionus sp.*	+	+	+	+
12	*Keratella sp.*	+	+	+	+
13	*Lepadella sp.*	*	+	*	*
14	*Nauplius sp.*	+	*	+	+
15	*Euchlanis sp.*	+	+	+	*
16	*Paramoecium sp.*	+	+	+	+
17	*Euglena sp.*	+	+	+	+
Total		**16**	**13**	**15**	**12**

*** Organism not present**

Table 45: Species Diversity of Phytoplankton at various Location of River: Redundant part of river at ch. (12+400km)

S. No	**Name of Species**	**No/L**			
		Location 1	**Location 2**	**Location 3**	**Location 4**
1	*Frustulia sp.*	+	+	+	+
2	*Gyrosigma sp.*	+	+	+	+
3	*Navicula sp.*	+	+	+	+
4	*Tabellaria sp.*	+	+	+	*
5	*Gomphonema sp.*	+	+	+	+
6	*Fragilaria sp.*	*	+	*	+
7	*Synedra sp.*	+	+	+	+
8	*Pinnularia sp.*	*	+	+	+
9	*Draparnaldiopsis sp.*	+	+	*	+

10	*Hyalotheca sp.*	+	*	+	*
11	*Spirogyra sp.*	+	+	+	+
12	*Gonatozygon sp.*	+	+	*	+
13	*Ulothrix sp.*	*	+	+	*
14	*Eudorina sp.*	+	+	+	+
15	*Anabaena sp.*	+	+	+	+
16	*Oscillatoria sp.*	+	+	+	*
17	*Spirulina sp.*	*	+	+	+
18	*Nostoc sp.*	+	+	+	*
19	*Mougeotia sp.*	+	*	+	+
20	*Zygnema sp.*	+	+	+	+
21	*Microspora sp.*	+	+	*	*
22	*Triploceras sp.*	+	+	+	+
23	*Eudorina sp.*	+	+	+	+
24	*Ceratium sp.*	+	+	*	+
25	*Glenodinium sp.*	+	+	+	+
26	*Closterium sp.*	+	+	+	+
Total		**22**	**24**	**21**	**20**

*** Organism not present**

Table 46: Species Diversity of Zooplankton at various Location of River: Redundant part of River at ch. 12+400km

S. No	**Name of Species**	**No/m^3**			
		Location 1	**Location 2**	**Location 3**	**Location 4**
1	*Nauplii sp. larvea*	+	+	+	+
2	*Cyclops sp.*	+	+	+	+
3	*Diaptomus sp.*	+	+	*	*
4	*Mesocyclops sp.*	+	+	+	+
5	*Tropocyclops sp.*	+	*	+	+
6	*Moina sp.*	+	+	+	*
7	*Bosmina sp.*	*	+	*	+
8	*Ceriodaphnia sp.*	+	+	+	+
9	*Daphnia sp.*	+	*	+	*
10	*Monostyla sp.*	+	+	*	+
11	*Brachionus sp.*	+	*	+	+
12	*Keratella sp.*	+	+	*	*
13	*Lepadella sp.*	*	+	+	+
14	*Nauplius sp.*	+	+	+	*
15	*Euchlanis sp.*	+	*	+	*
16	*Paramoecium sp.*	+	+	+	+
17	*Euglena sp.*	+	+	+	+
Total		**15**	**13**	**13**	**11**

*** Organism not present**

The sampling site is mainly a redundant part of river course which presently acts as a seasonal part time natural reservoir and drainage system for flood water during the monsoon season in Meghalaya. The sampling sites get inundated after receiving excess runoff waters from the nearby village lakes, ponds, Beels, small seasonal creeks and surface runoffs from nearby agricultural fields which get flooded during the monsoon. Along with the flood water, different microorganisms present in different surrounding water sources and agricultural fields also reach the sampling sites. Hence the area might show a higher degree of planktonic diversity during the month of Monsoon i.e. June –September. The sampling and study of Plankton diversity was conducted in the month of March 2021, which is the summer period. Therefore, there is also possibility of documentation of some species of planktons which might be present in the stagnant water of this old redundant part of River in rainy season.

D. Socio Economy Environment

As stated in previous section, the project road alignment traverses from West Garo Hill 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.

D.1. Socio-Demographic Setup

West Garo Hills is one of the largest district of Meghalaya located in the western part of the State. The Garo Hills district was divided into two districts, viz the West Garo Hills district and the East Garo Hills district in October 1976. The erstwhile West Garo Hills district was further divided into two administrative districts of West and South Garo Hills on June 1992. The district headquarters of West Garo Hills is Tura, which is the second largest town in the State after Shillong.The West Garo Hills district lies on the western part of the state of Meghalaya bounded by the East Garo Hills district on the east, the South Garo Hills on the south-east, the Goalpara district of Assam on the north and north-west and Bangladesh on the south. The district is situated approximately between the latitudes 90° 30' and 89° 40' E, and the longitudes of 26° and 25° 20' N.

Sl. No.	Land Classification	Area in Hectares
1	Geographical Area	367700
2	Reporting Area	367067
3	Forest (Classed and unclassed)	165085
4	Area not available for cultivation	21917
5	Other Cultivated land	39772
6	Fallow Land	45812
7	Net Area Sown	94481
8	Area Shown more than once	24957
9	Gross cropped Area	119438

Source: www.megagriculture.nic.in

➢ Total Population (Urban and rural)

In 2011, West Garo Hills had population of 643,291 of which male and female were 324,159 and 319,132 respectively. In 2001 census, West Garo Hills had a population of 518,390 of which males were 263,424 and remaining 254,966 were females. West Garo Hills District population constituted 21.68 percent of total Maharashtra population. In 2001 census, this figure for West Garo Hills District was at 22.36 percent of Maharashtra population.

There was change of 24.09 percent in the population compared to population as per 2001. In the previous census of India 2001, West Garo Hills District recorded increase of 28.41 percent to its population compared to 1991.

Religion –wise Population

Description	Total	Percentage
Hindu	122,936	19.11%
Muslims	106,788	16.60%
Christian	389,956	60.62%
Sikh	209	0.03%
Buddhist	3,392	0.53%
Jain	144	0.02%

Others	16,950	2.63%
Not Stated	2,916	0.45%

➢ Population Density

The initial provisional data released by census India 2011, shows that density of West Garo Hills district for 2011 is 175 people per sq. km. In 2001, West Garo Hills district density was at 140 people per sq. km. West Garo Hills district administers 3,677 square kilometers of areas.

➢ Literacy Rate

Average literacy rate of West Garo Hills in 2011 were 67.58 compared to 50.69 of 2001. If things are looked out at gender wise, male and female literacy were 72.39 and 62.70 respectively. For 2001 census, same figures stood at 57.04 and 44.15 in West Garo Hills District. Total literate in West Garo Hills District were 358,702 of which male and female were 193,438 and 165,264 respectively. In 2001, West Garo Hills District had 211,499 in its district.

➢ Sex Ratio

With regards to Sex Ratio in West Garo Hills, it stood at 984 per 1000 male compared to 2001 census figure of 968. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 976 girls per 1000 boys compared to figure of 960 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 West Garo Hills. There were total 112,514 children under age of 0-6 against 101,026 of 2001 census. Of total 112,514 male and female were 56,950 and 55,564 respectively. Child Sex Ratio as per census 2011 was 976 compared to 960 of census 2001. In 2011, Children under 0-6 formed 17.49 percent of West Garo Hills District compared to 19.49 percent of 2001. There was net change of -2 percent in this compared to previous census of India.

➢ Houseless Population

In 2011, total 84 families live on footpath or without any roof cover in West Garo Hills district of Meghalaya. Total Population of all who lived without roof at the time of Census 2011 numbers to 362. This approx 0.06% of total population of West Garo Hills district.

D.2. Agriculture and Forestry

In this district, Wet cultivation is practiced in the plain areas whereas Jhum or shifting cultivation is practiced in the hilly areas but gradually the Jhum cultivation has reduced. About 62% of the people residing in this district are engaged in agricultutal activities as per Census 2011 which makes the economy of West Garo Hills agrarian in nature. The main crop which is produced here is paddy (rice) but the agro climatic conditions are conducive for many agricultural activities. The agriculture in this district has features including dependence on rainfall, traditional methods of cultivation and predominance of seasonal crops. The rice is grown in the wet paddy fields in plains whereas on jhum fields in the hills. Other than rice, there are several other major crops such as maize, tapioca, millets, other pulses and cereals including different cash crops like jute-mesta, mustard, cotton, ginger, tobacco, sugarcane, etc. Rearing of livestock is a subsidiary occupation of the rural areas of the district. In this district, Net Area Sown for land use is 94481 hectares; Total cropped area is 119438 hectares and Area sown more than once is 24957 hectares; Cultivable barren land is 15270 hectares (District Census Handbook, West Garo Hills, 2011). The district is mostly covered with dense tropical mixed forest along with a small patch of temperate forest present in the higher parts of the Tura range (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India).

D.3. Transportation

Road transport is the only mode of communication in the district. The important roads present in the district are National Highway - NH-51, Paikan (Krishnai -Tura -Dalu road) which traverse through the district for about 126.28 Kilometres. The state roads which are constructed by North Eastern Council (NEC): Agia- Mendipather road- Phulbari-Tura road which is of 135.00 Kms and Garobada-Mankachar road which is of 20.00 Kms. Other major district roads are Tura-Garobada-Betasing-Ampati-Zilkzak-Mahendraganj Road, Tura-Selsella-Rajabala-Phulbari Road and Tura-Dadenjgiri-Phulbari-Tikrikilla Road. All the C. & R. D. Block Headquarters and several other important places are connected by black topped road. The Private Buses have increased considerably as well as plying in all the roads of the West Garo Hills district more than state buses. As per the Census 2011, the vehicles in this district seen in the year 2011-2012 are 1733 trucks, 63 buses, 71 taxi, 54 maxi taxi, 691 cars, 141 jeeps, 61 Govt. vehicles, 6649 two wheelers, 310 three wheelers and others 678 etc. and registered vehicles in West Garo Hills district are 10397 (District Census Handbook, West Garo Hills, 2011).

D.4. Industrial Situation

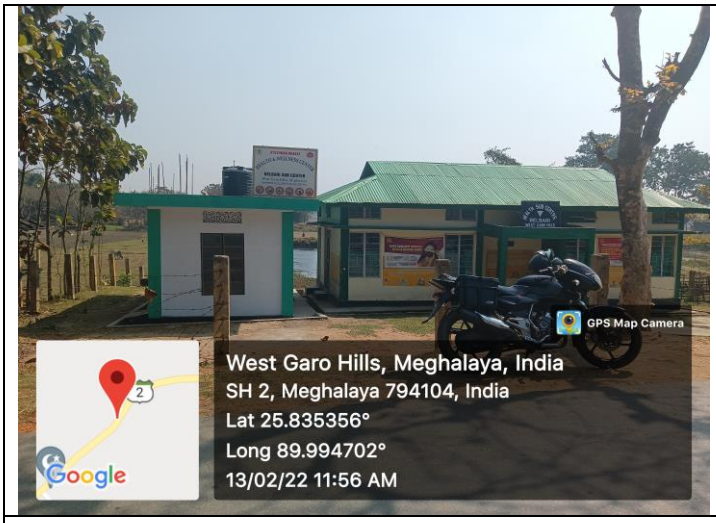
Weaving is one of the most important occupation of the district. Medium scale industries such as Cotton ginning mill and Cashew nut processing industry are found in the district including making of bamboo mats, Pottery making and basket making run as small scale industries. The cane and bamboo work is one of the traditional and popular industries of the district. They are carried on as major subsidiary occupations as well as most of the rural families produce their own requirements such as moras, winnower, traditional baskets of various size and shapes such as kok, mats, tray, fishing traps, boxes and containers made from bamboo (District Census Handbook, West Garo Hills, 2011). There is no industrial estate in this district. There are Agro based industries, soda water manufacturers, beverage manufacturing industries, jute and cotton textiles, woolen and silk clothings, wood and wood products, paper and paper products, furniture and fixtures, mineral and metal based products, leather based and chemical based ready-made garments and embroidery and electrical machinery, transport equipment and engineering units. As this is a hilly area, scope for service industries are very less and for new MSMEs, the potential area is food processing industry (Brief Industrial Profile of West Garo Hills District by Ministry of MSME, Govt. of India).

D.5. Cultural/ Religious and Public Utility Structures

Festivals and cultural activities are being celebrated throughout the year in Meghalaya. The department of arts and cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments.

The primary data/ socio economic profile of the villages/ blocks/will be generated using structured questioner once the alignment is frizzed. This survey includes, 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 (Social Impact Assessment -SIA) of this report.

There are few sensitive receptors such as schools, religious centres and health care centres along the project road. Utmost care will be taken to conserve these structures. However, if not feasible these will be either properly relocated or reconstructed in consultations with the local community. There are 84 community structures along this project road (

	
PHC near chainage KM 9+600	Hospital near chainage KM 16+400

Religious Stracture: There are few numbers of religious stracture are along the project road and 2 touching the ROW. Details of religious stractures in the project road has been given below inTable **49**

Table 49:Religious stracture near the Project Road

S. No	Ch. Km	**Type of Structure (School/college/ Hospitals etc.**	**Distance from Centre Line (Main Structure)**	**Side (Left/ Right**	**Physical Impact (Yes/NO)**	**Needs Relocation (Yes/No**
	0+100	Temple	34.91 m	RHS	No	No
	0+200	Temple	10m	LHS	No	No
	0+400	Church	50 m	LHS	No	No
	1+300	Church	16 m	LHS	No	No
	1+700	Church	45.6 m	LHS	No	No
	3+200	Temple	5.3 m	LHS	No	No
	5+400	Masjid	76.39 m	LHS	No	No
	5+600	Masjid	10 m	LHS	No	No
	6+100	Masjid	25.54 m	LHS	No	No
	6+150	Eidga Math	16.32 m	RHS	No	No
	6+900	Masjid	5 m	LHS	No	No
	8+600	Masjid	0 m	RHS	Yes	Yes
	9+100	Masjid	10	RHS	No	No
	9+500	Eid gah	10	LHS	no	no
	9+800	Mosque	18.70 m	RHS	No	No
	10+400	Masjid	11.23 m	RHS	No	No
	12+500	Masjid	15 m	RHS	No	No

S. No	Ch. Km	**Type of Structure (School/college/ Hospitals etc.**	**Distance from Centre Line (Main Structure)**	**Side (Left/ Right**	**Physical Impact (Yes/NO)**	**Needs Relocation (Yes/No**
	12+700	Masjid	65.79 m	RHS	No	No
	13+300	Masjid	1 m	RHS	Yes	Yes
	13+400	Masque	134.25 m	RHS	No	No
	14+400	Masjid	134.25 m	RHS	No	No
	14+700	Masjid	92.03 m	LHS	No	No
	15+000	Masjid	25.28 m	RHS	Yes	Yes
	15+400	Temple	38.14 m	LHS	Yes	Yes
	15+400	Temple	11.89 m	RHS	No	No
	15+600	Masjid	69.48 m	LHS	No	No
	16+200	Mosque	3 m	RHS	Yes	Yes
	16+600	Masjid	16.2 m	LHS	No	No
	17+300	Masjid	31.02 m	LHS	No	No
	17+800	Masque	119.39 m	LHS	No	No
	18+000	Masque	94 m	RHS	No	No
	18+100	Masque	10.77 m	RHS	No	No
	20+000	Church	37.61 m	LHS	No	No
	24+900	Temple	120.13m	LHS	No	No
	27+800	Church	130.86 m	RHS	No	No
	28+200	Church	435.57 m	LHS	No	No
	30+200	Church	100 m	LHS	No	No
	31+200	Church	2.99 m	RHS	No	No
	31+400	Church	15 m	LHS	No	No
	50+300	Church	209.15 m	RHS	No	No
	52+300	Church	50 m	LHS	No	No
	53+900	Church	15 m	LHS	No	No
	60+100	Church	10 m	RHS	No	No

S. No	Ch. Km	**Type of Structure (School/college/ Hospitals etc.**	**Distance from Centre Line (Main Structure)**	**Side (Left/ Right**	**Physical Impact (Yes/NO)**	**Needs Relocation (Yes/No**
	60+300	Church	53.66 m	RHS	No	No
	60+500	Church	50 m	LHS	No	No
	61+300	Church	100 m	RHS	No	No
	61+900	Temple		LHS		

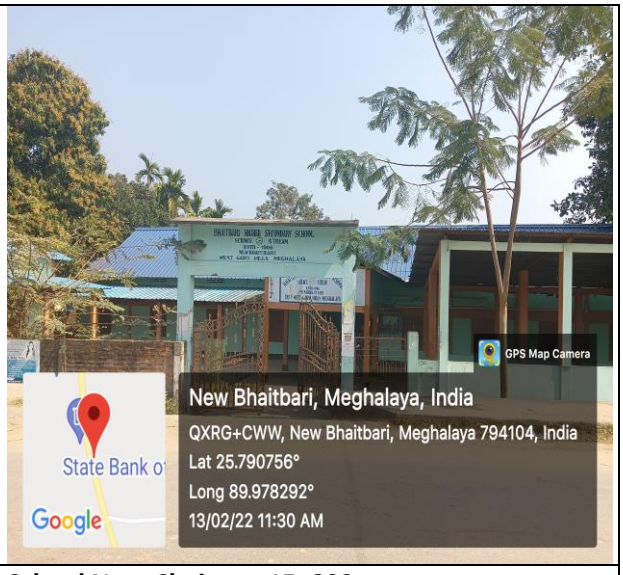
Table 50), some photographs are also provided below (Figure).

Educational Facilities: There are numbers of higher secondary schools, high schools, primary schools, numbers Anganbadis (institution to care for poor and deprived children as creche homes) etc. recorded in the project road stretch. Details of 20 major academic institutes near the ROW and 5touching the ROW of the project road have been given below inTable 47

Table 47: Educational Institutes near the Project Road

S. No	Ch. Km	Type of Structure (School/college)	Distance from Centre Line (Main Structure)	Side (Left/Right	Physical Impact (Yes/NO)	Needs Relocation (Yes/No
1	1+600	Shyam Nagar College	3m	LHS	No	No
2.	3+800	School	101 m	RHS	No	No
3.	9+900	Mosque	130 m	RHS	No	No
4.	10+100	Dr APJ Abdul Kalam College	11 m	LHS	No	No
5.	10+500	School	19.61 m	RHS	No	No
6.	11+200	School	41.23 m	LHS	No	No
7.	12+200	School	58 m	LHS	No	No
8.	15+200	School	211 m	RHS	No	No
9.	15+500	Madrassa	73.28 m	RHS	No	No
10	15+800	School	5m	LHS	No	No
11	16+200	College	0m(within the ROW)	LHS	Yes	Yes
12.	18+200	School	71.69 m	RHS	No	No
13	19+300	School	0m(within the ROW)	RHS	Yes	Yes
14	23+050	St. John Mary Vinery Higher Secondary School	0m(within the ROW)	RHS	Yes	Yes
15.	31+500	School	2 m	RHS	Yes	No
16	36+500	School	0m(within the ROW)	RHS	Yes	Yes
17.	42+200	School	49.41 m	LHS	No	No
18	49+400	School	0m(within the ROW)	LHS	Yes	Yes
19	52+300	School	50m	RHS	no	no
20	61+600	School	100 m	RHS	No	No

School near Chainage KM 3+800



School Near Chainage 15+800

College Near Chainage KM 15+900

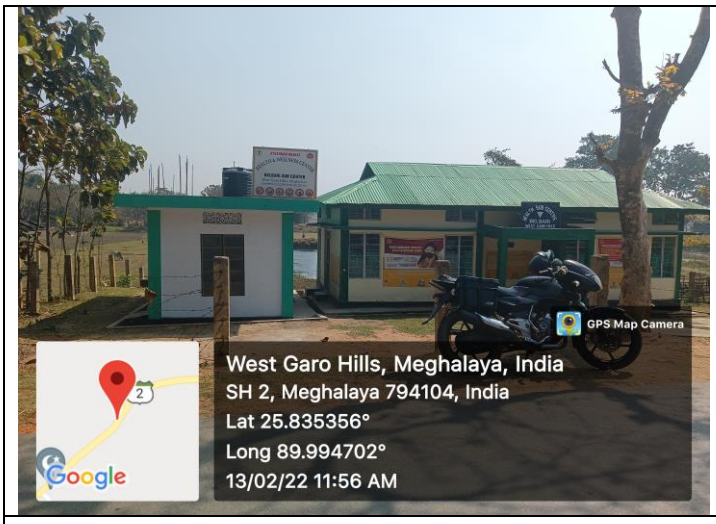
School Near Chainage KM 61+400

Health Care Facilities: There are 4 numbers of public health care centres along the project road, one of them is inside the project road ROW. Details of health centres in the project road has been given below in
Table 48

Table 48: Health Centres near the Project Road

S. No	Ch. Km	Type of Structure (Hospitals etc.)	Distance from Centre Line (Main Structure)	Side (Left/Right	Physical Impact (Yes/NO)	Needs Relocation (Yes/No
1.	9+600	PHC	88.9 m	LHS	No	No
2.	15+300	Hospital	5m	LHS	Yes	Yes
3.	16+400	Hospital	50m	LHS	Yes	No

4.	27+900	CHC	155 m	RHS	No	No



PHC near chainage KM 9+600

Hospital near chainage KM 16+400

Religious Stracture: There are few numbers of religious stracture are along the project road and 2 touching the ROW. Details of religious stractures in the project road has been given below in**Table 49**

Table 49:Religious stracture near the Project Road

S. No	Ch. Km	Type of Structure (School/college/ Hospitals etc.	Distance from Centre Line (Main Structure)	Side (Left/Right	Physical Impact (Yes/NO)	Needs Relocation (Yes/No
1.	0+100	Temple	34.91 m	RHS	No	No
2.	0+200	Temple	10m	LHS	No	No
3.	0+400	Church	50 m	LHS	No	No
4.	1+300	Church	16 m	LHS	No	No
5.	1+700	Church	45.6 m	LHS	No	No
6.	3+200	Temple	5.3 m	LHS	No	No
7.	5+400	Masjid	76.39m	LHS	No	No
8.	5+600	Masjid	10 m	LHS	No	No
9.	6+100	Masjid	25.54 m	LHS	No	No
10.	6+150	Eidga Math	16.32 m	RHS	No	No
11.	6+900	Masjid	5 m	LHS	No	No
12.	8+600	Masjid	0 m	RHS	Yes	Yes
13.	9+100	Masjid	10	RHS	No	No
14.	9+500	Eid gah	10	LHS	no	no
15.	9+800	Mosque	18.70m	RHS	No	No
16.	10+400	Masjid	11.23 m	RHS	No	No
17.	12+500	Masjid	15 m	RHS	No	No
18.	12+700	Masjid	65.79m	RHS	No	No
19.	13+300	Masjid	1 m	RHS	Yes	Yes

S. No	Ch. Km	Type of Structure (School/college/ Hospitals etc.	Distance from Centre Line (Main Structure)	Side (Left/Right	Physical Impact (Yes/NO)	Needs Relocation (Yes/No
20.	13+400	Masque	134.25m	RHS	No	No
21.	14+400	Masjid	134.25m	RHS	No	No
22.	14+700	Masjid	92.03 m	LHS	No	No
23.	15+000	Masjid	25.28m	RHS	Yes	Yes
24.	15+400	Temple	38.14m	LHS	Yes	Yes
25.	15+400	Temple	11.89m	RHS	No	No
26.	15+600	Masjid	69.48m	LHS	No	No
27.	16+200	Mosque	3 m	RHS	Yes	Yes
28.	16+600	Masjid	16.2 m	LHS	No	No
29.	17+300	Masjid	31.02m	LHS	No	No
30.	17+800	Masque	119.39m	LHS	No	No
31.	18+000	Masque	94 m	RHS	No	No
32.	18+100	Masque	10.77 m	RHS	No	No
33.	20+000	Church	37.61 m	LHS	No	No
34.	24+900	Temple	120.13m	LHS	No	No
35.	27+800	Church	130.86 m	RHS	No	No
36.	28+200	Church	435.57 m	LHS	No	No
37.	30+200	Church	100 m	LHS	No	No
38.	31+200	Church	2.99 m	RHS	No	No
39.	31+400	Church	15 m	LHS	No	No
40.	50+300	Church	209.15 m	RHS	No	No
41.	52+300	Church	50 m	LHS	No	No
42.	53+900	Church	15 m	LHS	No	No
43.	60+100	Church	10 m	RHS	No	No
44.	60+300	Church	53.66 m	RHS	No	No
45.	60+500	Church	50 m	LHS	No	No
46.	61+300	Church	100 m	RHS	No	No
47.	61+900	Temple		LHS		

Table 50: Type of CPR along the project road

SR.NO	Type of CPR	TOTAL
1.	Hand Pump	03
2.	Wells	00
3.	Religious Structure	47
4.	Schools/college	20
5.	Hospital	04
6.	Gov. Buildings	6
7.	Other	03
	GRAND TOTAL	**83**

Figure 35: Photographs of CPR along the project road

D.7. Archaeological Heritage

As per discussion with different stakeholders, field survey and informations obtained from ASI, it has been confirmed that there is no archaeological heritage site nearto existing or proposed RoW and also not in immediate project influence area.

6. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

During planning and design phase the road alignment, construction details, materials of construction etc. ultimately decide the impacts during later phases. Most of the impacts occur during construction and operation phase. While some of the construction phase impacts are temporary, others are permanent. Operation phase impacts are continuous in nature. The important criteria for identification of impact are the identification of the impact zone. For present study, a direct Corridor of Impact (COI) within 500 m and indirect impact of 10 Kms of the road alignment has been considered.

Environmental parameters are broadly classified into three groups.

a) Physical Environment includes: Air Quality, Water Resources, Water Quality, Noise and Land environment etc.
b) Biological Environment includes: Terrestrial & Aquatic Biodiversity and Roadside Plantation etc.
c) Social Environment includes: Demography, Employment, Health, Economy, Agriculture, Housing, Culture etc.

This chapter assesses the nature, type and magnitude of the potential impacts on the physical, biological and socio-cultural environmental components along the project road. This chapter presents key environmental issues associated with various aspects of the proposed project. The environmental impacts anticipated due to the development of the project road sections can be categorized as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project whereas the secondary impacts are those which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action.Interaction of the project activities with environmental attributes is presented as Activity-Impact matrix in Table 51.

Table 51: Activity-Impact Identification Matrix

Sl No.	Activities	Type of Impact						
		Air	Water	Noise	Flora	Fauna	Soil	Topography
1.	Labour and Constrcution camp		- ve/t					
	activities							
2.	Quarrying	-ve/t		- ve/t	- ve/p	- ve/p	- ve/t	- ve/p
3.	Material transport and	- ve/t		- ve/t				
	storage							
5.	Earthwork	- ve/t					- ve/t	- ve/t
6.	Use of construction	- ve/t	- ve/t	- ve/t			- ve/t	
	equipments							
7.	Plantation	+ve/p		+ve/p	+ve/p	+ve/p	+ve/p	+ve/p
8.	Drainage work	- ve/t	ve/t	- ve/t			- ve/t	- ve/t
9.	Culvert and bridge	- ve/t	ve/t	- ve/t	- ve/t	-ve/t	- ve/t	ve/p
	construction							
10.	Stripping of top soil	- ve/t					- ve/p	- ve/p
11.	Debris generation	- ve/t					- ve/t	
12.	Oil and grease		- ve/t				- ve/t	
13.	Construction in forest	- ve/t		- ve/t	- ve/t	- ve/t	- ve/p	- ve/p
	and sensitive areas							

Notes: t – temporary, p – permanent. Impact indicated in bold letters indicates significant impacts.

B. Positive Impacts due to improvement of sub-project road

The positive impacts expected from the up-gradation of the newly declared NH-127 B (Meghalaya portion) starting from Fakirganj at Chainage 0.000 km to Groigre near Tura at chainage 62.200 km includes:

- The project will have multiple benefits as it will provide all weather high speed National Highway.

Other than this, the project road will also be benefittedas mentioned below;-

- Fast and safe connectivity resulting in saving 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 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.

C. Adverse Environmental Impacts due to improvement of subproject road

The adverse environmental impacts anticipated from the improvement of the project road section are:

- Change in topography and land use due to acquisition of land for new alignment.
- Starting part of the project road is in river flood prone area. So soil erosion is one of the major issues in this project.
- Loss of productive soil and agriculture land,
- Cutting of road side trees that falls within formation width i.e. 10-30 m may reduce the ecological balance of the area and also increase soil erosion problem.
- Air, Water, Noise pollution and disposal of construction waste, during construction, will adversely impact the local environment band of the local residents. The impacts are generally temporary and limited to the construction period.
- A number of quarries and other sources will be established which will change the landscape and also lead to a loss of the natural resources. However, the operation of quarries is an independent and regulated activity.
- Adverse impacts on water quality of rivers crossing or running parallel to the proposed alignment in the form of silt deposition and runoff during construction are expected. However, this is short term and will be taken care of by controlled construction activities.
- Improvement on existing road and construction of new road and bridges, although limited, may enhance soil erosion, landslips and reduce the micro-level ecological balance of the area. Construction may also disturb the habitation of faunal diversity living in this area. These should, however, be only temporary/reversible effects.
- The project road mostly passes through mixed forests. So some part of those forests may be hampered during construction and operational phase.
- The improvement will also require the cutting of about 6185 trees.

D. Impacts and Mitigation Measure of the Sub-Project

Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at three different stages, namely:

- Design and Pre-Construction Stage
- Construction Stage
- Operation Stage

A few permanent as well as short-term and long-term adverse effects, mainly at the construction and operation stages, are, nonetheless, anticipated. Temporary short term impacts can be kept in check through proper planning and adopting environment friendly road construction methods and the appropriate regulatory measures.

D.1.Meteorological Parameters

I. Pre-Construction Stage

The Project Highway is located in a subtropical region with marked monsoon effects. Widening of roads usually leads to felling of roadside trees. In this project also, according to design stage EIA report more than approxmectly 6185 trees (as per field survey) were cut. Felling of roadside trees and addition of pavement surface may have led to formation of heat islands especially along the inhabited sections affecting the micro-climate. In addition, at green tunnel locations, the removal of trees increases the amount of direct sunlight resulting in higher temperatures along the highway. This increase in the daytime temperature assumes significance especially to the slow-moving traffic, the pedestrians and the first row of residences / receptors along the corridor, as the entire project stretch experiences temperatures as high as 38°C during summers. Although the impact is significant and long term in nature, it is reversible in nature provided trees as part of compensatory afforestation is planted and maintained along the road. It must be noted that the impact is unavoidable.

Mitigation Measure

Avoidance measures, such as the minimising of the number of trees to be cut etc, have been worked out as part of the design finalization. Though no major 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, loss of roadside plantations and the addition of increased pavement surface. However, there will be a total of 61850 trees are proposed to be planted along the road.

Impact of/ on	Extent of Impact (after Mitigation)
Meteorological Parameters	**Δ**

D.2. Land and Soil

Land Acquisition and Loss of Productive Land

I. Pre-Construction/Construction Stage

The proposed project road will need additional land for the widening & modernisation and construction of cross drainage structures as per the new design. Although land acquisition requirement has been kept to minimum level, it will have impacts on topography and change in land use in the region. Mostly the adjacent agricultural land to the road will be acquired for the widening purpose, which resulting in the loss of livelihood of the local residents.

Mitigation Measures:

- Adequate compensation and rehabilitation assistance shall be proposed for affected households as per the Government of India's policies.
- Income restoration measures/livelihood options for vulnerable group/resource poor sections and other affected persons as recommended shall be implemented.
- Alignment will be adjusted to avoid and minimize land acquisition
- Topsoil management during construction.
- Use of existing alignment to the maximum extent.

Felling of Trees

The project road is not passing through any reserved or protected forest. As the widening of proposed project road will required felling of approx. 6185 of trees.

Mitigation Measures:
To minimize loss of trees, the following mitigation measures have been /will be adopted during the detailed design and construction stage of the project:

- Widening option with minimal tree cutting has been considered.
- The compensatory plan has been developed in consultation with local forest department. As per compensatory afforestation, the tree plantation will be done ten times of tree cutting. Around 6185 numbers of trees will be planted against 61850 number of trees felled.

Compaction and Contamination of Soil

Contamination of soil during construction stage may happen 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 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 near water bodies.

Mitigation Measures:

- Construction equipment/vehicles should be routinely maintained to prevent leakage of fuels/ lubricants;
- Construction equipment/vehicles should be parked and maintained in designated areas on hard stand having perimeter drains to collect spilled liquids;
- Fuels and other liquid chemicals should be stored in designated storage areas with drip trays to collect leaked materials, if any.
- The Contractors shall ensure the use of a relatively new, well maintained hot mix plant (batch type) and maintenance of hot mix plants and batching plants should be regular and periodic to prevent any kind of oil leakage on soil surface.

Soil Erosion

The removal of roadside vegetation will cause erosion, and increased run-off would in turn lead to erosion of productive soil. The direct impact of erosion is the loss of embankment soil and danger of stability loss for the road itself. This impact is generally restricted to the ROW. The project has taken care of this issue at the engineering design stage itself, as at design gradients of 1:2, the slopes of the embankments are perceived to be stable for all stretches of road. These sections of the road embankment would need stone pitching or any other suitable turfing.

Mitigation Measures:

- Good engineering practices should be followed:
- Land clearance should be kept to a minimum (Site Boundary only);
- Areas that have been cleared shall have a dust suppressing system;
- Where practicable, excavated areas should be backfilled at the end of the working day.

Borrow Areas and Quarries

Need for opening borrows areas is anticipated. It may cause some adverse impacts if left un-rehabilitated. It may pose risk to people, particularly children and animals of accidentally falling into it as well as become potential breeding ground for mosquitoes and vector born disease. Illegal quarrying may lead to unstable soil condition; destroy the landscape of the terrain, air and noise pollution. Quarry material will be sourced from existing licensed quarries. The dredging and use of dredged material, if involved, may have its impact in terms of localized sedimentation level increase and dispersion of pollutants present in the dredged material in the river water.

Mitigation Measures

- Borrow areas if required, shall not be located near forest areas. The edges of borrow sites shall be no closer than 3 meters from any fence line or boundary. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have adequate drainage outlets unless the relevant landowner has agreed that the borrow area is to create a permanent tank or dam. Cut batter slopes shall not be steeper than 3 to 1 and shall be left by the Contractor in a tidy and safe condition to the satisfaction of the Engineer. Written clearance from the land owner/village head shall be obtained before leaving a site
- Borrow pits shall be selected from barren land/wasteland to the extent possible. Borrow areas should not be located on cultivable lands except in the situations where land owners desires to level the land. The top soil shall be preserved and depth shall be restricted to the desired level.
- Borrow areas should be excavated as per the intended end use by the owner. The Indian Road Congress (IRC):10-1961 guideline should be used for selection of borrow pits and amount that can be borrowed.
- The dredged material from the nearby water body shall be tested for presence of heavy metals and other pollutants before its reuse.
- The depths in borrow pits to be regulated so that the sides shall not be steeper than 25%, to the extent possible, borrow areas shall be sited away from populated areas. Borrow areas shall be leveled with salvaged material or other filling materials which do not pose contamination of soil.

Impact of/ on	Extent of Impact (after Mitigation)
Land & Soil Environment	**Δ**

II. Operation Stage

During the operation stage, soil contamination due to accidental spills or leaks from vehicle is a low probability as one of the main objectives of the project is to reduce accidents, but potentially disastrous to the receiving environment should they occur. These impacts can be long term depending upon the extent of spill.

Further, generation of Solid waste from the rest areas, toll plaza, etc can also have an impact on land if not managed properly. Dumping of solid waste on the land can cause the following impact:

- ground water contamination by the leachate generated by the waste dump
- surface water contamination by the run-off from the waste dump
- bad odour, pests, rodents and wind-blown litter in and around the waste dump
- generation of inflammable gas (e.g. methane) within the waste dump
- fires within the waste dump
- epidemics through stray animals

- acidity to surrounding soil
- release of greenhouse gas

Mitigation Measures:

- The project should develop a disaster management plan with specific reference to spill response.
- Solid waste generated should be segregated properly.
- Development of Solid Waste management Plan for the proper disposal of solid waste generated

Table 52:Impact on Topography, Soil & Land and Mitigation Measures

Topography and Soil	• Cut and fill operations during road construction	• The alignment passes through hill terrain and plain terrain. no substantial cut and fill operations are planned. Minimum cut will be ensured and the cut material will be reused as per the suitability.
	• Borrow earth	• Borrow earth will be procured from approved area • IRC guidelines will be followed during excavation • Top soil will be preserved & stockpiled properly. • Borrow area Redevelopment plan will be submitted prior to operation of the same. • Necessary clearance needs to be obtained prior to operation of the borrow area.
	• Quarries	• Operational and government licensed quarry have been identified, which will be used for procuring material. • Pollution Control Measures should be taken care. • Necessary clearance needs to be obtained prior to operation of the borrow area.
Land Environment	• Loss of topsoil	• Topsoil on stripping shall be removed and stockpiled on sides to be used on the side slopes, for top cover of borrow areas and for plantation pits
	• Loss of topsoil from borrowing	• Arable lands will be avoided for earth borrowing. If needed, topsoil will be separated and refilled after excavation
	• Borrowing of fill material	• Excavation from pre selected locations. After excavation the borrow pits will be dressed to match with the surrounding.

Impact of/ on	Extent of Impact (after Mitigation)
Land	**Δ**

D.3. Ambient Air Quality

I. Pre-Construction Stage

Impact to air environment during pre-construction stage will be limited to activities such as setting of construction camp, unloading of materials, exhaust from Diesel Generators, etc.

Mitigation Measure:

- Consent to Establish for emission/continuation of emission under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 should be obtained for Diesel Generator Set (s) of > 15 KVA for Non-Industrial use from SPCB
- LPG should be used in the labour camps for cooking purposes instead of wood.

II. Construction Stage

Construction stage impacts will have adverse impacts on the workers as well as the settlements adjacent to the road, especially those in the down wind direction.

The adverse impacts on air quality during construction stage are classified and presented in the table below. There are two types of pollution i.e. dust pollution and pollution from harmful gases.

Table 53: Adverse impacts on air quality during construction stage

1	Generation of dust	Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense;
		Transportation of raw materials from quarries and borrow sites
		Stone crushing, handling and storage of aggregates in asphalt plants
		Site levelling, clearing of trees, laying of asphalt
		Concrete batching plants;
		Asphalt mix plants – due to the mixing of aggregates with bitumen;
		Construction of structures and allied activities
2	Generation of polluting gases including SO_2, NO_x and HC	Hot mix plants
		Large construction equipment, trucks and asphalt producing and paving equipment
		The movement of heavy machinery, oil tankers etc.
		Toxic gases released through the heating process during bitumen production
		Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

The impacts are expected to be temporary (limited to construction period) and confined within construction areas.

Mitigation Measures:

- Vehicles delivering loose and fine materials shall be covered
- Limiting unnecessary idling of heavy machineries and other vehicles significantly reduce emission of polluting gases.
- Loading and unloading of construction materials in covered area or provisions of water fogging around these locations.
- Storage areas should be located downwind of the habitation area.
- Periodic water sprinkling needs to be done wherever required.

- Regular maintenance of machinery and equipment needs to be done. Vehicular pollution check shall be made mandatory and renewed as per requirement.
- Hot mix plants and other plants should be located at least 1.5 km from the nearest habitation, school, hospital, archaeological site, forest, rivers, streams and lakes, 500 m from ponds, and national highway, 250 m from state highway, unless otherwise required by statutory requirements after securing a No-Objection Certificate (NOC) from the SPCB. Hot mix plant shall be fitted with stack of adequate height as may be prescribed by SPCB to ensure enough dispersion of exit gases.
- Bitumen emulsion and bitumen heaters should be used to extent feasible.
- CTE & CTO for HMP, BMP, crushers & DG sets needs to be obtained.
- LPG should be used as fuel source in construction/labour camps instead of firewood.
- Mask and other PPE shall be provided to all the staffs/workers at construction site.
- Diesel Generating (DG) sets shall be fitted with stack/chimney of adequate height as per regulations (Height of stack = height of the building + 0.2 KVA. Low sulphur diesel shall be used in DG sets as well as machineries.
- Contractor should submit a site specific air pollution management plan.
- Avenue plantation may improve the air quality during operation stage.
- Regular air monitoring will be done to check the ambient air quality of the area.

Table 54:Impact on Air Environment and Mitigation Measures

Air Environment	• Generation of dust	• Sprinkling of water a. Earth handling site b. Borrow area c. Road construction site d. Access road route • Air pollution control at crusher and Plants a. PPE for Workers b. Stone crushing units and Plants should be with environment compliance. c. Necessary clearance needs to be obtained prior to operation of the borrow area. • Regulations of construction timings near sensitive receptors and settlements
	• Gaseous Pollution	• Vehicles and machineries will be regularly maintained to conform to the emission standards. • Asphalt mixing sites and Crusher should be placed 1 km away from residential area and outside forest area. • Asphalt plant will be equipped with pollution control equipment • Use of PPE by workers engaged in construction and application of asphalt mix on road surface.

Impact of/ on	Extent of Impact (after Mitigation)
Air Environment	**Δ**

III. Operation Stage:

Operation phase impact to ambient air will be primarily because of eissions from vehicles plying on the project road. In order to assess the impact from vehicular emission, an air dispersion model was run using ADMS-Roads – an internationally recognized dispersion model to predict impacts on air

environment due to vehicular movements. The model was run for the criteria pollutants NOx, PM_{10} and CO. Although VOC is not a criteria pollutant but it was also modeled as it has significant impact on health and climate change. The SO_2 was not modeled as the ambient concentration of this was found very low.

The model set-up and outputs are presented below for the projected traffic in the year 2020 and 2034. For the purpose of modeling, Atmospheric Dispersion Modeling System (ADMS) ROAD uses vehicular emission rates provided in the Design Manual for Roads and Bridges, UK database. The Project emission rates are calculated based on the vehicle class and speed in accordance with following equation.

E = (a + b.v + c.v2 + d.ve + f.ln(v) + g.v3 + h/v + i/v2 + j/v3).x

Where:

E is the emission rate expressed in g/km

v is the average vehicle speed in km/hr[The valid speed ranges are 5 km/h to 130 km/h for light duty vehicles, and 5 km/h to 100 km/h for heavy-duty vehicles.]

a to j, and x are coefficients

The projected traffic was split into 2 categories: i) vehicles weighing less than 3.5 ton; and ii) vehicles weighing more than 3.5 ton.

Vehicle exhaust emission rates

Emission rate for Passeneger Car(Gross Vehicle Weight < 3.5 ton)[7]				
	CO(g/kmhr)	HC (g/kmhr)	NOx (g/kmhr)	PM(g/kmhr)
Gasoline (Petrol) Vehicles				
Bharat Stage-IV (2017)	1	0.1	0.08	-
Bharat Stage-VI (2020)	1	0.10	0.06	0.0045
Diesel Vehicles				
Bharat Stage-IV (2017)	0.5	-	0.25	0.025
Bharat Stage-VI (2020)	0.5	-	0.08	0.0045
Emission rate for Heavy – duty diesel vehicles(GVW > 3.5 ton)[8]				
	CO(g/kmhr)	HC (g/kmhr)[9]	NOx (g/kmhr)	PM(g/kmhr)
Bharat Stage-VI (2020)	4	0.16	0.46	0.01

ADMS Road uses a wide range of emission rates - from DEFRA database to user given emission rates. In this project, Euro 4 emission rates have been used for the year 2019 while Euro 6 emission rates have been used for year 2043. It should be noted that since the year 2000, India started adopting European emission and fuel regulations for four-wheeled light-duty and for heavy-duty vehicles. Further, India adopted Euro 4 and Euro 6 emission standards and remaned those as Bharat Stage IV and VI. Therefore, we believe that the emission rates used in the model are very much applicable to Indian context. This section is revised to address the comments.

Till April, 2020 vehicles in India were manufactured to comply with Bharat stage –IV (2017) emission standard. Hence, BS-IV is considered as vehicle eahaust emission rates during calculation of 2020. Bharat stage –VI is implemented in India from April, 2020. Although being cognizant that there might be an enhanced emission standard in future but in want of any specific standard, BS-VI has been considered as vehicle exhaust emission rates for modelling of the year 2044.

It is pertinent to note here that significant reduction in vehicle exhaust parameters are expected with change from BS-IV to BS-VI, especially in case of diesel driven vehicles.

Details of Input data:

1) Traffic details: - Refer Chapter 3, Section D
2) Meteorology – West Garo Hills District, 2020

[7]It is assumed that 50% of light passenger vehicles are run on gasoline (Petrol) and rest of 50% on diesel
[8]100% of heavy vehicles run on diesel
[9]It is assumed that 100% of HC emissions are in the form of VOC

Treatment of Oxides of Nitrogen Concentrations

The key element in assessing the potential environmental impacts from ground level NO_2 concentrations is estimating the NO_2 concentrations from modelled NO_X emissions. The final NO_2concentration is a combination of the NO_X emitted as $NO_2$from vehicles the amount of NO_X that is converted to NO_2 by oxidation in the exhaust after release.
Generally, after NO_X is emitted from the vehicle, additional NO_2 is formed as the exhaust and reacts with the surrounding air. There are several reactions that both form and destroy NO_2, but the primary reaction is oxidation with ozone according to the following equation:

$$NO + O_3 \longrightarrow NO_2 + O_2$$

This reaction is essentially instantaneous as the exhaust entrains the surrounding air. It is limited by the amount of ozone available and by how quickly the exhaust mixes with the surrounding air. Thus, the ratio of NO_2 to NO_X increases as the plume disperses downwind.
There are four common methods used to estimate the final ratio of NO_2 to NO_X:

- Total Conversion: This method conservatively assumes all NO_X is converted to NO_2.
- USEPA Tier 2 Assumption: This method assumes a national default ration of NO_2 to NO_X of 0.75;
- Ozone Limiting Method (OLM): This method commonly assumes 10% of the Vehicle NO_X emission is NO_2 and that ozone is the limiting reagent for the above equation. The estimated NO_2 concentration can be calculated using the following equation:

$$NO_2 = (0.1 \times NOx) + O_3$$

Where:
NO_2 = estimated GLC of nitrogen dioxide (ppm)
NOx = predicted GLC of oxides of nitrogen (ppm)
O_3 = measured background concentration of zone (ppm)

- Ambient Ratio Method (ARM): This method typically relies on at least a year worth of ambient monitoring data and assumes the final exhaust NO_2 to NO_X ratio will be equal to the existing ambient NO_2 to NO_X ratio.

The total Conversion assumption were considered overly conservative and the OLM and ARM requires detailed baseline conditions which are not available for the study area.
Accordingly, the USEPA Tier 2 assumption was considered the most appropriate method while still remaining conservative enough that the actual NO_2 concentrations are likely less than those predicted by the modeling.
The project roadis devided into 3 homogenous ection. Each of the homogenious section traffic volume is given in Table 11 to Table 13.
Traffic Segment 1- Chainage Km 0.00-Km 19+500
Traffic Segment 2- Chainage Km 19+500-Km 47+200
Traffic Segment 2- Chainage Km 47+200-Km 62+100

Table 55: Air predicted data for Segment 1 (2021)

Model Year:	2021
Scenario:	1 hr Averaging Period.
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m
Maximum Predicted GLC in $\mu g/m^3$	

Parameters	Easting	Northing	Predicted Conc.
NO2	205435.47	2864667.00	33.99
PM_{10}	205435.47	2864667.00	1.50
CO	205435.47	2864667.00	85.46
CO is in mg/m3 i.e. 85.46 µg /m^3 = 0.085 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2[10]	205435.47	2864667.00	11.96
PM10	205435.47	2864667.00	00.57

Table 56: Air predicted data for Segment 1 (2044)

Model Year:	2044		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	205435.47	2864667.00	160.13
PM_{10}	205435.47	2864667.00	6.56
CO	205435.47	2864667.00	387.96
CO is in mg/m3 i.e. 387.96µg /m^3 = 0.39 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	205435.47	2864667.00	66.01
PM10	205435.47	2864667.00	3.41

Table 57: Air prediction near Receptor of section 1 (2021)

Model Year:	2021
Scenario:	1 hr Averaging Period.
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m

[10] We get NOx data in ADMS Road as output data and take national default ration of NO_2 to NOX of 0.75;

Maximum Predicted GLC in µg/m^3				
Air monitoring Location 1				
Parameters	Easting	Northing	Predicted Conc.	Background Conc.
NO2	210031.9	2873541	6.78	12.73
PM_{10}	210031.9	2873541	0.32	79.59
CO	210031.9	2873541	18.42	00
CO is in mg/m3 i.e. 18.42µg /m^3 = 0.018 mg/m^3				
Air monitoring Location 2				
NO2	205435.5	2864667	33.99	14.85
PM_{10}	205435.5	2864667	1.62	83.8
CO	205435.5	2864667	92.33	00
CO is in mg/m3 i.e. 92.33µg /m^3 = 0.092 mg/m^3				
Air monitoring Location 3				
NOx	201822.7	2866623	2.07	14.48
PM_{10}	201822.7	2866623	0.10	84.18
CO	201822.7	2866623	5.63	00
CO is in mg/m3 i.e. 18.42µg /m^3 = 0.006 mg/m^3				

Table 58: Air prediction near Receptor of section 1 (2044)

Model Year:	2044		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Air monitoring Location 1			
Parameters	Easting	Northing	Predicted Conc.
NO2	210031.9	2873541	44.23
PM_{10}	210031.9	2873541	2.28
CO	210031.9	2873541	135.16
CO is in mg/m3 i.e. 135.16µg /m^3 = 0.14 mg/m^3			
Air monitoring Location 2			
NO2	205435.5	2864667	160.13
PM_{10}	205435.5	2864667	8.27
CO	205435.5	2864667	489.25

CO is in mg/m3 i.e. 489.25µg /m^3 = 0.49 mg/m^3			
Air monitoring Location 3			
NOx	201822.7	2866623	13.05
PM_{10}	201822.7	2866623	0.67
CO	201822.7	2866623	39.93
CO is in mg/m3 i.e. 39.93µg /m^3 = 0.039 mg/m^3			

Table 59: Air predicted data for Segment 2 (2021)

Model Year:	**2021**		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	799614.44	2860383.00	10.02
PM_{10}	799614.44	2860383.00	0.47
CO	799614.44	2860383.00	26.87
CO is in mg/m3 i.e. 26.87µg /m^3 = 0.027 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	799614.44	2860383.00	4.10
PM10	799614.44	2860383.00	00.15

Table 60: Air predicted data for Segment 2 (2044)

Model Year:	**2044**		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	799709.3	2852160	48.73
PM_{10}	799709.3	2852160	2.49

Model Year:		**2044**	
CO	799709.3	2852160	146.91
CO is in mg/m3 i.e. 146.91 µg /m^3 = 0.15 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	199134.80	2847983.25	18.3234
PM10	199134.80	2847983.25	0.94

Table 61: Air prediction near Receptor of Segment 2 (2021)

Model Year:	**2021**			
Scenario:	1 hr Averaging Period.			
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m			
Maximum Predicted GLC in µg/m^3				
Air monitoring Location 4				
Parameters	Easting	Northing	Predicted Conc.	Background conc.
NO2	798668.3	2855901	8.70	10.12
PM_{10}	798668.3	2855901	0.31	81.35
CO	798668.3	2855901	17.49	00
CO is in mg/m3 i.e. 17.49µg /m^3 = 0.017 mg/m^3				

Table 62: Air prediction near Receptor of Segment 2 (2044)

Model Year:	**2044**			
Scenario:	1 hr Averaging Period.			
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m			
Maximum Predicted GLC in µg/m^3				
Air monitoring Location 4				
Parameters	Easting	Northing	Predicted Conc.	
NO2	798668.3	2855901	37.76	
PM_{10}	798668.3	2855901	1.93	

CO	798668.3	2855901	113.82	
CO is in mg/m3 i.e. 113.82µg /m^3 = 0.11 mg/m^3				

Table 63: Air predicted data for Segment 3 (2021)

Model Year:	**2021**		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	214829.59	2833839.50	25.935
PM_{10}	214829.59	2833839.50	1.04
CO	214829.59	2833839.50	53.78
CO is in mg/m3 i.e. 53.78 µg /m^3 = 0.054 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO2	214829.59	2833839.50	15.19
PM10	214829.59	2833839.50	00.46

Table 64: Air predicted data for Segment 3 (2044)

Model Year:	**2044**		
Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Parameters	Easting	Northing	Predicted Conc.
NO_2	206130.70	2841919.50	111.29
PM_{10}	206130.70	2841919.50	5.59
CO	206130.70	2841919.50	317.47
CO is in mg/m3 i.e. 317.47µg /m^3 = 0.317 mg/m^3			
Scenario:	24 hr Averaging Period.		
Maximum Predicted GLC in µg/m^3			

Parameters	Easting	Northing	Predicted Conc.
NO2	206130.70	2841919.50	51.60
PM10	206130.70	2841919.50	2.59

Table 65: Air prediction near Receptor for segment 3 (2021)

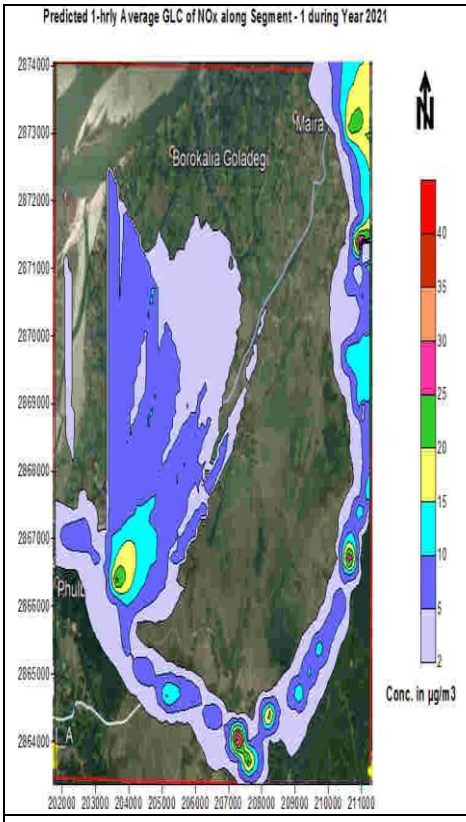
Model Year:	**2021**			
Scenario:	1 hr Averaging Period.			
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m			
Maximum Predicted GLC in µg/m^3 Air monitoring Location 5				
Parameters	Easting	Northing	Predicted Conc.	Background conc.
NO2	202735.7	2843646	9.17	11.48
PM_{10}	202735.7	2843646	0.37	70.44
CO	202735.7	2843646	19.03	00
CO is in mg/m3 i.e. 19.03µg /m^3 = 0.019 mg/m^3				
Air monitoring Location 6				
NO2	211142.8	2834647	30.77	13.55
PM_{10}	211142.8	2834647	1.23	78.64
CO	211142.8	2834647	63.80	00
CO is in mg/m3 i.e. 63.88µg /m^3 = 0.064 mg/m^3				
Air monitoring Location 7				
NOx	221197.6	2832754	22.77	13.46
PM_{10}	221197.6	2832754	0.91	77.1
CO	221197.6	2832754	47.19	00
CO is in mg/m3 i.e. 47.19µg /m^3 = 0.047 mg/m^3				
Air monitoring Location 8				
NOx	222779.9	2832566	5.36	14.1
PM_{10}	222779.9	2832566	0.21	81.1
CO	222779.9	2832566	11.12	00
CO is in mg/m3 i.e. 11.14µg /m^3 = 0.011mg/m^3				

Table 66: Air prediction near Receptor (2044)

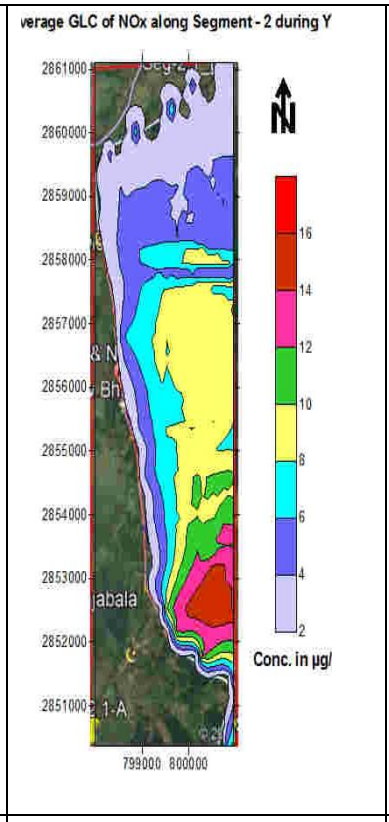
Model Year:	**2044**

Scenario:	1 hr Averaging Period.		
Assumptions:	The average vehicle speed for light duty vehicles – 80 km/hr The average vehicle speed for heavy duty vehicles – 60 km/hr The height of canyon – 0m		
Maximum Predicted GLC in µg/m^3			
Air monitoring Location 5			
Parameters	Easting	Northing	Predicted Conc.
NO2	211142.8	2834647	37.18973
PM_{10}	211142.8	2834647	1.87
CO	211142.8	2834647	105.09
CO is in mg/m3 i.e. 105.09 µg /m^3 = 0.105 mg/m^3			
Air monitoring Location 6			
NO2	211142.8	2834647	113.9805
PM_{10}	211142.8	2834647	5.73
CO	211142.8	2834647	325.19
CO is in mg/m3 i.e. 325.19µg /m^3 = 0.325 mg/m^3			
Air monitoring Location 7			
NOx	221197.6	2832754	105.26
PM_{10}	221197.6	2832754	5.29
CO	221197.6	2832754	300.26
CO is in mg/m3 i.e. 300.26µg /m^3 = 0.3 mg/m^3			
NOx	222779.9	2832566	23.62
PM_{10}	222779.9	2832566	1.19
CO	222779.9	2832566	67.40
CO is in mg/m3 i.e. 67.01 µg /m^3 = 0.067mg/m^3			

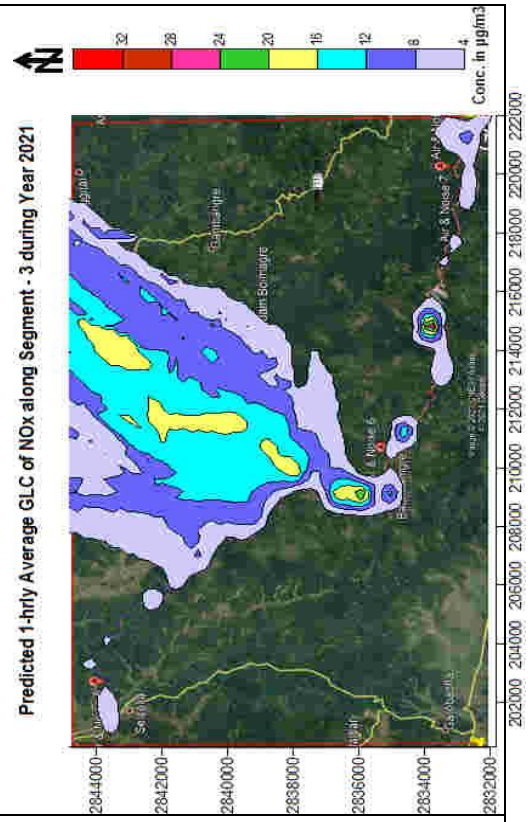
Predicted Ground Level Concentration for NOx – 1 hr Averaging Period, 2021



Segment-1

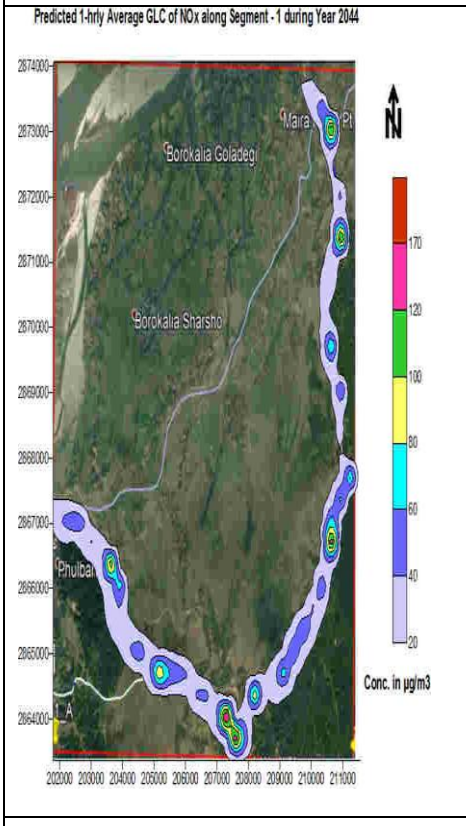


Segment-2

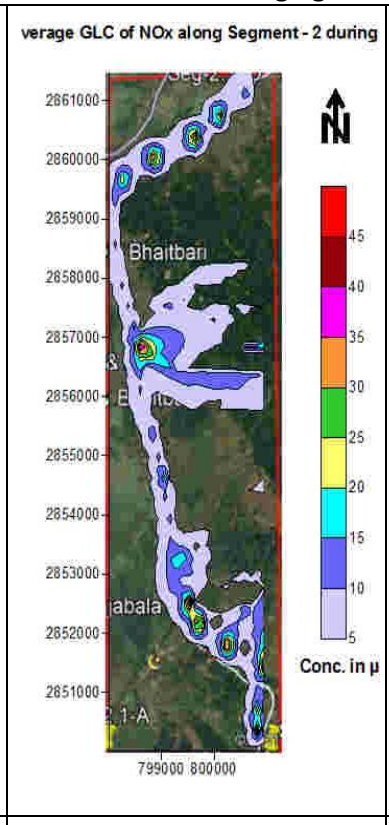


Segment-3

Predicted Ground Level Concentration for NOx – 1 hr Averaging Period, 2044



Segment-1



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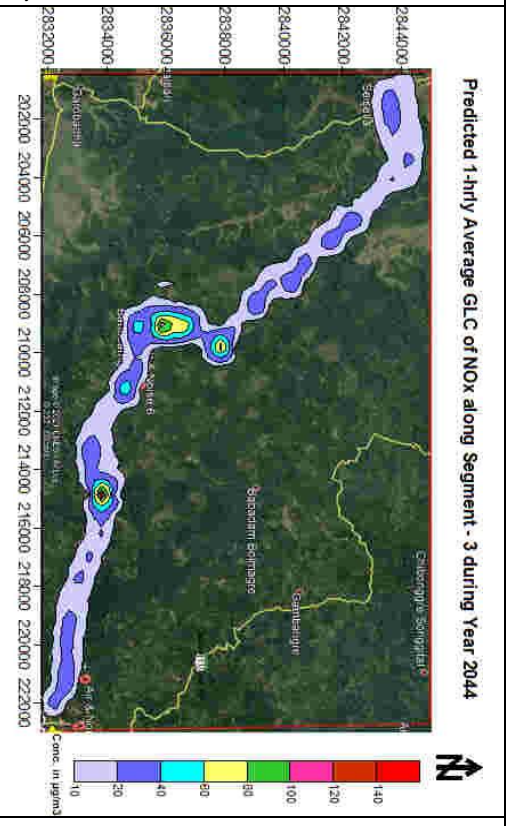
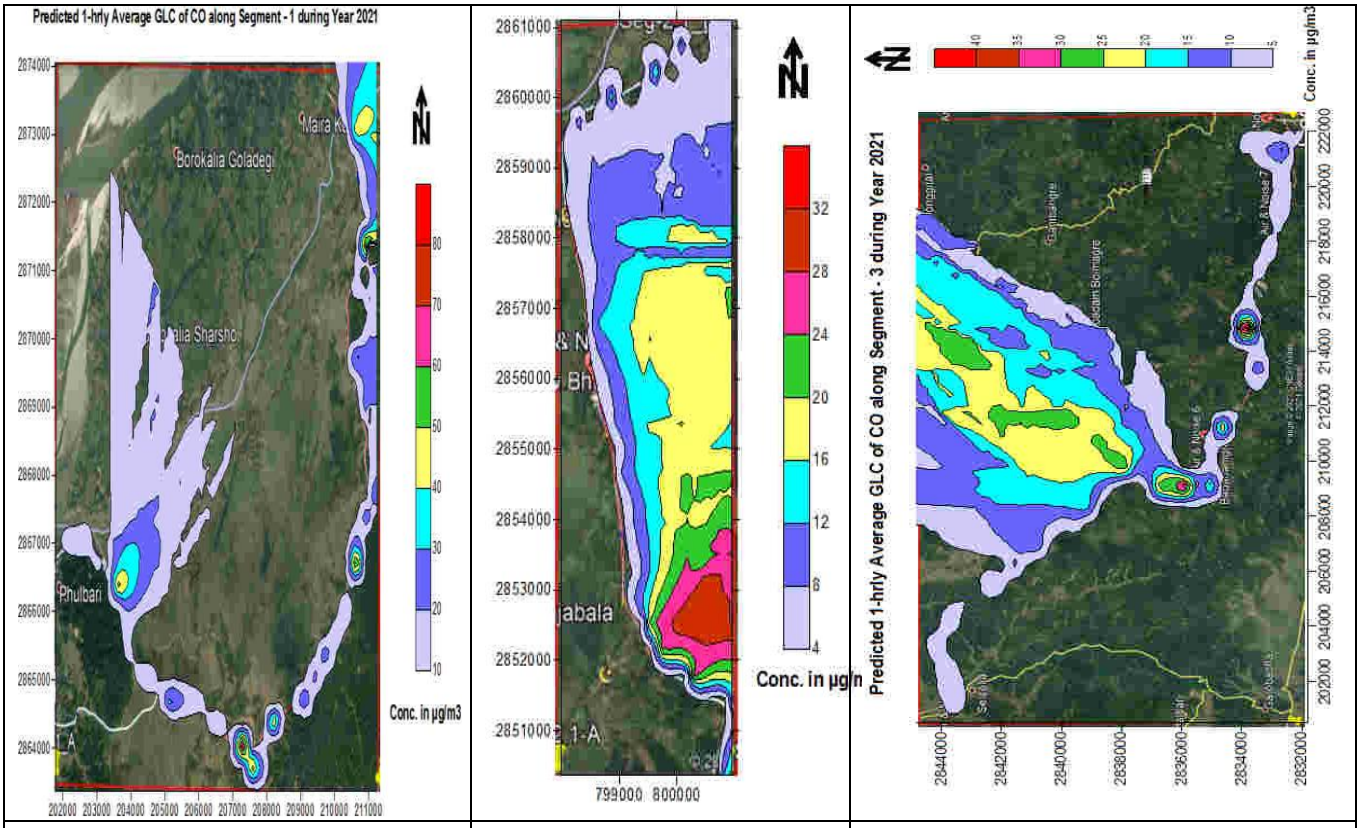


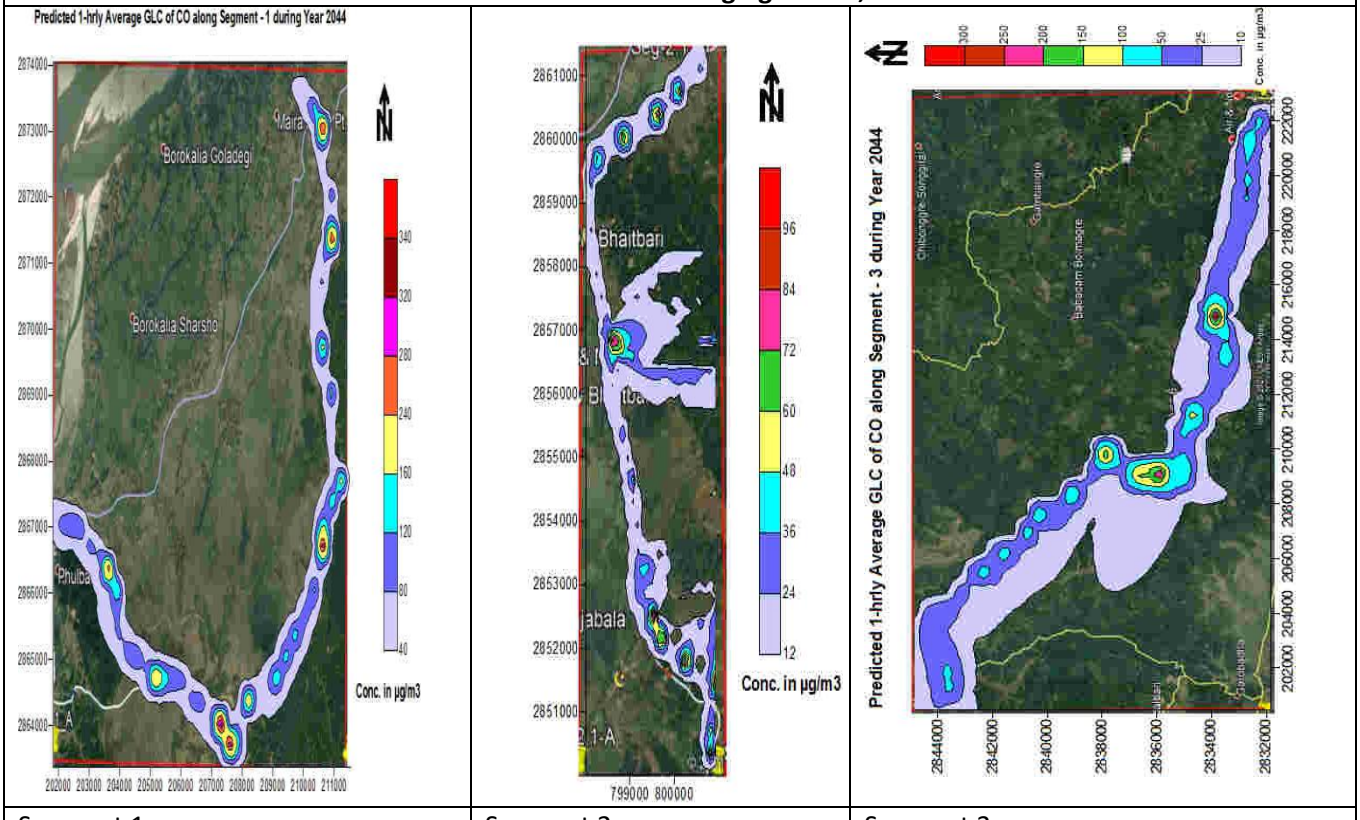
Segment-3

Predicted Ground Level Concentration for CO – 1 hr Averaging Period, 2021



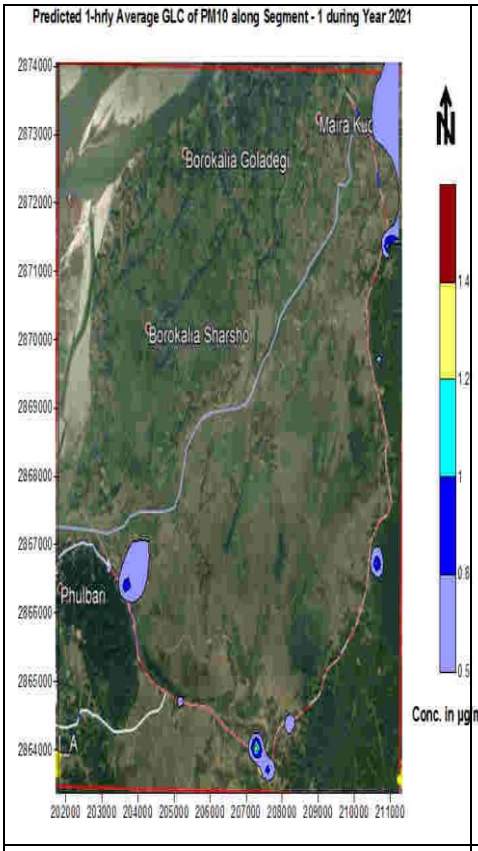
Segment-1	Segment-2	Segment-3

Predicted Ground Level Concentration for CO – 1 hr Averaging Period, 2044

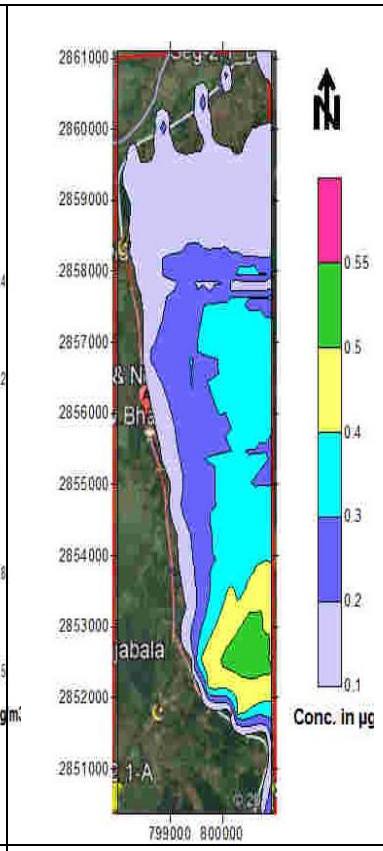


Segment 1	Segment 2	Segment 3

Predicted Ground Level Concentration for PM10 – 1 hr Averaging Period, 2021



Segment 1



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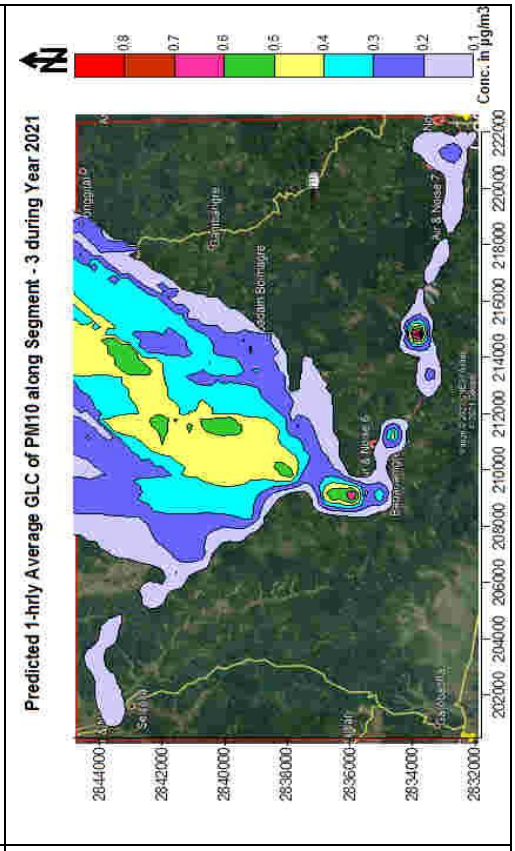
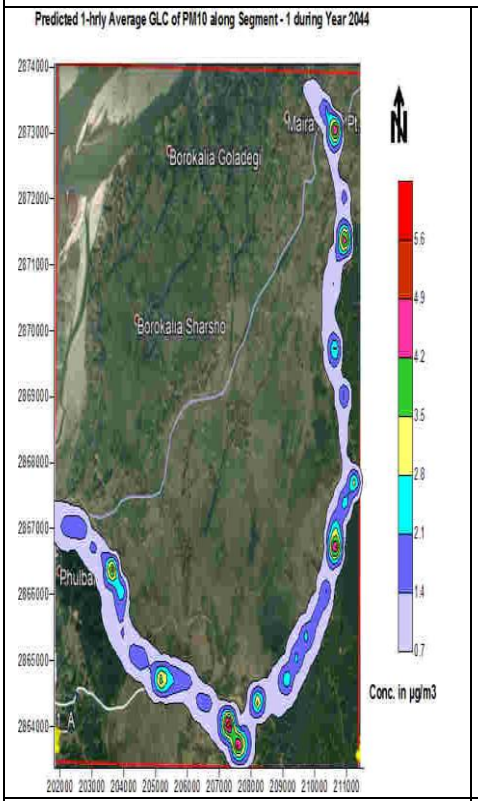
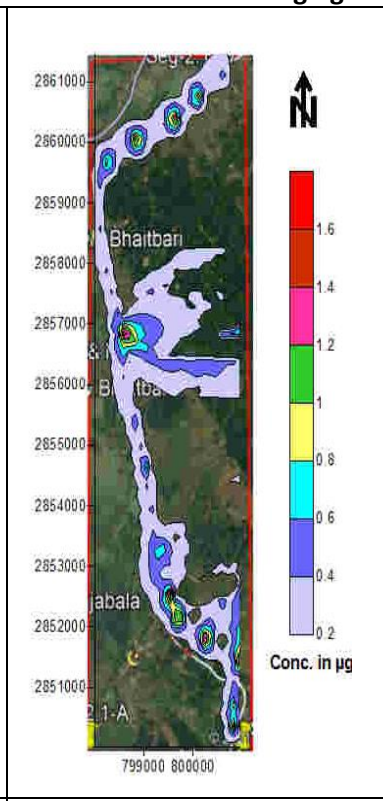


Segment 3

Predicted Ground Level Concentration for PM10 – 1 hr Averaging Period, 2044



Segment 1



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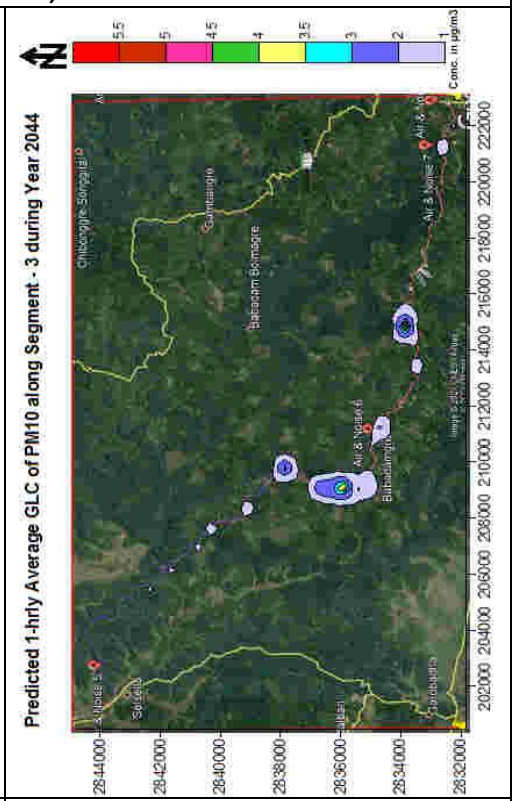


Segment 3

Anticipated Residual Impact- Year 2044

Therefore, based on the above, it can be concluded that the operation of the project road in the year 2044 is likely to cause exceedance for the selected criteria pollutants. It was predicted that in the year 2044, few exidence of NO2 will take place due to high traffic volume and this will be increase further impact on air environment.It should be noted that there is no 24-hrly average for VOC however, EU prescribes a limit of 5 µg/m^3 as an annual average.

It has been observed from the model output that when the traffic volume increases, the concentration of air pollutants also increases correspondingly. However, the maximum predicted pollutant concentrations of CO, NO2 and PM10 over the existing ambient air quality are found to be within the National Ambient Air Quality Standards.

Mitigation Measures:
Implementation of stricter emission norms for the vehicles is the only mitigation measure that will have significant influence on the ambient air quality. In the year 2044, if 50% of the total vechile turns into electric vechile then the impact will be less. However, implementation of such norms for vehicles plying on the project road is beyond the control of the proponent.
Therefore, the proponent may take initiatives to raise the awareness of the road users.

D.4. GHG Emission

I. Construction Stage

The GHG emissions during a road construction project involve the following major sources:

- Transport emissions owing to transportation of man and material
- Material emissions owing to extraction/production of construction materials
- Machines emissions owing to consumption of fuel by engines used in construction

A detailed study conducted for the World Bank titled “Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation- A Toolkit for Developing Countries” established the typical GHG emission rate in terms of ton CO_2eq per km of road construction. According to this study, for national road, GHG emissions due to material production such as aggregate, bitumen, structures and road furniture are the main contributor, at about 66 percent of totalemissions.Materials transport is also a significant GHG producer, at around 30 percent for national road.

Table 67: Typical breakdown of GHG emissions by generator for various road categories (t CO_2eq. /km)

Type of Road	Transport emissions	Material emissions	Machines emissions	Total (t $C0_2$ eq.)
National Road	235	523	36	794

Source: Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation - A Toolkit for Developing Countries, World Bank, 2010. (http://siteresources.worldbank.org/INTEAPASTAE/Resources/GHG-ExecSummary.pdf)

Therefore, the 62.000km of road construction would result in emission of approximately 49,228t CO_2eq.

Mitigation Measures:

Alternative practice	Work components & GHG generators concerned	Remarks, if any
Use labor intensive techniques for excavation	Earthworks (Transport, Equipment)	
Optimize location of road safety barriers	Equipment/furniture (Materials, Transport, Equipment)	GHG emissions from barriers > 5% of total emissions
Optimize street lighting	Equipment/furniture (Materials,	

	Transport, Equipment)	
Use recycling	Pavement (Materials, Transport, Equipment)	
Consider gravel roads and surface treatment instead of bituminous / cement concrete pavements	Pavement (Materials, Transport, Equipment)	
Ensure low roughness	Structures (Materials, Transport)	
Ensure recycling of steel	Structures (Materials, Transport)	GHG emissions from metal > 10% of total emissions

Reduction in Transport Emissions:

Transport of materials represents about 30% of the GHG emissions of a road project. From that, about 50% are related to local transport.

- Use of more efficient road vehicle fleets having a lower unit emission ratio. This can be significant as the efficiency improves with the use of trucks with higher payload (50% decrease in unit emission and savings of more than 20% in total transport emissions).
- Modal shift from road to more efficient modes (rail or water having unit emissions 17 times lower) over long distances. Further improvement can be up to 8% of the total emissions after road transport has been optimized

Reduction in Material Emissions:

- Excavation in hard soil generates two to three times more GHG than in ordinary soil.
- The use of drilling rigs rather than light drillers is twice as productive, but produces 35% more GHG per cubic meter of rock excavated.
- Cold mixtures as well as recycling technologies and materials have lower emissions (a factor of three when compared to hot mixture bituminous structures).

Reduction in Machine Emissions:

- Regular maintenance of the machineries ensures optimum performance of the machines.

II. Operation Phase

The GHG emissions are estimated based on the per day traffic volume of the yearly estimated total Passenger car unit (PCU) at each section. GHG emissions based on HDM-4 are presented in Table 68 and Table 69. Sections are defined as per old DPR data.

Table 68: Annual CO2 Emission (tonnes),Base Case - Without Project

	Hydrocarbon (HC)	**Carbon monoxide (CO)**	**Nitrous oxide (NOx)**	**Sulphur dioxide SO_2**	**Carbon dioxide (CO_2)**	**Particulates Par**	Lead (Pb)
Section 1 (0.000-26.000)km							
2022	263.71	528.10	178.30	21.09	18,906.31	65.91	**0.00**
2030	549.14	1,099.60	371.23	43.91	39,366.91	137.25	**0.01**
2035	829.90	1,661.80	561.01	66.37	59,493.98	207.42	**0.01**
2040	1,338.85	2,680.96	905.08	107.07	95,980.61	334.62	**0.02**
2045	2,402.33	4,810.85	1,624.14	192.11	172,229.66	600.40	**0.03**
2050	2,362.32	4,730.75	1,597.08	188.91	169,361.39	590.40	**0.03**
Section 2 (26.000-48.000)km							
2022	70.49	141.55	47.82	5.63	5,064.51	17.61	**0.00**
2030	143.88	289.02	97.66	11.50	10,340.43	35.94	**0.01**

2035	207.30	416.55	140.76	16.56	14,902.23	51.77	**0.01**
2040	305.28	613.59	207.35	24.39	21,950.14	76.24	**0.02**
2045	459.16	923.05	311.92	36.68	33,018.78	114.66	**0.03**
2050	723.28	1,454.21	491.41	57.78	52,017.63	180.62	**0.04**
Section 3 (48.000-81.200)km							
2022	384.45	771.83	260.66	30.72	27,611.44	96.02	**0.02**
2030	716.09	1,438.69	485.90	57.20	51,456.58	178.81	**0.03**
2035	971.86	1,953.95	659.97	77.61	69,871.10	242.63	**0.05**
2040	1,416.29	2,849.06	962.37	113.08	101,863.06	353.52	**0.09**
2045	2,230.88	4,490.42	1,517.23	178.09	160,523.38	556.78	**0.15**
2050	**3,686.36**	**7,427.04**	**2,509.73**	**294.19**	**265,439.06**	**919.82**	**0.29**

Table 69: Annual CO2 Emission (tonnes), Improvement Case - With Project

Section 1 (0.000-26.000)km							
2022	260.53	521.73	176.15	20.83	18,678.20	65.11	**0.00**
2030	443.07	887.49	299.77	35.43	31,769.16	110.72	**0.01**
2035	660.46	1,322.89	446.82	52.81	47,354.89	165.05	**0.01**
2040	1,068.09	2,138.67	722.06	85.42	76,566.45	266.95	**0.01**
2045	1,608.97	3,221.66	1,087.67	128.67	115,338.24	402.13	**0.02**
2050	2,461.72	4,929.07	1,664.07	196.87	176,465.20	615.25	**0.03**
Section 2 (26.000-48.000)km							
2022	70.49	141.55	47.82	5.63	5,064.51	17.61	**0.00**
2030	143.88	289.02	97.66	11.50	10,340.43	35.94	**0.01**
2035	207.30	416.55	140.76	16.56	14,902.23	51.77	**0.01**
2040	305.28	613.59	207.35	24.39	21,950.14	76.24	**0.02**
2045	459.16	923.05	311.92	36.68	33,018.78	114.66	**0.03**
2050	723.28	1,454.21	491.41	57.78	52,017.63	180.62	**0.04**
Section 3 (48.000-81.200)km							
2022	384.45	771.83	260.66	30.72	27,611.44	96.02	**0.02**
2030	716.09	1,438.69	485.90	57.20	51,456.58	178.81	**0.03**
2035	971.86	1,953.95	659.97	77.61	69,871.10	242.63	**0.05**
2040	1,416.29	2,849.06	962.37	113.08	101,863.06	353.52	**0.09**
2045	2,230.88	4,490.42	1,517.23	178.09	160,523.38	556.78	**0.15**
2050	**3,686.36**	**7,427.04**	**2,509.73**	**294.19**	**265,439.06**	**919.82**	**0.29**

The generated CO and CO_2 emission without project in (section 1) 2022 is expected to be 528.10 and 18,906.31 Tones in the base case. The expected CO and CO_2 emission with project in the projected year 2050 would be 4,929.07 and 176,465.20Tones which are9.3 times more than the base year of GHG calculation. Whereas without project CO and CO2 emmision in 2050 is 4,730.75 and the impact due to other green house gases is expected to be insignificient. Emissions summary of each years are presented in Annex-9.

Mitigation Measures:

- Record energy consumption by grid, fuel and other necessary machineries regularly
- Carry out annual energy audits to find out energy efficiency measures to reduce consumption

- Reduce air trips from head office and use common pooling during travel to site
- Optimization of electrical equipment and machineries using fossil fuel

D.5. Noise and Vibration:

Noise level may increase temporarily in the close vicinity of construction activities, maintenance workshops and earth work site. These construction activities are expected to produce noise levels in the range of 80 - 95 dB (A) (at a distance of about 5 m from the source). Although this level of noise is higher the permissible limit for ambient noise level for residential/commercial levels but will occur only intermittently and temporary. This noise level will attenuate fast with increase in distance from noise source. Since the project road is passing through considerable built-up area, impact of noise on sensitive structures such as schools, hospitals is highly anticipated. There are several noise sensitive receptors such as educational institutes, health centres alongwith residential areas. Noise barriers shall be provided in those sensitive noise receptors to avoid detrimentalimpact due to noise pollution.

Impacts on Noise Level

The assessment of potential road noise impacts helps in understanding one of the most significant pollution, the noise pollution. Some salient features related to potential noise impact of a road development include: (i) the road noise impact is greatest where busy road passes through densely populated areas, townships and markets (ii) the range of noise level should be understood in relation to the habitation type also; for example, road noise in industrial area is not likely to be problematic but at sensitive location like schools and hospitals; its impact may be significant, (iii) mitigation of noise in urban areas is rather difficult, especially at the road intersections.

I. Construction Phase

Noise will be generated due to different construction activities in the project stretch and at plant areas. Piling, if necessary, will cause vibration. Noise and vibration from this source will be unavoidable but the impact will only be temporary and affect people living or working near the project locations. The different sources of noise are as below

(i) Movement and operation of heavy construction machineries, equipments & vehicles.
(ii) Construction and demolition activities
(iii) Operation of plants & crusher
(iv) Excavation work for foundations and grading

Mitigation Measures:

- New machineries and equipments shall be used for the project.
- DG sets shall be fitted with acoustic enclosures or kept within a room.
- PPEs (ear plugs) shall be provided to all the staffs/workers at construction sites.
- Machineries, equipments, plants and vehicles need to be maintained on regular basis.
- Noise barrier (Vegetative) needs to be provided at sensitive (Noise) locations.
- Construction activities should be limited to day time only.
- No horn board shall be provided at sensitive (Noise) locations.
- Avenue plantation may form an effective sound buffer during the operation stage.
- Regular noise monitoring shall be done to check the noise limit with respect to the standard prescribed limit of CPCB.

Table 70:Impact on Noise Environment and Mitigation Measures

Noise Environment	• Noise level may likely to increase during construction phase	• Properly maintained equipment to be used • Noise levels of machineries used shall

		confirm to relevant standard prescribed in Environment (Protection) Rules, 1986. • Ear plugs and muffs will be used by the workers as per requirement during construction activities. • Regulation of timing of construction work generating noise pollution near the sensitive areas.

Estimation of Construction Phase Noise

At the outset, it should be noted that unavailability of exact information on the construction methodology, hours of work, no. of equipment and their ratings / fuel consumption, construction schedule, etc. are the limiting factors while estimate the construction noise for this subject project; however, to represent the possible worst case scenario, an effort has been made based on our knowledge on the construction of similar project using QUESTOR Construction Noise Tool.

The QUESTOR Construction Noise Tool is a simple application capable of calculating noise levels for construction sites. It is based on the construction site noise calculation model documented in PR70 "How much noise do you make A guide to assessing and managing noise on construction sites" by Dr Alan Wills (KVÆRNER) and David Churcher (CIRIA). The tool itself works on a relationship of one receiver to many sources.

'QUESTOR Construction Noise Tool' provides a library of sample plants and the activities they are performing from the **BS 5228 standard: The British Standard on Noise**. The total noise level calculated by the application is the noise level at the receiver.

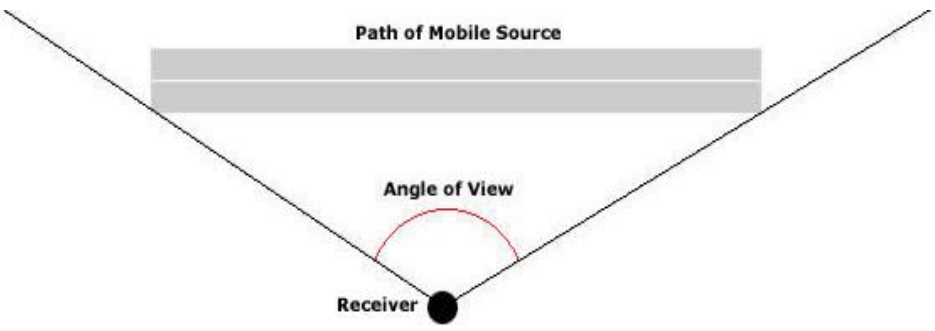
ID	Type	Noise pressure (dB), 1m from the source	Distance (m)	Barrier	Reflection	On Time (%)	Angle of View (^{0})	Traffic Volume / hour	Speed (km/hr)	Total (dB(A))
Site Clearing										
1	Dozer	116	50	None	None	20	90	10	10	46
2	Tracked excavator	113				20	90			76
3	Tracked loader	113				20	90			76
4	Wheeled loader	108				20	90			71
									Total noise from site at receiver	80
Ground Excavation										
1	Dozer	114	50	None	None	20	90	10	10	44
2	Tracked excavator idling	96				20	90			59
3	Tracked excavator	113				20	90			76
4	Wheeled loader	104				20	90			67
5	Tracked loader	112				20	90			75

ID	Type	Noise pressure (dB), 1m from the source	Distance (m)	Barrier	Reflection	On Time (%)	Angle of View (^{0})	Traffic Volume / hour	Speed (km/hr)	Total (dB(A))
									Total noise from site at receiver	79
Tipping Fill										
1	Dump Truck	110	50	None	None	100	90	10	10	57
									Total noise from site at receiver	57
Spreading Fill										
1	Wheeled excavator / loader	104	50	None	None	50	90	10	10	81
2	Dozer	117				50	90	10	10	61
									Total noise from site at receiver	81
Spreading Fill										
1	Wheeled excavator / loader	104	50	None	None	50	90	10	10	81
2	Dozer	117				50	90	10	10	61
									Total noise from site at receiver	81
Ground leveling										
1	Dozer	114	50	None	None	50	90	10	10	58
2	Grader	111				50	90	10	10	55
									Total noise from site at receiver	60
Unloading										
1	Tipper lorry	113	50	None	None	50	90	10	10	57
2	Tracked loader	112				50	90	10	10	89
									Total noise from site at receiver	89
Rolling gravel / bricks										
1	Road roller	108	50	None	None	100	90	10	10	55
									Total noise from site at receiver	85
Compacting fill										
1	Vibratory roller	106	50	None	None	50	90	20	15	84
2	Compactor rammer	108	50	None	None	50	90	20	15	86
									Total noise from site at receiver	88
Compacting sub-base										
1	Compactor rammer	108	50	None	None	100	90	20	15	89

ID	Type	Noise pressure (dB), 1m from the source	Distance (m)	Barrier	Reflection	On Time (%)	Angle of View (^{0})	Traffic Volume / hour	Speed (km/hr)	Total (dB(A))
									Total noise from site at receiver	89
Compacting earth										
1	Compactor rammer	108	50	None	None	100	90	20	15	89
									Total noise from site at receiver	89
Road surfacing										
1	Asphalt melter (Stationary)	103	50	None	None	70	NA	NA	NA	59
2	Asphalt spreader	110	50	None	None	70	90	10	10	88
3	Road roller and lorry	96	50	None	None	80	90	10	10	42
									Total noise from site at receiver	88
Installation of traffic light controls										
1	Groove cutter	115	50	None	None	100	NA	NA	NA	73
									Total noise from site at receiver	73

Assumptions

- Receiver Distance: The minimum distance in meters between the source plant and the receiver – considered as 50m.
- On Time (%): The percentage of time (of the overall time period in question) for which this plant is on.
- Barrier: If there is a barrier between the source and the receiver (None - To reflect the worst-case scenario)
- Reflection: If the receiver is within 1m of a wall then select this option
- Angle of view: 90^0
- Traffic Volume (veh/hour): Total number of return journeys that is made by the mobile plant in an hour
- Speed: Average speed of the plant in kilometers per hour



As depicted in the above picture, it is considered that for particular construction zone, the source is located at a distance of 50m with 90^0 angle of view. Accordingly, the sound pressure levels are predicted at the receptor location during different activities.

Assessment of Impact:

Based on the calculations presented below, it is anticipated that whenever the construction will happen in any zone other than industrial, the ambient noise level will exceed the statutory level at a distance of 50m away from the construction zone, if no barrier is put. Hence, the impact is categorized as minor-negative due to a minor impact of transient nature.

Mitigation Measures:

In view of above, following mitigation measures are proposed:

- All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB(A). If required, machinery producing high noise as concrete mixers, generators etc., must be provided with noise shields;
- At construction sites within 500m of human settlements, noisy construction activities shall be stopped between 9.00 PM and 6.00 AM;
- Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum;
- Workers in the vicinity of high noise levels must wear ear plugs and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 85 dB(A) per 8-hour shift.

II. Operation Phase

To assess the noise levels at the various sensitive receptor locations along the corridor, the prediction of noise levels has been made for the horizon years 2035 and 2045, using the FHWA Transport Noise Model version 3.0. TNM computes incremental highway traffic noise at nearby receivers. As sources of noise, it includes noise emission levels for the following vehicle types:

- Automobiles: all vehicles with two axles and four tires -- primarily designed to carry nine or fewer people (passenger cars, vans) or cargo (vans, light trucks) – generally with gross vehicle weight less than 4,500 kg (9,900 lb);
- Medium trucks: all cargo vehicles with two axles and six tires -- generally with gross vehicle weight between 4,500 kg (9,900 lb) and 12,000 kg (26,400 lb);
- Heavy trucks: all cargo vehicles with three or more axles -- generally with gross vehicle weight more than 12,000 kg (26,400 lb);
- Buses: all vehicles designed to carry more than nine passengers; and
- Motorcycles: all vehicles with two or three tires and an open-air driver / passenger compartment

The procedure for prediction of noise levels involves the following steps:

- Identification of various receivers,
- Assemble input parameters, and
- Application of the model.

Input Data are used to run the model are as following:

- Traffic Volume- one hourly data of traffic volume from public consultant has been presented.
- Design Speed- data of design speed from engineering consultant has been used which is 80Km for light vehicles and 60Km for heavy vehicles.
- The receptor site condition in terms of tree zone, barrier is also incorporated

In order to assess the impact on ambient noise during the operation phase comparisons are made between the baseline noise level and predicted noise level for the year 2035 and that in year 2045.

Table 71: Output of Transport Noise Model version 3.0

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
clg 1.600-1	College	204241	2865186	49.3	54.7	58.4	• The predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 3.800-1	School	202981.86	2864541.35	45.9	51.3	55.0	• The predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 31.500-10	School	202754.55	2843655.46	61.8	67.1	70.8	• The baseline noise level and predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 36.500-11	School	205724.04	2841988.28	46.2	51.4	55.1	• The predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
							3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 37.300-12	School	206301.5	2841706.89	44.3	49.6	53.3	• The predicted noise level in 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 42.200-13	School	209213.26	2838379.52	57.1	62.3	65.9	• The baseline noise level and predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 49.400-14	School	211818.54	2834210.96	48.5	53.8	57.4	• The predicted noise level in 2035 and 2045 exceeds the baseline noise level. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 52.300-15	School	214293.17	2833399.57	39.7	45.0	48.6	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA.

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
							• The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 61.600-16	School	222425.74	2832205.51	39.7	44.9	48.6	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Chc 27.900-1	Church	200290.09	2845118.06	32.5	37.9	41.6	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Msq 9.900-1	Masque	799993.31	2860670.57	38.9	44.2	47.9	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
Clg 10.100-2	College	799810.66	2860511.64	43.3	48.7	52.4	• The baseline and predicted noise level in 2022 and 2035 does not exceed the permissible level of noise i.e. 50dBA. • The noise level in the year of 2045 exceeds the permissible limit of noise. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 10.500-2	School	799473.99	2860310.74	36.3	41.7	45.4	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 11.200-3	School	798869.84	2859964.61	38.9	44.3	48.0	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 12.200-4	School	798129.14	2859339.72	39.2	44.6	48.3	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
							3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 15.200-5	School	798394.28	2856426.99	32.3	37.6	41.3	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. The difference between the noise level in 2035 and 2045 is more than 3dB.
Mds 15.500-1	Madrassa	798546.51	2856243.27	31.9	37.3	41.0	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA.
Sch 15.800-6	School	798670.72	2855891.14	35.9	41.3	45.0	• The difference between the baseline noise level and predicted noise level is more than 3dB.
Clg 16.200-3	College	798813.82	2855521.56	36.3	41.7	45.4	• The predicted noise level in 2035 and 2045 exceeds the permissible level of noise i.e. 50dBA. • The difference between the noise levels of 2035 and 2045 is more than 3 dB.
Sch 18.200-7	School	799130.63	2853499.95	35.5	40.9	44.6	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 19.300-8	School	799538.12	2852536.86	34.4	39.8	43.5	• The baseline and predicted noise level in

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
							2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Sch 23.050-9	School	199213.15	2849469.33	32.3	37.7	41.4	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Phc 9.600-1	Public Health Centre	800204.69	2860871.78	50.6	56.0	59.7	• The predicted noise level in 2022, 2035 and 2045 exceeds the permissible level of noise i.e. 50dB. • The difference between the noise levels of 2022, 2035 and 2045 is more than 3 dB.
Vhs 12.000-1	Veterinary Hospital	798206.58	2859566.48	40.2	45.5	49.2	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.
Hsp 15.300-1	Hospital	798616.51	2856339.93	45.3	50.7	54.4	• The noise level in the year of 2022 does not exceed the permissible noise limit. • The predicted noise level in 2035 and 2045

Receptor Name	Description of Receptor	Coordinates		Baseline Noise Level	Predicted Noise Level in 2035	Predicted Noise level in 2045	Remarks
		Easting	Northing				
							exceeds the permissible level of noise i.e. 50dBA. • The difference between the noise levels of 2035 and 2045 is more than 3 dB.
Hsp 16.400-2	Hospital	798909.59	2855308.83	38.6	44.0	47.7	• The baseline and predicted noise level in 2022, 2035 and 2045 does not exceed the permissible level of noise i.e. 50dBA. • The difference between the baseline noise level and predicted noise level is more than 3dB. • The difference between the noise level in 2035 and 2045 is more than 3dB.

Conclusion –

Based on the analysis present in the above table it may be concluded that:

- Noise levels (Leq) near the receivers are found to be marginally higher than desired levels for the respective categories. The predicted levels showincrease in noise levels for future years at all receivers considering increase in traffic volume.
- 50% and above receptors shows that the predicted noise level in 2035 and 2045 are more than the permissible noise level i.e., 50 dB. So, it has a significant impact upon ambient noise.
- Less than 25% receptor shows that the predicted noise level in 2035 does not exceed the permissible noise level i.e., 50 dB.
- The difference between the noise level of 50% and receptors in 2035 and 2045 are more than 3 dB. So it has a significant impact on ambient noise of this area.

Noise dispersion

A small road corridor has been selected to develop noise contour for year 2035 as well as year 2045 also. The contour lines are generated by plotting a contour zone within 500 m distance from edge of the project road on both side of the road. Due to model limitation, it is not possible to select the whole road corridor in the modelling domain. Therefore, spatial dispersions of noise have been show with a small stretch of road. Figure 36and 37 shows noise level contour around a small road corridor for year 2035 and 2045 respectively.

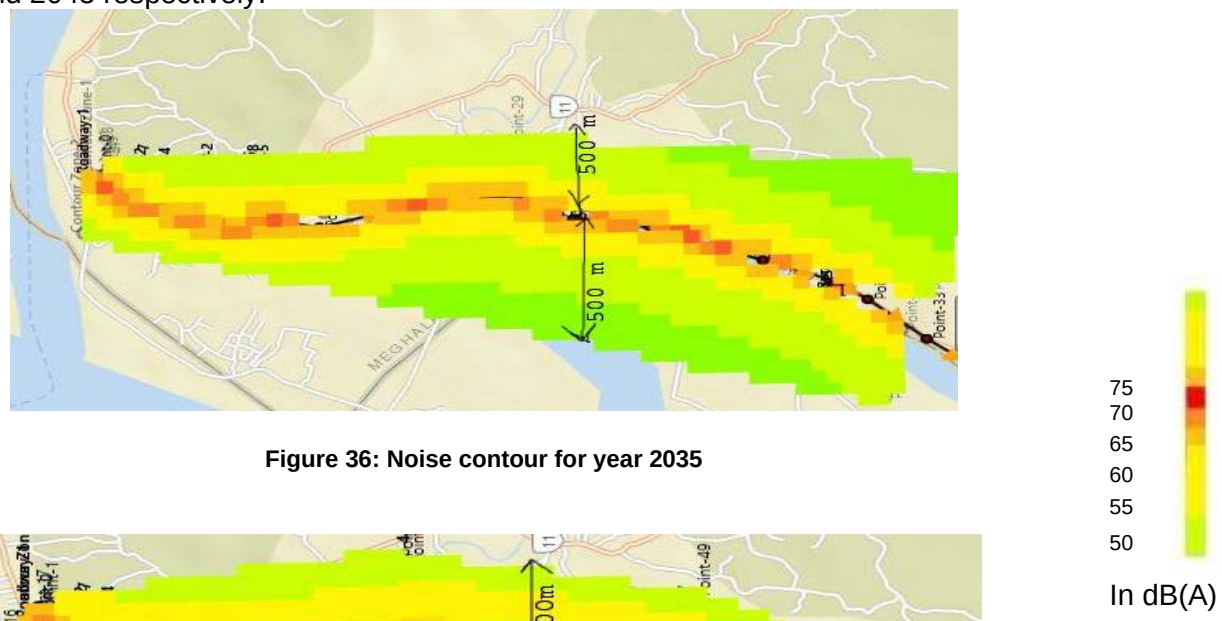


Figure 36: Noise contour for year 2035

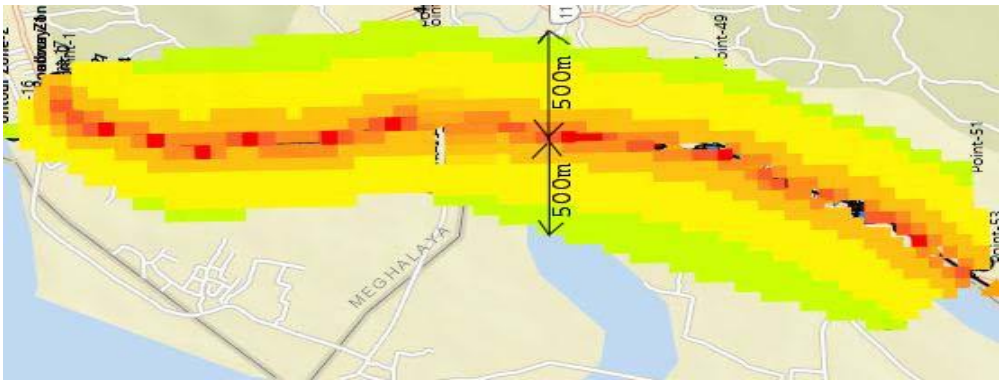


Figure 37: Noise contour for year 2045

It can be seen from the Table 71that noise levels (Leq) near the receivers are found to be higher than desired levels for the respective categories when compared with prescribed standards of CPCB

(Government of India) as well as IFC (World Bank EHS Guidelines). The predicted levels show increase in noise levels for future years at all receivers considering increase in traffic volume. The current spot measurement level at few sensitive receptors shows much lower value compared to the traffic-based assessment indicating noise is being attenuated by various existing barriers like trees, buildings etc. Installations of physical noise barriers are proposed sensitive locations to keep the projected noise levels at these locations within CPCB/WB EHS standards i.e. 50 dB(A).

Mitigation Measures:

- If the line-of-sight is broken by the barrier between the source and the receiver, barrier insertion loss is typically 5 dB. For each additional 1 m (3 ft) of barrier height beyond the line-of-sight blockage, an increase in barrier insertion loss of 1.5 dB can be considered typical. Noise barriers are usually designed with an insertion loss goal of 10 dB in mind. Actual barrier insertion losses of between 6 and 8 dB are quite common[11].
- Beside the existing barrier in terms of tree zones and/or walls it is recommended to put additional wall of 3m height and width of 30cm, so that 15 dB noise will reduce.
- The plantation grown will also act as a noise barrier. Predicted noise levels indicate that beyond 500m distances no impact of project road vehicular noise will be felt.

Impact of/ on	Extent of Impact (after Mitigation)
Noise Environment	**ΔΔ**

Vibration

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. Ambient vibration or environmental vibration seldom have such magnitude to beperceptible or cause audible ground borne noise unless there are specific vibration sources close by. During the project construction and operation stage, the impact of vibration is very negligible and temporary during construction stage.

Source of Vibration

- Increase in noise levels due to running of heavy construction equipment
- Frequent vibration impact due to demolition (existing pavement, road surfaces, etc.),piling, and compaction work.
- Noise propagation due to plying of heavy construction vehicles at the sites
- Blasting operation (if any) may lead to temporary ground borne vibration
- High noise emitting from the construction equipment
- Noise generated from the running of heavy vehicles deployed in the construction activities.

Table 72: Magnitude of Impact of Vibration Annoyance

10	Vibration is likely to be intolerable for more than a very brief exposure to this level	Major
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	moderate
0.3	Vibration might be just perceptible in residential environments	Minor

[11] Source- https://www.fhwa.dot.gov/ENVIRonment/noise/measurement/mhrn06.cfm

0.14	Vibration might be just perceptible in most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible/ No change

Impact of Vibration due to Road Construction and Operation

Ground-borne vibration can be a concern for nearby habitation of a transit system route or maintenance facility, causing buildings to shake and rumbling sounds to be heard. In contrast to airborne noise, ground-borne vibration is not a common environmental problem. It is unusual for vibration from sources such as buses and trucks to be perceptible, even in locations close to major roads. Some common sources of ground-borne vibration are heavy vehicles on rough roads, and construction activities such as drilling, compaction, piling and operation of heavy earth-moving equipment.

Many construction activities related to road infrastructure give rise to ground-borne vibration that may cause damage to structures or be perceptible to occupants in adjacent buildings and, therefore, give rise to complaints.

These vibrations are produced by the varying forces between tyre and road and can become perceptible in buildings if heavy vehicles pass over irregularities in the road near the properties. Both compression and shear waves are produced and their amplitudes and attenuation with distance depend on a number of factors including the soil composition and the nature of the geological strata.

Mitigation Measures

After using the above methods to locate potential human impacts or building damage from construction vibrations, the next step is to identify control measures. Similar to the approach for construction noise, mitigation of construction vibration requires consideration of equipment location and processes, as follows:

Notify the local people prior to undertake the construction activities associating with higher vibration level such as activities using vibrating rollers.

The vibrations should be reducedconsiderablyby ensuring and keeping correcttrack geometry by advanced measurement.

Expanding the right of way (buffer zone) is sometimes the easiest method of reducing the vibrationimpact.

Design considerations and project layout:

- Route heavily-loaded trucks away from residential streets, if possible. Select streets with fewest homes if no alternatives are available.
- Operate earth-moving equipment on the construction lot as far away from vibration-sensitive sites as possible.

Sequence of operations:

- Phase demolition, earth-moving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.
- Avoid night time activities. People are more aware of vibration in their homes during the night time hours.

Alternative construction methods:

- Avoid impact pile-driving where possible in vibration-sensitive areas. Drilled piles or the use of a sonic or vibratory pile driver causes lower vibration levels where the geological conditions permit their use (however, see cautionary note below).
- Select demolition methods not involving impact, where possible. For example, sawing bridge decks into sections that can be loaded onto trucks results in lower vibration levels than impact demolition by pavement breakers, and milling generates lower vibration levels than excavation using clam shell or chisel drops.
- Avoid vibratory rollers and packers near sensitive areas.

Noise and Vibration Management

There are several measures indicated tocurtail the noise levels emanating from the construction sites in the EMP:

- Noise barrierssuchastemporary wallsshould be established around the yard near residentialareaandsensitivereceptor during the activities such as pile driving which generate the high level of noise;
- Reroute truck traffic away from the residential areas, if possible select streets with fewer homes if no alternative routeisavailable;
- Site equipmenttobeplacedawayfromtheresidentiallocation and sensitiveareas;
- Construct walled enclosures around especially noisy activities or clusters of noisegenerating equipment;
- All plant equipment and vehiclesbeingfittedwithappropriatenoise suppression equipment to reduce noise levels as far as possible;
- All equipment should be operating in good condition.Use of equipmenthavinginbuilt enclosed aircompressor and mufflers onallengines;
- All site workers are trained in noise reduction such asproperuseofmachinery and hearing protection;
- All site workers must wear appropriate hearing protection if in close proximity to machinery for extended periods;
- Avoid night time construction activities as much as possible in noise sensitive areas;
- Avoid pile driving work where possible in noise sensitive areas by quieter alternatives where geological conditions permit their use;

Plantations of trees and shrubs (as green belts) for instance would contribute little to actual noise reduction, but they do have a psychological effect in reducing the perceived nuisance of the construction noise, and they are often used to soften the visual appearance of mounds and walls.

Impact of/ on	Extent of Impact (after Mitigation)
Vibration	Θ

D.6. Water Quality and Resources:

I. Consruction Phase

The different construction activities and allied components may contaminate both surface and ground water quality. The different potential impacts on water quality due to the project activities are as below:

Surface Water Quality and Siltation:

Construction activities may increase turbidity level increasing the sediment load. Sometimes contamination of surface water may take place due to accidental spills of construction materials, oil, grease, fuel, and paint. Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers camps and from spillages from vehicle parking and/or fuel and lubricant storage areas. During construction phase, care would be exercised to control silt so that the water available in the ponds and wells especially those located very near to the ROW may not be contaminated.

Extraction of sand from the river bed will increase turbidity and affect propagation of fishes and other aquatic life mainly benthic organisms. The macro-benthic life which remains attached to the river bed material may get dislodged and carried away downstream by turbulent flow. Mining and dredging activities, poorly planned stockpiling and uncontrolled dumping of overburden, and chemical/fuel spills from equipment's and machinery involved in dredging may cause deterioration of water quality for downstream users, and poisoning of aquatic life. However, the river bed sand quarries identified for the project have no density and diversity of benthic fauna. Fishing is practiced in the water bodies intersecting the project road. There are several ponds adjacent to the proposed project road. Moreover, any extraction of river bed material is regulated by different authorities like State Environmental Impact Assessment Authority, State Pollution Control Board and State Mining Department with an objective to conserve top soil, avoid impact on aquatic biodiversity, hydrological regime etc. by haphazard and unscientific mining of minor minerals. The project will utilize river bed materials from existing licensed quarries with all stipulated conditions of above mentioned authorities.

Mitigation Measure**:**

- Construction works near waterways/water bodies will not be undertaken during the monsoon season
- Retaining walls have been proposed to prevent erosion
- Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
- No construction camp within 500m of any water body
- Locate all parking, repair and fuel and hazardous material storage area away from any water body. Vehicle parking and maintenance areas will have waterproof floors from which drainage is collected and treated to legal standards.
- Refuel vehicles only in dedicated areas with waterproof floors from which drainage flows to an oil/water separator before discharge
- Collect all waste oil, store in sealed damage-proof containers and dispose it to recyclers.
- All equipment operators, drivers, and warehouse personnel will be trained in immediate response for spill containment and eventual cleanup.
- Temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies/waterways;
- The slopes of embankments leading to water bodies should be modified and rechanneled to prevent entry of contaminants.
- Comply with requirements of the clearance issued by the relevant state authority for mining in rivers
- No construction related activities of bridges during breeding season of fish and other aquatic species.

Loss of Water Bodies:

There are 13 locations where the proposed road passes through the edge of ponds. Most of them are within the right of way very close to the alignment. Retaining walls are proposedat such locations. Earth filling may be required in some cases but limited to a narrow strip of 1-1.5 m. Thiswill cause reduction in volumetric capacity of these ponds. However, overall impact will not be significantsince the project area is endowed with abundant surface water resources. Moreover, the usage of

theseponds is limited to washing/cattle bathing and fishing. No other aquaculture was observed other thanfishing of some indigenous variety mostly for domestic consumption and restricting mosquito breeding.
Construction activities on bridges shall be stopped during breeding time of fish andother aquatic species.

Mitigation Measure

- Alignment may be suitably modified to avoid encroachment of water bodies wherever possible
- Efforts shall be made to increase its volumetric capacity either by increasing depth or area wherever feasible.
- Borrow areas shall be converted into ponds at least equivalent to filling.

Alteration of Surface Water Hydrology/Drainage:

There are few minor bridges and major bridges found in the project road.None of these bridges are situated on any major river or its tributaries. All are either seasonal Nullah, Water logged area or Redundant part of old River channel. Three major bridge is proosed in the project road. Diversion of some nallahs may be required for a very short period. Courses of those nallahs will bebrought back to original within no time once construction is finished.

Mitigation Measure

- 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
- The Construction materials will be stored at a minimum distance of 500m from the water body.
- To maintain an efficient storm water flow, all drains will be regularly cleaned as part of regular maintenance.

Ground Water Quality:

Water for construction purpose will be sourced mainly through major streams along the project road. Suitable arrangement for drinking in the campsite will be managed by contractor without affecting availability to local community. The area is not classified as critical semi-critical or overexploited by CGWB. However, uncontrolled drinking water abstraction can deteriorate the situation. Contamination of groundwater is not envisaged since all construction camps will have septic tanks or mobile toilets depending on the number of workers in each camp.

Mitigation Measures:

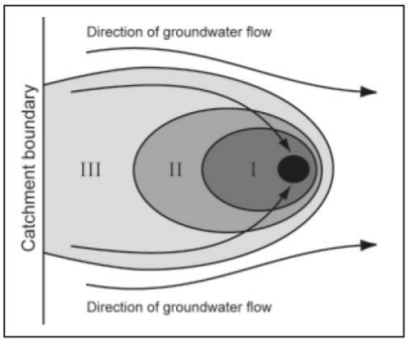
- Provision for adequate numbers of septic tank to avoid contamination of ground water.
- Requisite permission will be obtained for abstraction of groundwater.
- The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.
- Water harvesting structures shall be proposed for groundwater augmentation in the project area.
- No change in groundwater regime is envisaged hence no mitigation is proposed.

Drainage pattern: Diversion of major streams due to construction is expected. Hence, diversion of some nallahs may be required for a very short period. Courses of those nallahs will be brought back to original within no time once construction is finished.

Mitigation Measures:

- Provision of proper drainage through culverts along the project road (if required)
- All the water bodies will be crossed by the bridges and structures without affecting their original course and flow
- Stabilizing and turfing of slopes along the water bodies (If required)

Protection of a Groundwater Source



With respect to water intended for human consumption, a Special Protect on Zone around potable abstraction sources (springs, wells, boreholes) is established to protect them from pollution. The adjacent figure shows a typical arrangement of zones around an abstraction source.Immediately adjacent to the source and based upon a 50-day travel time from any point below the water table to the source (50 days being the decay period for most biological contaminants). All potable sources should have a minimum Protection Zone of 50m radius.

Rain Water Harvesting

Rainwater harvesting structures should be installed to compensate for the loss of groundwater for construction purpose and a part of water conservation. These are cost effective method for recharging of ground water level in the project area. The rainwater-harvesting chamber shall be placed at different locations along the project road.

The typical dimensions of the rainwater harvesting structures are 2 x 2 x 0.75m^3. A perforated RCC Slab covers the chamber. There is a 20cm filling, which also acts as sediment trap. There is another sediment trap in the bottom from where debris can be removed manually after certain period. A vertical drain (PVC pipe) is then sunk from the bottom of the chamber to a depth which varies as per the water table. However, the Rainwater harvesting pit should be at least 3 - 5 m. above the highest ground water table.

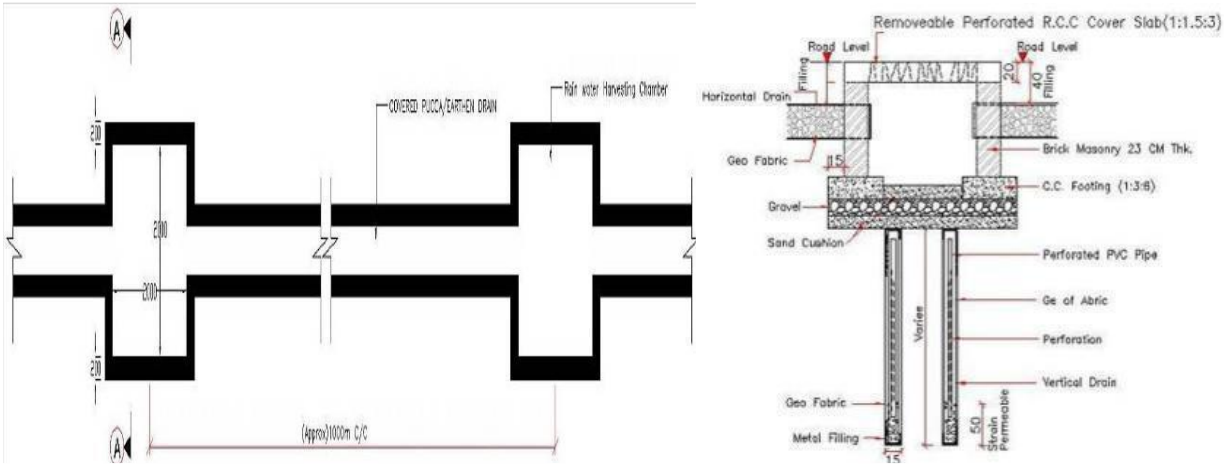


Figure 38: Rain Water Harvesting Structure

Contractor, along with the Engineer shall identify exact locations considering their feasibility where water can be stored for the summer. This shall act as good environmental practice.

MitigationMeasures*:*

- Silt fencing should be implemented while constructing along the project road,
- Fuelling of equipment and machineries should be done in designated place having appropriate spill containment.

Table 73: Impact on Water Environment and Mitigation Measures

Water Environment	• Drainage pattern	• Provision of proper drainage through culverts along the project road (if required) • All the water bodies will be crossed by the bridges and structures without affecting their original course and flow • Stabilizing and turfing of slopes along the water bodies (If required)
	• Siltation of water bodies	• Silt fencing around water bodies during construction to avoid silt laden runoff entering water body (If Required) • No solid waste will be dumped in or near the water bodies or rivers
	• Flooding due to siltation of drainage channel	• Excavated earth and other construction materials should be stored away from water bodies
	• Water for construction	• Water surface would be selected so that local availability is not affected
	• Contamination from waste	• Provision of septic tanks to prevent any untreated sewage discharge from construction worker camps • Oil interceptions at construction machine maintenance yards
	• Contamination from fuel and waste	• Vehicle maintenance will be carried out in a confined area, away from water sources and it will be ensured that used oil or lubricants are not disposed to water courses
	• Sanitation and water use in construction camps	• Construction camp will be organized in a planned manner • Proper sanitation facilities including toilets should be provided • Camps will have separate water supply facilities so that local water sources are not affected

Impact of/ on	Extent of Impact (after Mitigation)
Water Environment	**Δ**

II. Operation Phase

It is envisaged that the construction and renovation of cross-drainage structures will improve existing drainage system leading to positive impact. However, risk of spillages should be managed adequately.

Management of Spillages

When considering the risk of spillages from a highway and potential pollution to the receiving environment, the following factors must be considered:

- the calculated spillage risk return period must not be greater than 1 in 100 years;
- the calculated spillage risk return period must not be greater than 1 in 200 years where spillage could affect: important drinking water supplies or important commercial activities; and
- spillage risk from existing outfalls must not be increased.

Impact of/ on	Extent of Impact (after Mitigation)

Water Environment	**Δ**

Bottom Sediment

Anumber of processes influencethe sedimentary content and quality of river water. Sediments have an important role in the nutrient cycle of aquatic environment. In rivers the predominant source of bottom sediments is land runoff.Impoundmentsand estuaries are often characterized by heavy siltation from tributary streams.
It is necessarytoknowthe existing geochemical characteristics of the bottomsedimentof the surface water bodiesas during the construction phase, foundation of the piers/well shall be constructed inthe crossing rivers/estuaries which may cause some disturbance.

Impact on bottom sediment during Road Construction and Operation stage

There may be some disturbance to the bottom sediment during the construction phase, particularly during the construction of bridge. As there is only 01 major bridge (ch. 51+536km at redundant part of river), it is anticipated that the impact on bottom sediment is negligible and for a short time.

During operation stage no adverse impact on bottom sediment is envisaged.

Mitigation Measures:

- Construction works near waterways/water bodies will not be undertaken during the monsoon season
- Retaining walls have been proposed to prevent erosion wherever required.
- Provision of temporary silt traps or sedimentation basins along the drainage leading to the water bodies;
- No construction camp will be established within 500m of any water body
- Locate all parking, repair and fuel and hazardous material storage area away from any water body. Vehicle parking and maintenance areas will have waterproof floors from which drainage is collected and treated to legal standards.
- Refuel vehicles only in dedicated areas with waterproof floors from which drainage flows to an oil/water separator before discharge
- Collect all waste oil, store in sealed damage-proof containers and dispose it to authorized recyclers.
- All equipment operators, drivers, and warehouse personnel will be trained in immediate response for spill containment and eventual cleanup.
- Temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies/waterways;
- The slopes of embankments leading to water bodies should be modified and rechanneled to prevent entry of contaminants.
- Comply with requirements of the clearance issued by the relevant state authority for mining in rivers
- No construction related activities of bridges during breeding season of fish and other aquatic species.

Turbidity

Construction activities may increase turbidity level increasing the sediment load. Sometimes contamination of surface water may take place due to accidental spills of construction materials, oil, grease, fuel etc. Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers camps and from spillages from vehicle parking and/or fuel and lubricant storage areas. During construction phase, care would be exercised to control silt so that the

water available in the ponds and wells especially those located very near to the ROW may not be contaminated.

Extraction of sand from the river bed will increase turbidity and affect propagation of fishes and other aquatic life mainly benthic organisms. Mining and dredging activities, poorly planned stockpiling and uncontrolled dumping of overburden, and chemical/fuel spills from equipment's and machinery involved in dredging may cause deterioration of water quality for downstream users, and poisoning of aquatic life.

Mitigation Measure:

- Retaining walls have been proposed to prevent erosion wherever required.
- Construction works near waterways/water bodies will not be undertaken during the monsoon season
- Locate all parking, repair and fuel and hazardous material storage area away from any water body. Vehicle parking and maintenance areas will have waterproof floors from which drainage is collected and treated to legal standards.
- Refuel vehicles only in dedicated areas with waterproof floors from which drainage flows to an oil/water separator before discharge.
- Collect all waste oil, store in sealed damage-proof containers and dispose it to recyclers.
- Temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies/waterways;

D.7. Construction Waste and Management

Excavated earth/muck is likely to be generated due to dismantling of existing pavement. The muck will also be generated during cutting of road section. All the muck generated will be disposed as per C&D Waste Management rule 2016. The details of muck generated in the project and its disposal locations are provided below:

Muck generated in the project and muck disposal location data awaited from DPR consultant.(These table will update upon the receipt below mentioned information from DPR consultant)

Table 74:Abstract of Muck Generated in the project

Abstract of Muck Generated in the project						
Chainage		Total Cutting Volume	Total Filling Volume	Quantity of Muck Generated	Quantity of Muck Utilized in different construction Activity	Balance Quantity of Muck for disposal
From	To	(Cum)	(Cum)	(Cum)	(Cum)	(Cum)

Table 75: Muck Disposal Locations

Muck Disposal Locations				
District	Location	Coordinates	Capacity of Dumping Site (Cum)	Amount of Muck Disposed (Cum)

Muck Disposal Locations				
District	**Location**	**Coordinates**	**Capacity of Dumping Site (Cum)**	**Amount of Muck Disposed (Cum)**

Mitigation measures:
Contractor will use the excavated road side material for construction of road. The rest unsuitable material will be disposed suitably. The lead and lift has been considered in cost estimates. The Contractor will not dispose the excavated unsuitable material generated from hill section to other side (valley side) of the project road. Proper disposal plan will be prepared by the Contractor to dispose the unsuitable material generated from hill cutting/ road excavation.

D.8. Natural Disaster

Flood and flash flood is common during the monsoon in the vicinity of the proposed project road. During public consultation it was revealed by the local people that flash flood occurs in several villages in the project area during the months of monsoon season. Hence All CD structures have been proposed to design with anticipated risk of flood. Embankment height along potential flood affected areas shall increase. Lined and unlined side drains have been included in the design to avoid water-logging.
Relevant IS codes have been adopted in designing the structures to sustain the highest magnitude of earthquake.

D.9. Ecology and Biodiversity:

The building of highways leads to direct destruction and removal of existing ecosystems, and the reconfiguration of local landforms. Moreover, expansion of roads has diverse ecological effects on the topography which is signified by both abiotic and biotic components of terrestrial and aquatic ecosystems. The activities like land clearing, ground excavation, cut and fill operations and the construction of a particularl facility itself adds a substantial amount of PM into the atmosphere and are also a source of airborne particles. These activities have also been identified as a major source of pollutants to natural water bodies such as rivers, lakes and streams. Pollutants emitting from various activities like soil erosion, use of fossil fuels, paint, solvents, cleaners, use of harmful chemicals, construction debris and dirt are added to adjacent water bodies through both direct and indirect discharges which leads to physical, chemical and biological degradation of water quality.

Heavy loss of roadside trees is also asociated with the construction of Highways.Dust also provides adsorption surfaces for volatile contaminants that are subsequently deposited either by dry or wet deposition, thus causing phytotoxic pollutants to enter plant tissues, hence results in respiratory ailments in animals and humans. Road dust impacts vegetation by covering surfaces and affecting photosynthesis, respiration and transpiration, there by resulting in plant injury and decreased productivity.

It has been established that automobile act as line sources of heavy metal pollutants.The deposition of heavy metals on the soil surface can also lead to their absorption through roots by the plants and their subsequent accumulation. However, the concentration of metals has been known to decrease with distance. The level of contamination could lead to the leaching of these metals to adjacent

farmlands and potable water sources, which would eventually find their way into the food chain. Also, constant exposures to the vehicular emissions could lead to the bioaccumulation of these metals in plants and humans until it reaches the critical maximum level of toxicity.

The roadway infrastructure causes measurable impacts on the morphology of stream and river channels which in turn disturbs the biota. The most damaging agent in aquatic habitats has been said to be siltation and increasing nutrient loads. This can lead to changes in the diversity of aquatic species.

The loss of habitat, reduced habitat quality by fragmentation and the loss of connectivity through the transformation of existing land covers to roads and road-induced land use and land cover change are some major effects to landscapes due to road network. Habitat fragmentation is believed to have the greatest long-term impact on nature and the effect of road construction varies and depends on the type of road, being constructed.

The microclimatic changes produced affect the leaf litter and vegetation composition, soil macro invertebrates, interior-dwelling forest birds, herpetiles, mammals and overall species richness. Roads infrastructure affects both biotic and the abiotic components of ecosystem by changing the dynamics of populations of plants and animals, altering flows of materials in the landscape, introducing exotic elements, and changing levels of available resources, such as water, light and nutrients.

The impacts of the highways on the ecological environment can be divided into the impact on environment, vegetation and animals. The impacts include:

- Exposure and erosion of soil surface
- Destruction of surface vegetation
- Decrease in plant species and ecosystem structure and function
- Destruction of wildlife habitat
- Disturbances in wildlife migration
- Changing direction of surface run-off
- Landscape patching
- Change the state of riverbed
- Reduce the flood discharge capacity of the river
- Change the topography of the river, hydrological conditions and surface vegetation

Most of the project road stretch passes through human habitation, agricultural area, built-up and degraded non classified forest areas without any National Parks, Wildlife Sanctuaries and other eco-sensitive areas nearby.
There is hardly presence of any Presence of Endangered/ Schedule - I species in the project area confirm by site visit as well as consultation with community and Forest/Wildlife department. Majority of the important species are reported from outside of the ROW.
The traffic – animal conflicts during the operation stage shall be resolved by implementing speed calming mitigation measures such as road humps, rumble strips, speed limits, sign boards etc.

The acquisition of productive agricultural land at some stretches is inherent to the road development projects. The loss of crops on productive agricultural land is inevitable during construction stage due to operating heavy vehicles.
It is essential to make provisions for the transportation of agricultural equipment and animal crossing wherever necessary by providing service roads, speed breakers (road humps, rumble strips, signboards, etc.). Although situation does not warrant for the provision of exclusive underpasses, all possible efforts shall be made to avoid animal- traffic conflict arising out of proposed improvement of project roads.
There is a scope of slight impact to local domestic animals, which graze in the area especially after the road is constructed. Increased vehicle movement in the area might lead to accidents involving

animals.Apart from this, micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost due to loss of their habitat.

Mitigation Measures:

- The Contractor shall take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal.
- Mandatory / Regulatory sign for entire section of project road for every 2 km at alternate side is proposed.
- The compensatory plantation shall act as the new habitat for the birds, animals and insects species
- If any animal is found near the construction site at any point of time, the contractor shall immediately upon discovery thereof contact authorized wildlife rescuer or Forest Dept for rescue of snakes or other distressed wildlife.
- Special care of Ponds shall be taken since the wildlife and Public dependent on these water bodies.

Impact on Flora and Mitigation measures:

The project has a significant, direct and long-term impact on roadside trees in the Pre-construction stage. 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. Removal of roadside tress will reduce comfort levels for slow moving traffic and pedestrians.
Approximately 6185 numbers of trees needs to be fallen down due to the proposed road project. Felling of trees is also involved resulting in habitat destruction and fragmentation. Plantation in adjacent unused land shall be carried out throughout the project road effectively with proper provision as per state forest department guidelines. This will bring down the adverse impact of tree felling and help in restoration process of local ecosystem. Special care must be taken for rare, threatened or endangered species (if any) in project area.

Mitigation Measures**:**

- Trees impacted due to the project shall only be cut after requisite permission from State Forest Department is obtained.
- Trees impacted by the project shall be compensated by planting of endemic tree species which are highly tolerable to vehicular emissions and dust will be taken up as per IRC: SP 21.
- The median in urban sectors are landscaped with small tree/bushes and blooming shrubs to avoid future tree cutting when the road is upgraded further.
- All necessary measures such as siting of construction establishments away from human habitations; increase of stack height; regular maintenance of construction equipments and vehicles; etc. shall be taken up to reduce the dust and gaseous emissions during construction activities.
- The compensatory plantation shall act as the new habitat for avifauna, lesser mammals, herpetofauna & insects. List of species recommended for taking up compensatory afforestation has been presented in below tables. Local authority and populace may also be consulted for selection of species types.

- All efforts shall be made for survival of planted trees. A Memorandum of Understanding should be signed with competent authority or agency to take up the plantation.

Roadkill Possibility

The proposed road alignment is not located inside or within a 10-kilometer distance from a legally protected or key biodiversity area which was identified as the corridor of impact.

There is very little or zero possibility of road kill of major wildlife in the proposed ROW. Majority of the species, are confined only in Nokrek itself.

Allthough there is very less probability of presence of elephants or other wildlife in the area, the project team would still be proposing some mitigation measures-

Mitigation Measures:

- If any animal/wildlife is found near the construction site at any point of time, the contractor shall immediately upon discovery thereof contact authorized wildlife rescuer or Forest Dept for rescue of snakes or other distressed wildlife.
- For safety of the working force, adequate lights would be installed in labour camps and construction areas to avoid any conflict with elephants or other wildlife.
- Mandatory / Regulatory sign for entire section of project road for every 2 km at alternate side is proposed especially near Rongram Town.
- All ditches and trenches excavated during would be barricaded proper during construction and would be filled properly to avoid any accidents.
- A orientation program on wildlife and biodiversity would be organized by team for the construction workers with emphasis on important " Do's and Don'ts" and personal safety.

Table 76: Species Recommended for Plantation

Scientific Name	**Role**
AzadirachtaiIndica	Noise barrier, Pollution sink, Economic & Medicinal Value
Cassia fistula	Landscaping, Flowering plant, Pollution sink
Ficus bengalensis	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus religiosa	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Magnifera indica	Noise barrier, Pollution sink, Shed, Economic & Medicinal Value
Syzygium cumini	Pollution sink, Economic Value (fruit bearing)
Terminalia arjuna	Noise barrier, Pollution sink
Terminalia chebula	Noise barrier, Pollution sink, Shed, Economic & Medicinal Value
Alstonia scholaris	Noise barrier, Pollution sink, Shade, Supports other species
Dillenia indica	Noise barrier, Pollution sink, Shed, Economic & Medicinal Value
Mimusops elengi	Noise barrier, Pollution sink, Shed, fruit
Lagerstroemia speciosa	Landscaping, Flowering plant, Pollution sink
Bombax ceiba	Landscaping, Flowering plant, Pollution sink
Mesua ferrea	Noise barrier, Pollution sink, Shed, Economic & Medicinal Value
Neolamarckia cadamba	Noise barrier, Pollution sink, Shed, Economic & Medicinal Value

Impacts on Aquatic Ecology & Biodiversity

Impacts on the aquatic ecology during construction include increase in the silt inflow to the surface water bodies and disposal of liquid wastes and untreated sewage from construction camps and labour camps into the surface water bodies. There is no significant impact on aquatic ecology during operation stage except during accidental chemical spill in the project area entering the surrounding water bodies and proving detrimental to aquatic fauna. Contamination of the surface water due to spillage of construction material, sediment loading & increased turbidity shall result in decline in the number and diversity of aquatic flora and fauna and thus the food web species during construction period. No negative impacts are envisaged on the aquatic ecology during the operational phase. Presence of Gangetic Dolphins and Chelonia Species art documented from the Brahmaputra River system which is outside of the direct influence zone of the project site, thus there would be minimal or no impact on them .

Mitigation Measures

- Construction of road embankments shall be adhered to specified norms as per slope ratio and turfing on the slopes will reduce the embankment erosion. Construction of cross drainage structures will be taken up during lean flow period to avoid the silt inflow to the surface water bodies.
- If any aquatic animals such as turtles are found near the construction site at any point of time, the contractor shall immediately upon discovery thereof contact authorized wildlife rescuer or Forest Dept for rescue of said animals.
- No fishing should be allowed by construction workers
- Liquid wastes and sewage from the construction establishments will be treated to meet the CPCB standards before disposing it into water bodies.
- Accidental chemical spills shall be handled by emergency spill procedure such as stopping the flow; removing ignition source; initiating emergency response; cleanup and safe disposal will be followed.
- Provision for silt traps has been made at regular intervals, especially at major cross drainage structures to trap the silt before it reaches the water bodies along the subproject road.

I. Construction Stage

The construction of balanced road shall involve removal of topsoil and clearing of vegetation cover and felling of trees. However, in this project, widening and strengthening of the road does not involved acquisition of forest land. Hence diversion of forest land is not required. Though the loss of these trees is an irreversible and long-term impact, the loss of the roadside plantations shall have to be compensated in accordance to the principles of the Forest (Conservation) Act.

Impact of/ on	Extent of Impact (after Mitigation)
Biological Environment	**Δ**

II. Operation Phase

The operation phase is envisaged to have significant long-term positive impact with regard to roadside plantation. In accordance with the NGT ruling, 1:10 trees will have to be planted and maintained as part of this project. It is recommended to plant two rows of trees and shrubs on either side of the road. Large sized trees can be planted at the back and small trees or shrubs can be planted in the front in an alternate manner, between two large trees.

Impact of/ on	Extent of Impact (after Mitigation)
Biological Environment	**ΔΔΔ (Positive)**

D.10. Social Environment

Amenities and Facilities

The traffic movement will be within the constricted width available and the traffic shall be managed as per the Traffic management Plan during construction of the project road.

Mitigation Measures:

Traffic management Plan shall be developed for each area of construction with clear marking of entry and exit points, timings for loading/ unloading. The local administration should be informed of project activities and schedule.

All public utilities like electricity lines, telephone lines or water pipelines which are likely to be impacted shall be replaced before the start of work.

Some squatters shall be affected and the compensation and mitigation shall be as per the RAP prepared for the project.

Change in Land Use

The construction of the project road, bypasses and rest areas will induce a chain reaction towards change in land use. Change In land use will be sparked off as a result of land speculation. The availability of cheap labour and easy access to markets in the city will make roadside areas quite an incentive for the industrialist and hoteliers. Reduced transportation costs and availability of high-class transportation facilities for raw materials and products will be the most important advantage of the improved road.

Mitigation Measures:

Anticipating the future land use changes, the local administration should develop a master plan for this area.

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, the rapid depletion of natural resources, by means with which these areas cannot cope is a distinct possibility. Development of such vital Infrastructure will lead to over exploitation of the environmental resources (e.g. too much groundwater pumping, indiscriminate wastewater disposal, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

Mitigation Measures:

Local administration should anticipate these impacts and accordingly develop a master plan with adequately designed infrastructure.

Cultural Properties

Cultural properties lying near the ROW are most susceptible to impacts due to pre construction and construction activities. Clearing of the site during movement of road construction machinery is likely to require a belt of about 4-5m from the edge of the carriageway, which is likely to adversely impact cultural properties. Cultural properties will be subjected to varying degree of impact depending upon their placement in the ROW. Structures, which are close to the proposed CW, are likely to need relocation. The project shall directly impact some temples which have to be relocated. The construction shall also partially impact some cultural assets which shall be rehabilitated. The access of some of these cultural properties shall also be compromised.

Loss of Monuments/ Religious structures

There is no monument along the project road, which might be impacted due to the widening activity. There are 12 number of religious structuresare on the ROW of project road. Adjustment in alignment is required in order to minimize the loss to these religious structures.

Socio-Economic Profile

The impact of the improvements of project road on the socio-economic environment will be significantly beneficial. Improved access and reduced travel time and cost will be major stimuli to economic growth, particularly in rural areas. Better access of agricultural goods to market will be

important and a major contributor to poverty reduction. Increased labour mobility will occur. This has both positive and negative impacts. Increased access is a two-way phenomenon, and the corollary to increased access to the project areas is increased access for the residents of these areas to more sub-urban life-styles. Out-migration may result. There is also the likelihood of the relocation of homes and businesses to new roadside locations.

During construction, benefits to local people can be maximized if the contractor recruits construction workers locally regardless of gender. Where possible, he/she should also not discriminate in the employment of women.

Community Impacts

Community impacts are mostly due to the resettlement of people due to widening and strengthening of the project road to 4 lanes. Construction camps may put stress on local resources and the infrastructure in nearby communities resulting to people raising grievances. This sometimes leads to aggression between residents and migrant workers.

Construction Safety and Accidental Risk

Construction of the road will result in the generation of waste. In isolated places, the amount of waste generated may be greater than normal because of substandard subsoil materials, which will need to the replaced.

Debris generated on account of the above-mentioned activities if not properly disposed might give rise to health problems in the area. However, the structures to be dismantled during pre-construction phase will mainly be of semi-permanent and temporary nature and much of the waste shall be salvageable.

In case of non-local labour, labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries. These labourers hired from outside can have clashes with the local population on account of cultural and religious differences. In order to properly address public grievances, a grievance register should be maintained at site.

In and around vegetation areas if alternative fuels are not made available to the workforce, there is a likelihood that trees / branches will be cut down for cooking or heating purposes.

Unsanitary conditions in the labour camps might also result in impact on health of labourers as well as the local population. Transmission of diseases is also facilitated by the migration of people. During the construction phase work, crews and their dependents may bring with them a multitude of communicable diseases including Sexually Transmitted Diseases (STDs) like AIDS. This is more so if the nature of the project requires more male-workers, who have migrated from other parts of the state or country.

During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas. Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities. Other problems perceived during construction period is inconvenience to the local people as well as the highway passengers due to traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.

The traffic amount and speeds are likely to increase throughout the road corridors. The accident risk would tend to increase. Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas.

Mitigation measures:

- During the construction phase, contractors shall be required to adopt and maintain safe working practices. Internationally accepted and widely used safety procedures should be followed during (i) road works (ii) handling of large construction equipment and machineries, (iii) handling of chemicals and hazardous materials and inflammable substances (iii) welding (iv) electrical works etc.

- Contractor shall arrange all PPEs for workers, first aid and fire-fighting equipment's at construction sites. An emergency plan shall be prepared duly approved by engineer in charge to respond to any instance of safety hazard.
- To avoid disruption of the existing traffic due to construction activities, comprehensive traffic management plan shall be drawn up by the concessionaire. Traffic in construction zones shall be managed as per the provisions of IRC SP 55.
- After construction is completed in a particular zone, it shall be opened for normal operation. All diversions/access roads should be closed before start of normal operation.
- Use of retro-reflective traffic signs, and cantilever/gantry types overhead signs, thermoplastic road marking paints, delineators, traffic cones, empty bitumen drums, barricades, and flagmen will be used to ensure traffic management and safety. Conduct of regular safety audit on safety measures adopted during construction. The audit will cover manpower and their safety, machinery, temporary works, equipment and vehicles, materials storage and handling, construction procedures, environment, site safety guidelines, and miscellaneous services.

Risk at Hazardous Activity

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any toxic chemical, if any will be strictly in accordance with the manufacturer's instructions. The Engineer will be given at least 6 working days' notice of the proposed use of any toxic chemical. A register of all toxic chemicals delivered to the site will be kept and maintained up to date by Contractor. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, handling and storage procedures, and emergency and first and procedures for the product.

Risk of Lead Pollution

No man / woman below the age of 18 years will be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

First Aid

At every workplace, a readily available first and unit including an adequate supply of sterilized dressing material and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor heath units with one bed for every 250 workers. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided as prescribed.

Potable Water

In every workplace at suitable and easily accessible places a sufficient supply of cold potable water (as per IS:10500) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided. All water supply storage will be at a distance of not less than 15m from any latrine, drain or other source of pollution. Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well will be properly chlorinated before water is drawn from it for drinking water. All such wells will be entirely closed in and be provided with a trap door, which will be dust proof and waterproof. 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 a month.

Accidents Involving Hazardous Materials

Pre Construction and Construction Stage

During pre construction and construction stage the storage of hazardous materials such as fuel and lubricants at construction camps will be after obtaining permissions/ license from State Chief Controller of Explosives.

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.

Nuisance to Nearby Properties

Nuisance to nearby properties is likely to result from:

- noise and vibration from mechanical devices and construction plant;
- dust during quarrying, construction and the trafficking of new surfaces prior to sealing
- gaseous emissions from heavy equipment; and
- Fumes from asphalt boiling sites.

These will be of particular concern at the locations where service roads will be constructed. There will be regular watering of the road surfaces or the application of emulsion coats near villages, where dust is a nuisance. Noise generating equipment such as power generators and concrete mixers will be kept away from populated/commercial areas.

Impact of/ on	Extent of Impact (after Mitigation)
Social Environment	**+**

E. Summary of Impacts & Conclusion

In conclusion, from the results of the impact assessment it can be seen that the environmental impacts will be low or medium, if all proposed mitigation measures of the EMP are implemented. Positive impacts are related to creating of job opportunities especially during construction. The summary of Impacts are as under

Impact of/ on	Extent of Impact (after Mitigation)	
	Pre-construction / Construction Phase	Operation Phase
Meteorological Parameters	Δ	Δ
Land Environment	Δ	Δ
Air Environment	Δ	ΔΔ
GHG Emission	Δ	
Water Environment	Δ	Δ
Noise Environment	Δ	ΔΔ
Biological Environment	Δ	Δ
Social Environment	Δ	Δ

Extent of impact:

ΔΔΔ = high negative
ΔΔ = medium negative
Δ = low negative
Θ = nil
+ = locally positive
+ + = regionally positive

Based on the analysis of environmental impacts in the above sections, it can be concluded that the project is anticipated to cause the following environmental impacts:
No direct physical impact on Sensitive receptors like educational institutes during the remaining constructions.
Minimum impact on vegetation during the remaining constructions, as there are few areas where vegetation need to be removed.
No damage to Cultural and religious structures during remaining constructions is envisaged.
Whenever Construction will happen in any zone other than industrial, the ambient noise level will exceed the statutory level at a distance of 50m away from the construction zone, if no barrier is put. Hence, proper mitigation measures should be implemented.

7. Public Consultation &Information disclosure

A. Meaningful Consultation

Meaningful consultations were carried out during detailed design and Supplementary EIA preparation. All the principles of information dissemination, information solicitation, integration, co-ordination, and engagement into dialogue were incorporated in the consultation process. A framework of mitigating different environmental impacts likely from the project was strengthened and modified based on opinions of all those consulted, especially at the micro level by setting up a dialogue with the village people from whom information on site facts and prevailing conditions were collected. This will be continued during the implementation of the project through grievance redress mechanism.

B. Objectives of the Public Consultations

The process of public participation/ consultations was taken up as an integral part of the project in accordance with environmental assessment requirements. The objectives of these consultations are:

- To inform and educate the general public, specially potentially impacted communities/ individuals and stakeholders about the proposed project activities;
- To familiarize the people with technical, environmental, social and economic issues of the project for better understanding;
- To solicit the opinion of the affected communities/ individuals on environmental issues and assess the significance of impacts due to the proposed development;
- To foster co-operation among officers of PWD, the communities and the stakeholders to achieve a cordial working relationship for smooth implementation of the project;
- To identify the environmental issues relating to the road improvement work;
- Assess the views of the beneficiary communities and their willingness to participate in the project in a bottom up planning and decision making process;
- To secure people's inputs in respect of project planning, selection of mitigation measures and monitoring strategies;
- To ensure lessening of public resistance to change by providing them a platform in the decision making process;
- To inculcate the sense of belongingness among the public about the project.

C. Methodology

Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires as well as unstructured questionnaires. Questionnaire survey/ discussions were designed to obtain background information and details of general environmental issues that concern people in the project area. In addition, environmental issues were discussed with relevant organizations, government officials, beneficiaries, community leaders and experts. In addition, personal discussions with officials, on site discussion with affected stakeholders, and reconnaissance visits have also been made to the project area**.**

D. Consultation with the Gov. Officials

Consultation with Government officials like; PWD officials, Forest official, Block Development officers, Circle inspectors etc. 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

assessedand documented in Social Impact Assessment (SIA) Report**.**

E. Stakeholders Consultations

- Stakeholder Consultation & interview with key persons of the villages and surrounding area were other major sources of primary data, apart from sample Families surveys to appraise existing condition and proper perspective of Government's development schemes in operation in the area.
- The stakeholders are all the people getting affected by the project or are responsible for the project, whether directly or indirectly. The community participation programmes in social impact assessment ensured that information is disseminated to all the PAPs and other stakeholders in appropriate ways. The information dissemination has taken place in vernacular, detailing about the main project features and the entitlement framework. Due consideration has also been given to address the views of the women and vulnerable groups.
- Both primary and secondary stakeholders were identified, based on the above criteria. They were invited to take part in the consultation series and were solicited to participate in planning and implementation of the R&R programme.
- Primary stakeholders included those affected negatively or positively by the project, like the PAPs, project beneficiaries and project implementing agencies. Secondary stakeholders included other individuals and groups, with an interest in the project.
- The details of the Public Consultation with the attendance sheet are annexed as Annexure 6 and some photographes during public consultation is shown in fig. 39.

Table 77: Brief Description of Some Sample Public Consultation

Date / Place	No of Participants	Major Issues	Agreed upon	Mitigation Measures - Input to technical Design
Place: Fakirganj Bazar, 20/10/2020	Total-13 Male-13 Female-0	The existing alignment passes through the town area. It is also a junction town and many Goods vehicles passes through the town. There are both commercial and residential establishments along the alignment. It has been revealed from the Public consultations that the people on both side of the road, considering future potential in development, but afraid of road accident and menace like trafficking and HIV. Some of them also put the issue of construction of concrete drains for the development of the sewage system of the town.	Combined effort of the local authorities with the Government officials as well as the other stake holders would remove all the obstacles for development.	The local authorities also assured that they would help in development of roads project. Road safety awareness campaign should be made at schools

Date / Place	No of Participants	Major Issues	Agreed upon	Mitigation Measures - Input to technical Design
Place : Pathorkata, 24/10/2020	Total-24 Male-20 Female-4	A detailed public consultation was organized with the potential project affected persons, people's representatives, shopkeepers, businessmen, and others regarding the project benefits and vis-à-vis estimated loss. The most important topic of discussion was the alignment which passes through the two-market complex, which is fully affected. The residents with their representatives all disagree in demolishing of the market complex, partially or fully.	The local people had agreed in the view of the proposed road project which will bring some hope to the movement of the heavy vehicles and development of the area but against any damages to the market structures.	The PWD officials had agreed to take special care for traffic movement and road safety.
Place : Rajabala, 23/10/2020	Total-8 Male-8 Female-0	Detailed discussion infront of a community structure being held to understand the requirement of the affected community and their vision for the rehabilitation of the same. The perceived benefits and losses in relation to the project were also discussed and the views of the local people regarding the project were recorded. People are aware about the positive impacts of the project in terms of the improved road infrastructure and other benefits in relation to the overall communication development.	Combined effort of the local authorities with the Government officials as well as the other stake holders would remove all the obstacles for development. Road Safety will be look after	The local authorities also assured that they would help in development of road project. Road safety awareness campaign should be made at schools. There would ample signage and other road furniture to reduce the accident.
Place: Haldibari, 20/10/2020	Total-10 Male-8 Female-2	If the existing road is to be improved, there is loss of residential & commercial and religious structure. The livelihood loss of the people is apprehended. Therefore, the local people had trade of this loss for future development. The local were positive about development. As per the suggestions received through public consultation, the proposed project and its benefits is the only feasible option for development of the area.	The proposed road project is the only feasible option for development.	The people agreed to cooperate and help in all possible ways for the successful of the project.As the people are very much against the demolishing the religious structures some less PRoW would be acquired
Place : Bhaitbari, 22/10/2020	Total-48 Male-38 Female-10	People are aware about the positive impacts of the project in terms of the improved road infrastructure and other benefits in relation to the overall communication development.	The road after constructed would have major impact on both the economic and social life of the locals of the area.	The road is expected to be completed by two years.

Date / Place	No of Participants	Major Issues	Agreed upon	Mitigation Measures - Input to technical Design
Place : Nidanpur, 20/10/2020	Total-7 Male-7 Female-0	The livelihood loss of the people is apprehended. The local people want some jobs of unskilled labour and petty supplier to the Civil Contractor. The local were positive about development. As per the suggestions received through public consultation, the proposed project and its benefits is the only feasible option for development of the area.	The proposed road project is the only feasible option for development.	The people agreed to cooperate and help in all possible ways for the successful of the project. The PWD assure to provide jobs and petty contract as many as possible to the local people.
Place : Selsella, 23/07/2020	Total-14 Male-14 Female-0	It is also a junction town and many Goods vehicles passes through the town. There are both commercial and residential establishments along the alignment. Some of them also put the issue of construction of concrete drains for the development of the sewage system of the town.	Combined effort of the local authorities with the Government officials as well as the other stake holders would remove all the obstacles for development.	The local authorities also assured that they would help in development of roads project. Road safety awareness campaign should be made at schools
Place: Babadam, 24/07/2020	Total-11 Male-6 Female-5	The youths were also explained in detail about the projects and their entitlements about trainings. The conception and myths regarding the developmental works were also noted. The main point of discussion was health and education which is poor in the area due to lack of communication.	The proposed road project is the only feasible option for development.	The people agreed to cooperate and help in all possible ways for the successful of the project.
Place: Chambagiri, 20/10/2020 **Female FGD**	Total-6 Male-0 Female-6	Focus Group discussion with the Female population reveals that there is need for training of the locals in handicrafts mainly weaving. During discussion it has been observed that skills of weaving, tailoring, making of small artefacts of bamboo are almost at a dead end. The local females want the Executing Agency to take care of the proper training and marketing of the same. The female participants apprehend about the increase in the number of road accidents.	The female participants apprehend about the increase in the number of road accidents and would be dangerous to the children and students who usually not careful using the roads	It has been suggested to make traffic safety awareness campaign at the schools and localities. It is also learnt that a NGO would be recruited for developing the awareness of the people of PIA regarding, trafficking, gender issues and other social stigmas.

Date / Place	No of Participants	Major Issues	Agreed upon	Mitigation Measures - Input to technical Design
Place : Chakchakia Hat, 23/10/2020	Total-16 Male-10 Female-6	The town is basically a trading hub. The cultivators as well as the traders are concern of selling their agricultural and industrial output at proper price Though the town lacks in many infrastructural facilities, but they think that with better communication there would be economic development their prosperity. All other issues would be solved automatically.	The road after constructed would have major impact on both the economic and social life of the locals of the area.	The road is expected to be completed by two years and being look as a positive step to future.
Place : Thombolagiri, 25/10/2020	Total-31 Male-31 Female-0	It is also a junction town and many Goods vehicles passes through the town. There are both commercial and residential establishments along the alignment. Some of them also put the issue of construction of concrete drains for the development of the sewage system of the town.	The local people had agreed in the view of the proposed road project which will bring some hope to the movement of the heavy vehicles and development of the area but against any damages to the market structures.	The local authorities also assured that they would help in development of roads project. Road safety awareness campaign should be made at schools
In addition to the above specific public consultations and FGDs the peoples were also consulted. In the villages the impact of social and economic are more. In all the villages the access to the market would increase and based on this the valuation of land and properties would also increase. Detailed public consultation are given in Section 7.11				

Public consultation at Syamnagar

Public Consultation at Pabomari

Public Consultation at Mokbolkholgre

Public Consultation at Humaijhura

Public Consultation at Humaijhura

Public Consultation at Uttar Balachanda

Public Consultation at Simbokolgre

Public Consultation at Belbari

Figure 39: public consultations at different locations along the project road

F. Major outcome of Public 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 and other inventory survey were already in progress and they have already interacted with them.
- According to local people poor condition of the existing road is a major issue of transport.
- According to local people water logging during rainy season is one of the major issues along the project road.

- Community consultations will help to avoid opposition to the project, which is otherwise likely to occur at any stage or time.
- Villagers also expressed their concern related to unavailability of drinking water, power supply, medical facilities, public toilets, drainage system 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.
- 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**.**

8. Environment Management and Monitoring Plan

A. Introduction

Environmental impacts could be positive or negative, direct or indirect, local or regional and also reversible or irreversible. The impacts generated during Pre-construction /Design stage, construction and operational stage of the road, along with management plan for these impacts has been discussed in this section. Environmental management considerations in the form of EMP have been designed for project activities based on the client's requirement. The plan outlines existing and potential problems that may impact the environment and recommends corrective measures wherever required. Enhancement measures are also proposed in order to provide good environmental practices and improve the aesthetics of the project area.
This EMP consists of a set of mitigation, monitoring and institutional measures to be taken up for the project to avoid, minimize and mitigate adverse environmental impacts and enhance positive impacts. The plan also includes the actions needed for the implementation of these measures. The major components of the Environmental Management Plan are:

- Mitigation of potentially adverse impacts;
- Monitoring of EMP implementation during project implementation and operation; and
- Institutional arrangements to implement the EMP

The environmental management measures shall be implemented during the various stages of the project viz: Pre-construction/Design stage, Construction stage and Operational stage.

B. Objectives Of Environment Management Plan

The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction and operational phases of the project to eliminate adverse environmental impacts, to offset them, or to reduce them to acceptable levels. The main aim of the Environmental Management Plan is to ensure that the various adverse impacts are mitigated and the positive impacts are enhanced. The main objectives of this EMP are:

- To formulate avoidance, mitigation and compensation measures for anticipated adverse environmental impacts during construction and operation, and ensure that environmentally sound, sustainable and good practices are adopted;
- To stipulate monitoring and institutional requirements for ensuring safeguard compliance; and
- The project road should be environmentally sustainable.

Environmental management measures shall be implemented during the various stages of the project viz: Pre-construction stage, Construction stage and Operational stage.

C. Pre-Construction Stage

C.1. Pre-construction activities by the Authority/ Consultant

Prior to the contractor mobilization, the PIU will ensure that an encumbrance free Corridor is handed over to enable the start of construction. Clearance involves the following activities:

- Removal and felling of trees, which is very minimal;
- Relocation of common property resources and utilities like telephone poles, electric poles and hand pumps;

- Formal arrangements for maintenance of enhancement sites. This includes plantation of trees and barricades along the road; and
- Modification (if any), of the contract documents by the Engineer of the Independent Consultant.

C.2. Pre-construction Activities by Contractor

Pre-construction stage involves mobilisation of the Contractor and the activities undertaken by the Contractor pertaining to the planning of logistics and site preparation necessary for commencing construction activities. The activities include:

- Joint field verification by the Environment Specialist of the Independent Consultant and Contractor to check the different applicable component of EMP.
- Identification and selection of material sources (quarry and borrow material, water, sand etc).
- Procurement of construction equipment / machinery such as crushers, hot mix plants, batching plants and other construction equipment and machineries.
- Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
- Apply for and obtain all the necessary clearances/ NOC's/ consents from the agencies concerned.
- Planning traffic diversions and detours including arrangements for temporary land acquisition.

D. Construction Stage

D.1. Construction Activities by the Contractor

Construction stage is the most crucial stage in terms of activities that require careful management to avoid environmental impacts. There are several other environmental issues that have been addressed as part of good engineering practices, the costs for which have been accounted for in the Engineering Costs.

D.2. Construction Activities by the Authority/ Consultants

The PIU/Consultant shall be involved in the smooth execution of the project and assisting the contractor during this phase. Their work shall include but not limited to:

- Monitoring and guiding the contractor for the implementation of EMP and EMoP during construction stage;
- Monitoring and guiding the contractor on adopting good environmental and engineering practices;
- Arrangement of plantation through the Forest Department;
- Arranging training to the contractor and other stakeholders according to the needs rising; and
- To make changes in the design if need so arises.

E. Operation Stage

The operational stage involves the following activities by the Authority Monitoring of environmental conditions through approved monitoring agency; and Monitoring of operational performance of the various mitigation/enhancement measures carried out. In this project operation phase is considered for 2 years.

F. Environment Management Plan

The Environmental Management Plan indicating the issues, management measures, locations and responsibility matrix is presented in the below table.

Table 78: Environment Management Plan

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
PRE-CONSTRUCTION STAGE							
P1	Alignment,	• The alignment as finalized by shifting / adjusting the centreline of the road, adopting of suitable cross-sections and adjustment of the median width to minimize land acquisition, loss of settlements and to avoid environmentally sensitive features compatible with project activities.	Interaction with concerned utility authorities and local public	Included under DPR	Throughout Corridor	PIU, Revenue Dept. NGOs Collaborating Agencies	**-**
P2	Land Acquisition	• The acquisition of land and private properties will be carried out in accordance with the RAP and entitlement framework for the project. It will be ensured that all R & R activities including implementation of Environment Management Plan are completed before the start of work. • PIU has to ascertain that any additional environmental impacts resulting from acquisition of land are addressed and integrated into the EMP and other relevant documents.	Review final design.	Included under DPR	Throughout Corridor	PIU, Revenue Dept. NGOs Collaborating Agencies	-
P3	Preservation of Trees	• All efforts will be made to preserve trees including evaluation of minor design adjustments/ alternatives to save trees. Specific attention will be given for protecting giant trees, and locally	Check budget provision for compensatory and additional	Covered under costs for DPR consultants	Throughout Corridor	PIU Forest Department Contractor	-

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		important trees (religiously important etc.). • Tree cutting is to proceed only after all the legal requirements including attaining of In-principle and formal Clearances from the Forest Dept./ MoEF& CC are completed and subsequently a written order is issued to the Contractor. • 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.	plantation.				
P4	Relocation of Utilities and Common Property Resources (CPR)	• All utilities and CPRs i.e., water supply lines, religious structures, hand pumps will be relocated before the construction starts. **There are 5 educational institute (ref to Table 47), 2 religious stractureand (ref to Table 49) no health (ref to** • Table 48) care center comes on the ROW • The PIU will relocate these properties in consultation and written agreement with the agency/ owner/community. • Environmental considerations with suitable/required actions including health and hygiene aspects will be kept in mind	Interaction with concerned utility authorities and local public	Part of Administrative and resettlement costs	Throughout Corridor	PIU Concerned Agencies Contractor	-

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		while relocating all utilities and CPRs.					
P5	Orientation of Implementing Agency and Contractors	• The PIU shall organize orientation sessions and regular training sessions during all stages of the project. This shall include on-site training (general as well as in the specific context of the sub-project). • These sessions shall involve all staff of Authority Engineer, field level implementation staff of PIU and Contractor. The contractor will ensure that his staff including engineers, supervisors and operators attend the training sessions.	-	Covered under costs for DPR consultants	Throughout Corridor	Contractor	PIU
P6	Joint Field Verification	• The Environmental Expert of AE and the Contractor will carry out joint field verification to ascertain any additional possibility to saving trees, environmental and community resources. • The verification exercise should 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.	-	Covered under costs for DPR	Throughout out Corridor	Contractor Environmental Expert of AE	PIU
P7	Assessment of Impacts due to	• The Environmental Expert of AE will assess impacts and revise/ modify the	Review of detail design	Covered under	Throughout out Corridor	Contractor Environmental	PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
	Changes/Revisions/Additions in the Project Work	EMP and other required sections of the project documents in the event of changes/ revisions (including addition or deletion) in the project's scope of work.	documents & drawings and comparison with site conditions	costs for DPR		Expert of AE	
P8	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 Km away from the nearest village/ settlement preferably in the downwind direction. • The Contractor shall submit a detailed layout plan for all such sites and approval of Environmental Expert of AE/PMC shall be 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 "PIU through Environmental Expert of AE/PMC. • The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.			Throughout out Corridor	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		The engineer will ensure that the regulatory and legal requirements are being complied with.					
P9	Other Construction Vehicles, Equipment and Machinery	• All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Indian Standard (IS) 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) Rules, 1986. • The Contractor shall maintain a record of PUC for all vehicles and machinery used during the contract period, which shall be produced for NH verification whenever required. • Mobile equipment shall be placed at least 100 m away from the nearest dwelling.	Site observation	Included in civil works cost.	Throughout out Corridor	Contractor	Environmental Expert of AE and PIU
P10	Borrow Areas	• Finalizing borrow areas for borrowing earth and all logistic	Review of design	Included in civil works cost	Along the Project	Contractor	Environmental Expert of AE

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		arrangements as well as compliance to environmental requirements, as applicable, will be the sole responsibility of the contractor. • The Contractor will not start borrowing earth from selected borrow areas until the formal agreement is signed between landowner and contractor and a copy is submitted to the PIU/Environmental Expert of AE through the Engineer. • Locations finalized by the contractor shall be reported to the Environmental Expert of AE and who will in turn report to PIU. • Planning of haul roads for accessing borrow 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 as per Borrow Area Rehabilitation Guidelines) and will use the existing village roads wherever available. • In addition to testing for the quality of borrow materials by the AE, the environmental personnel of the AE will be required to inspect every borrow area location prior to approval • The AE will make sure that each such site is in line with IRC and other	documents, contractor documents and site observation		Influence Area		and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		project guidelines. • Necessary clearances need to be obtained prior to operation of Borrow areas.					
P11	Setting up construction camps	• Camps shall be located at least 500m away from the nearest built-up area. • Sewage system for a construction laborer's camp shall be designed, built and operated so that no pollution to ground or adjacent water bodies/watercourses take place. • Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. • In relation to underground water resources, the contractor shall take all necessary precaution to prevent interference with such water resources. • All relevant provisions of the Factories Act, 1948 and the Building And other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	Review of design documents, contractor documents and site observation	Included in civil works cost	All construction campsite identified by the contractor	Contractor	Environmental Expert of AE and PIU
P12	Quarry	• Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials, quality and other logistic arrangements. • In case the contractor decides to	Review of design documents, contractor documents and site observation	Included in civil works cost	Along the Project Influence Area	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		use quarries other than recommended by DPR consultants, then it will be selected based on the suitability of the materials and as per established law. • 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 PIU through Engineer. • Contractor will also work out haul road network and report to Environmental Expert of AE and will inspect and in turn report to PIU before approval.					
P13	Arrangement for Construction Water	• To avoid disruption/disturbance to other water users, the contractor will extract water from fixed locations and consult the Environmental Expert of AE before finalizing the locations. • 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 AE and PIU prior to initiation of any construction work.	Checking of documentation and Talk to local people	Included in civil works cost	Along the Project Road	Contractor	Environmental Expert of AE and PIU
P14	Labor	• The contractor preferably will use	Interaction with	Included in	Along the	Contractor	Environmental

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
	Requirements	unskilled labor from local communities to give the maximum benefit to the local community.	Local people	civil works cost	Project Area		Expert of AE and PIU
P15	Construction Camp Locations – Selection, Design and Lay-out	• Sitting of the construction camps will be selected by the contractor as per the guidelines. • Construction camps will not be proposed within 500 m 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 1000 m from watercourses. • The waste disposal and sewage system for the camp will be designed, built and operated such that no odor is generated.	Review of design documents and site observation	Included in civil works cost	Along the Project Road	Contractor	Environmental Expert of AE and PIU
P16	Arrangements for Temporary Land Requirement	• The contractor 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 Contractor will submit a copy of agreement to the Environmental Expert of AE. The Environmental Expert 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	Check LA records; design drawings vs. land plans;	Part of Administrative and resettlement costs	Along the Project Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		activity) is included in the contract.					
P17	Implementation - Information Meetings	• The contractor will organize at least 2 implementation information meetings in the vicinity of Project Site (minimum one in each section) for general public to consult and inform people about his plans covering overall construction schedule, safety, use of local resources (such as earth, water), traffic safety and management plans of debris disposal, drainage protection during construction, pollution abetment and other plans, measures to minimize disruption, damage and in convenience to roadside users and people along the road. • The first Implementation information meeting be conducted within four weeks of mobilization. The people should be informed about the date, time and venue at least 7 days prior to meetings. Public shall be informed about the meeting through display of posters at prominent public places (panchayat offices, offices of Market committees, Notice board of religious places etc.) and distribution of pamphlets along roadside communities or in any manner deemed fit. • The contractor will maintain a channel of communication with the communities through his designated	-	Covered under costs for DPR consultants	Along the Project Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		Environment and Safety Officer to address any concern or grievances. • Periodic meetings will also be conducted during the construction period to take feedback from communities or their representatives to ensure minimum disturbance. The mechanism and contents for disclosure shall be approved by PIU prior to the meetings.					
		CONSTRUCTION STAGE					
C1	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 from the Environmental Expert of AE. • During construction, at any point in time, if rare / threatened / endangered floraspecies is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineershallapprovedetailed conservation processes, plans and designsas well as associated modification in the project design. • The Contractor under any	Review of relevant documents tree cutting permit, compensatory plantation plan	compensatory plantation cost is included in section 4.2 of Table 81	Along the work in progress	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		circumstances will not cut trees other than those identified for cutting and for which he has written instructions from the PIU. The PIU will issue these instructions only after receiving all stages of clearances from the Forest Department/ MoEF& CC. • Vegetation only with girth of over 30 cm will be considered as trees and shall be compensated, in the event of PIU's instruction to undertake tree cutting. • The sub grade of the existing pavement shall be used as embankment fill material. • The existing base and sub-base material shall be recycled as sub-base of the haul road or access roads. • The existing bitumen surface may be utilized for the paving of cross roads, access roads and paving works in construction sites and campus, temporary traffic diversions, haulage routes etc.					
C2	Disposal of debris from dismantling structures and road surface	• The contractor shall identify disposal sites. The identified locations will be reported to the Environmental Expert of AE. These locations will be checked on site and accordingly approved by Environmental Expert of AE prior to any disposal of waste materials. • All arrangements for transportation during construction including	Field surveyandinteraction withlocalpeople.Reviewof consentletter	Included in civil works cost.	Along the work in progress	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		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 Environmental Expert of AE. • 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 Environmental Expert of AE. • Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area. Guidelines for management of Debris Disposal site is attached in Annexure 17.					
C3	Other Construction Waste Disposal	• The pre-identified disposal locations will be a part of Comprehensive Waste Disposal Management Plan to be prepared by the Contractor in consultation and with approval of Environmental Expert of AE. Location of disposal sites will be finalized prior to initiation of works on any particular section of the road. • The Environmental Expert of AE will approve these disposal sites after conducting a joint inspection on the site	Check Contractor Records. Field observation	Included in civil works cost.	Along the Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		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 (if so desired by the owner/community and approved by the Environmental Expert of AE). • All waste materials will be completely disposed and the site will be fully cleaned and certified by Environmental Expert of AE before handing over. Guideline for waste disposal and management is attached in annexure 13. • 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.					
C4	Stripping, stocking and preservation of top soil	• The topsoil from all areas of cutting and all areas to be permanently covered 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	Site observation	Included in civil works cost.	Along the Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		piling will be pre-identified in consultation and with approval of Environmental Expert of AE.Guideline for soil conversation and reuse is attached in annexure 18. The following precautionary measures will be taken to preserve them till they are used: • 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. • 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. • 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 only in case where these are to be rehabilitated as farm lands (not those in barren areas) • top dressing of the road embankment and fill slopes, • filling up of tree pits, in the median					

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		and in the agricultural fields of farmers, acquired temporarily.					
C5	Accessibility	• The contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project road, providing temporary connecting road. • The contractor will take care that schools and religious places are accessible to Public. The contractor will also ensure that the work on / at existing accesses will not be undertaken without providing adequate provisions and to the prior satisfaction of Environmental Expert of AE. • The contractor will take care that the cross roads are constructed in such a sequence that construction work over the adjacent cross roads are taken up one after one so that traffic movement in any given area not get affected much.	Review traffic Management plan Field observation of traffic management and safety system	Included in Civil work cost	Along the Road	Contractor	Environmental Expert of AE and PIU
C6	Planning for Traffic Diversions and Detours	• Temporary diversions will be constructed with the approval of the Resident Engineer and Environmental Expert of AE for which contractor will seek prior approval for such plans. • Detailed Traffic Control Plans will be prepared and submitted to the Resident Engineer for approval, seven days prior to commencement of works on any section of	Review traffic Management plan Field observation of traffic management and safety system	Included in Civil work cost	Along the Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		road. The traffic control plans shall contain details diversions; traffic safety arrangement during construction; safety measures for night – time traffic and precautions for transportation of hazardous materials. Traffic control plans shall be prepared in line with requirements of IRC's SP- 55 document and 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 AE and PIU. 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).					
C7	Earth from Borrow Areas for Construction	• No borrow area will be opened without permission of the Environmental Expert of AE. The location, shape and size of the designated borrow areas will be as approved by the Environmental Expert of AE and in accordance to the IRC recommended practice for borrow pits for road embankments (IRC 10: 1961). The	Review of design documents and site observations	Included in civil works cost	Borrow Areas	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		borrowing operations will be carried out as specified in the guidelines for sitting and operation of borrow areas. Borrow area management guideline is attached in annexure 11. • 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 Environmental Expert of AE 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 Environmental Expert of AE. • The final rehabilitation plans will be approved by the Environmental Expert of AE.					
C8	Quarry Operations	• The contractor shall obtain materials from quarries only after the consent of the Department of Mining /	Review of design documents and	Included in civil works cost	Quarry Areas	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		SPCB (both the states) / District Administration or will use existing approved sources of such materials. Copies of consent/ approval/ rehabilitation plan for opening a new quarry or use of an existing quarry source will be submitted to Environmental Expert of AE and the Resident Engineer. • The contractor will develop a Comprehensive Quarry Redevelopment plan, as per the Mining Rules of the state and submit a copy to PIU and AE prior to opening of the quarry site. Guideline for siting operation and re-development of quarry operations is attached in annexure 16. • The quarry operations will be undertaken within the rules and regulations in force in the state.	site observations				
C9	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, which are part of the	On site observation Interaction with workers and local community	Included in civil works cost	All Roads Used	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		works, 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 with specific attention to the settlement areas. • The unloading of materials at construction sites/close to settlements will be restricted to daytime only.					
C10	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 'PIU' through the Engineer. • The contractor will source the requirement of water preferentially from ground water but with prior permission from the Central Ground Water Board. A copy of the permission will be submitted to 'PIU' through the Engineer prior to initiation of construction. • The contractor will take all precaution to minimize the wastage of water in the construction process/ operation.	Checking of Documentation and talk to local people	Included in civil works cost	Along the Project	Contractor	Environmental Expert of AE and PIU
C11	Disruption to Other Users of	• While working across or close to any perennial water bodies, contractor will	Checking of Documentation	Included in civil works cost	All Water Bodies Used	Contractor	Environmental Expert of AE

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
	Water	not obstruct/ prevent the flow of water. • Construction over and close to the perennial streams shall not be undertaken in any season. • The contractor will take prior approval of the River Authority or Irrigation Department for any such activity. The PIU and the Engineer will ensure that contractor has served the notice to the downstream users of water well in advance.	and talk to local people				and PIU
C12	Drainage	• Contractor will ensure that no construction materials like earth, stone, ash or appendage is disposed off in a manner that blocks the flow of water of any water course and cross drainage channels. Contractor will take all-necessary measures to prevent any blockage to water flow. In addition to the design requirements, the contractor will take all required measures as directed by the Environmental Expert of AE and the 'Resident Engineer' to prevent temporary or permanent flooding of the site or any adjacent area. • To maintain the surface water flow/drainage, proper mitigation measures will be taken along the road, like: i. Drainage line will be constructed all along the project road. ii. Good engineering and construction	Review of design documents	Included in civil works cost	Drainage line along the road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		practice should be followed Use of sediment traps, silt fencing, oil and grease turfing etc. to minimise of the soil movement. Guideline for sediment control is attached in annexure 22.					
C13	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 water bodies (including wells) adjacent to the ROW 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. in present case three Sedimentation Cum Grease Trap are proposed, However the item has been kept in case need arises during construction. • Enhancement of road side ponds,	Field observation	Included in civil works cost	All Surface Water Bodies Along the Road	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		mostly big ponds; ch10+100km, ch 10+200, ch 11+500km, ch 16+100km, ch 17+700km, ch 22+400km, ch 44+700km, ch 54+800km and ch 55+600km) should be considered. • Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby watercourse.					
C14	Slope Protection and Control of Soil Erosion	• The contractor will take slope protection measures as per design, or as directed by the Environmental Expert of AE to control soil erosion and sedimentation. • 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. Guidelines for slope stabilisation is given in Annexure 19. • Contractor will ensure the following aspects: 1.During construction activities on road embankment, the side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. 2.Turfing works will be taken up as soon as possible provided the season is favourable	Review of design documents and site observation	Included in civil works cost	Along the Roads	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		for the establishment of grass sods. Other measures of slope stabilization will include mulching netting and seeding of batters and drains immediately on completion of earthworks. 3.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. 4.Along sections abutting water bodies, stone pitching as per design specification will protect slopes.					
C15	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. • All waste arising from the project is to be disposed off in the manner that is acceptable and as per norms of the State Pollution Control Board.	Review of Monitoring data maintained by contractor	Included in monitoring cost (ref. Table 80)	Along the road	Contractor	Environmental Expert of AE and PIU
C16	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	Review of Monitoring data maintained by contractor	Included in monitoring cost (ref. Table 80)	Along the Roads	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		canal/ponds. • All location and layout plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Environmental Expert of AE and PIU. • 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. • Oil and grease traps will be provided at fuelling locations, to prevent contamination of water. • 'Oil interceptors' shall be provided in wash down areas and re-fuelling areas • In all, fuel storage and refuelling areas, if located on agricultural land or areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage. • Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to AE and PIU) and					

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		approved by the Environmental Expert of AE. All spills and collected petroleum products will be disposed off in accordance with MoEF&CC and state PCB guidelines. • Environmental Expert of AE and Resident Engineer' will certify that all arrangements comply with the guidelines of PCB/ MoEF&CC or any other relevant laws.					
C17	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 1 km 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 40m from a unit located in a cluster should be less than 500 g/m3. The pollution monitoring is to be conducted as per the monitoring plan. • Alternatively, only crushers licensed by the SPCB shall be used. Required certificates and consents shall be	Standards CPCB methods Observations Review of Monitoring data maintained by contractor	Included in monitoring cost (ref. Table 80)	Along the Roads, Construction Site/ Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		submitted by the Contractor in such a case to the Environmental Expert of AE through the 'Engineer'. • Dust screening vegetation will be planted on the edge of the ROW for all existing roadside crushers. Hot mix plant will be fitted with dust extraction units.					
C18	Emission from Construction Vehicles, Equipment and Machineries	• 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 SPCB. • The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Monitoring results will also be submitted to 'PIU' through the 'Engineer'.	Standards CPCB methods Review of monitoring data maintained by contractor	Included in monitoring cost (ref. Table 80)	Along the Roads , all vehicles used/ Camps	Contractor	Environmental Expert of AE and PIU
C19	Noise Pollution: Noise from Vehicles, Plants and Equipments	• The Contractor will confirm the following: • All plants and equipment used in construction shall strictly conform to the MoEF& CC/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	As per Noise rule, 2000 Consultation with local people and Review of noise level monitoring data maintained by contractor Observation of construction site	Included in monitoring cost (ref. Table 80)	Along the Roads , all vehicles used/Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		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 to keep noise levels at the minimum. • At the construction sites within 150 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 construction activities will be permitted around educational institutes/health centres (silence zones) up to a distance of 100 m from the sensitive receptors i.e., school, health centres and hospitals between 10.00 pm to 6.00 am. • Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to Environmental Expert of AE through the 'Engineer'.					

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
C20	Personal Safety Measures for Labour	• Noise barriers / trees will be planted along the road especially in front of sensitive locations, for such mitigation measure. the boundary wall should be 50 m. before and after the sensitive locations. • Contractor will provide: • Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc. • Welder's protective eye-shields to workers who are engaged in welding works • Protective goggles and clothing to workers engaged in 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. • The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the	Site observation Review records on safety training and accidents. Interact with construction workers	Included in civil works cost	Along the Roads , all vehicles used/Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract.Guideline to ensure worker's safety during construction is attached annexure 20. • 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 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					

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		be prepared by the Contractor during mobilization and will be approved by AE and PIU.					
C21	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 Environmental Expert of AE and 'Resident Engineer' for the information and protection of traffic approaching or passing through the section of any existing cross roads. Proper guideline of traffic management plan is attached in annexure 21. • The contractor will ensure that all signs, barricades, pavement markings are provided as per the MOSRT&H 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 Environmental Expert of AE and ' Resident Engineer'	Review trafficmanagem entplanField observationof trafficmanagem entandsafety system	Included in civil works cost	Along the Roads , all vehicles used/Camps	Contractor	Environmental Expert of AE and PIU
C22	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	Fild observation and interaction with construction workers.	Included in civil works cost	Along the Roads	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		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 'Resident Engineer'.					
C23	Risk at Hazardous Activity	• All workers employed on mixing Asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. • The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working days' notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site	Field survey and interaction with local people.	Included in civil works cost	Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		shall be kept and maintained up todateby the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures forthe product. This should comply with Hazardous Material Act.					
C24	Risk of Lead Pollution	• Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. • Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	Field survey and interaction with local people.	Included in civil works cost	Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU
C25	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.Guidelines for emergency	Site observation and Review records on safety training	Included in civil works cost	Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		management system is attached in annexure 12.					
C26	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 • Equipment and trained nursing staff at construction camp.	Interact with construction workers	Included in civil works cost	Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU
C27	Informatory Signs and Hoardings	• The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required as per IRC and MoRT&H specifications.	Site observation	Included in civil works cost	Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU
C28	Road side Plantation Strategy	• The contractor will do the plantation at median and/or turfing at embankment slopes as per the tree plantation strategy prepared for the project. • Minimum 90 percent survival rate of the saplings will be acceptable otherwise the contractor will replace dead plants at his own cost. The contractor will maintain the plantation till they handover the project site to NHAI. • Environmental Expert of AE will	Review of relevant documents tree cutting permit, compensatory plantation plan	Included in the environmental budget (Ref: Table 81)	Along the Roads	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		inspect regularly the survival rate of the plants and compliance of tree plantation guidelines.					
C29	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) including fishing in any water body and hunting of any animal. • If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Environmental Expert of AE and carry out the AE instructions for dealing with the same. • Environmental Expert of AE 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. • All efforts during the design stage should be made to minimize the tree felling requirement • Compensatory plantation should be started during construction phase parallel to the construction activities. . Guideline for tree plantation is attached in annexure 10.	Field observations	Included in civil works cost	Along the Roads	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
	Pedestrians, animal movement	• Monitoring of tree felling along the road • Temporary access and diversion, with proper drainage facilities. • Access to the schools, temples and other public places must be maintained when construction takes place near them. • Fencing wherever cattle movement is expected. • If any animal/wildlife is found near the construction site at any point of time, the contractor shall immediately upon discovery thereof contact authorized wildlife rescuer or Forest Dept for rescue of snakes or other distressed wildlife.	Field observation Interaction with local people	Included in civil works cost	Near habitation on both sides of schools, temples, hospitals, graveyards,construction sites, haulage roads, diversion sites.	Contractor	Environmental Expert of AE and PIU
C30	Chance Found Archaeological Property	• All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. • The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Environmental Expert of AE of such discovery and carry out the AE instructions	Check LA records; design drawings vs. land plans;	Included in civil works cost	Along the Roads, construction sites/Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		for dealing with the same, waiting which all work shall be stopped. • The AE will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.					
C31	Labour 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 AE and 'PIU' prior to their construction. • The construction will commence only upon the written approval of the Environmental Expert of AE. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the AE. • The construction camps will be located away from the habitation as discussed in chapter 3 (project description, section F). guideline for siting construction camp is given in annexure 15. • The sewage system for such	On site observation Interaction with workers and local community	Included in civil works cost	Along the Roads, construction Camps/site	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		camps will be properly designed and built so that no water pollution takes place in adjacent canals					
C30	Potable Water	• The Contractor will construct and maintain all labour 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 Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. • Testing of water will be done as per parameters prescribed in IS 10500:1991.	Review of design documents and site observation	Included in civil works cost	Along the Roads, construction Camps/construction site	Contractor	Environmental Expert of AE and PIU
C31	Sanitation and Sewage System	• The contractor will ensure that - • the sewage system for the camp are designed, built and operated in such 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			Along the Roads, construction Camps/Construction Sites	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
C32	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 Environmental Expert of AE. • Unless otherwise arranged by 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 Environmental Expert of AE will have to be provided by the contractor.			Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU
C33	Consultation	• The Environmental Expert of AE will contact the responsible people with the enhancement drawing of the site for which enhancement has been proposed and take their consent before the start of work. • Accesses to Different Schools along the road will be developed to the satisfaction of 'PIU'.			Along the Roads	Contractor	Environmental Expert of AE and PIU
C34	Clean-up Operations, Restoration and Rehabilitation	• Contractor will prepare site restoration plans, which will be approved by the Environmental Expert of AE. 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			Along the Roads, construction Camps	Contractor	Environmental Expert of AE and PIU

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		Comprehensive Waste Management Plan and as approved by AE. • All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed in pre identified approved areas or in places suggested by the Environmental Expert of AE areas in a layer of thickness of 75 mm-l50 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 to the Environmental Expert of AE and PIU will certify in this regard.					
		OPERATION STAGE					
O1	Air pollution due to vehicular movement	• Compensatory tree plantations shall be maintained as prescribed by forest department.80% survival rate for additional plantation shall be maintained • Regular maintenance of the road will be done to ensure good surface condition • Ambient air quality monitoring. If monitored parameters exceeds prescribed limit, suitable control measures must be taken.	As per CPCB requirements	Included in Operation/ Maintenance cost (Ref: Table 81)	Throughout the Corridor	PIU	**PIU**

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		• Signages shall be provided reminding the drivers/road users to properly maintain their vehicles to economize on fuel consumption. • Enforcement of vehicle emission rules in coordination with transport department or installing emission checking equipments					
O2	Noise due to movement of traffic	• Effective traffic management and good riding conditions shall be maintained • Speed limitation and honking restrictions near sensitive receptors. • Construction of noise barriers near sensitive receptors with consent of local community • The effectiveness of the multilayered plantation should be monitored and if need be, solid noise barrier shall be placed. • Create awareness amongst the residents about likely noise levels from road operation at different distances, the safe ambient noise limits and easy to implement noise reduction measures while constructing a building near road.	Noise monitoring as per noise rules ,2000 Discussion with people at sensitive receptor sites	Included in Operation/ Maintenance cost (Table 81)	At Sensitive receptors	PIU	**PIU**
O3	Soil erosion at embankment during heavy rainfall.	• Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching, river training structures etc. • Necessary measures to be	On site observation	Included in Operation/ Maintenance cost	At bridge locations and embankment slopes and other probable	PIU	**PIU**

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
		followed wherever there are failures			soil erosion areas.		
O4	Siltation/ Contamination	• Regular visual checks shall be made to observe any incidence of blockade of drains. Regular checks shall be made for soil erosion. • Monitoring of surface water bodies	On site observation	Included in Operation/ Maintenance cost	Near surface Waterbodies	PIU	**PIU**
O5	Water logging due to blockage of drains,culverts or streams	• Regular visual checks and cleaning (at least once before monsoon) of drains to ensure that flow of water is maintained through cross drains and other channels/streams. • Monitoring of water borne diseases due to stagnant water bodies	On site observation	Included in Operation/ Maintenance cost	Near surface Water bodies/cross drains/side drains	PIU	**PIU**
O6	Vegetation	• Planted trees, shrubs, and grasses to be properly maintained. • The tree survival audit to be conducted at least once in a year to assess the effectiveness	Records and field observations. Information from Forestry Department	Included in Operation/ Maintenance cost	Project tree plantation sites	PIU	**PIU**
O7	Accident Risk due to uncontrolled growth of vegetation	• Maintain shoulder completely clear of vegetation. • Minimum offset as prescribed in IRC:SP:21-2009 to be maintained • Regular maintenance/trimming of plantation along the roadside • No invasive plantation near theroad.	Visual inspection and check accident records	Included in Operation/ Maintenance cost	Throughout the project stretch	PIU	**PIU**
O8	Accident risk	• Traffic control measures,	Review accident	Included in	Accidents	PIU	**PIU**

Sl. No.	Environmental Issue	Management Measures	Monitoring Methods	Mitigation Costs	Location	Responsibility	
						Planning and Execution	**Supervision/ Monitoring**
	associated with traffic movement.	including speed limits, will be forced strictly. • Further encroachment of squatters within the ROW will be prevented. • No school or hospital will be allowed to be established beyond the stipulated planning line as per relevant local law • Monitor/ensure that all safety provisions included in design and construction plan • seareproperlymaintained • Highway patrol unit(s) for round the clock patrolling. Phone booth for accidental reporting and ambulance • services with minimum response time for rescue of any accident victims, if possible. • Tow-way facility for the break down vehicles if possible.	records	Operation/ Maintenance cost	prone areas		
O9	**Transport of Dangerous Goods**	• **Existence of spill prevention and control and emergency responsive system** • **Emergency plan for vehicles carrying hazardous material**	**Review of spill prevention and emergency response plan Spill accident records**	**Included in Operation/ Maintenance cost**	**Throughout the project stretch**	**PIU**	**PIU**

AE: Authority Engineer, PIU: Project Implementation Unit

G. Environmental Monitoring Program

The purpose of the monitoring program is to ensure that the envisaged purpose of the project is achieved and results in desired benefits to the target population. To ensure the effective implementation of the Environmental Management Plan (EMP), it is essential that an effective monitoring program should be designed and carried out. The environmental monitoring program provides such information based on which management decision may be taken during construction and operational stages. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect.

G.1 Objective of Monitoring Program

The Objectives of environmental monitoring program are-

- E valuation of the efficiency of mitigation and enhancement measures;
- U pdating of the actions and impacts of baseline data;
- A doption of additional mitigation measures if the present measures are insufficient; and
- G enerating the data, which may be incorporated in environmental management plan in future projects.

G.2. Environmental Monitoring

Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. All monitoring strategies and program have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analyzed statistically and published. The design of a monitoring program must therefore have regard to the final use of the data before monitoring starts.

G.3. Methodology

Monitoring methodology covers the following key aspects:

- C omponents to be monitored;
- P arameters for monitoring of the above components;
- M onitoring frequency;
- M onitoring standards;
- R esponsibilities for monitoring; and

H. Performance Indicators

The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:-

Ambient Air Quality Monitoring

The air quality parameters viz. Sulphur di-oxide (SO2), Oxides of Nitrogen (NOX), Carbon Monoxide (CO) and Particulate Matter (PM 2.5 & PM 10) shall be regularly monitored at identified locations from the start of the construction activity. The air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards.
The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Noise Quality Monitoring

The noise levels shall be monitored at designated locations in accordance with the Ambient Noise Quality standards. The duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan.

Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, Coliform, Total Suspended Solids, Total Dissolved Solids, Iron, etc. shall be monitored at all identified locations during the construction stage as per standards prescribed by Central Pollution Control Board and IS:10500 quality standards. The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Soil Quality Monitoring

Soil quality parameters such as NPK, oil & grease and heavy metals shall be monitored at all the identified locations during the construction stage as per the standards. The duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

I. Monitoring Plans for Environment Condition

To ensure the effective implementation of the mitigation measures and environmental management plan, it is essential that an effective Environmental Monitoring Plan (EMoP) to be designed. The EMoP contains parameters, location, sampling and analysis methods, frequency, and compared to standards or agreed actions that will indicate non-compliances and trigger necessary corrective actions. The objectives of the EMoP are to:

- E nsure that impacts do not exceed the applicable legal standards
- C heck the implementation of mitigation measures in the manner described in the EIA report
- M onitor implementation of the EMP
- P rovide an early warning of potential environmental damage
- C heck whether the proposed mitigation measures have been achieved the intended results, and or/ other environmental impacts occurred.

Monitoring plan does not include the requirement of arising out of Regulation Provision such as obtaining NOC/ consent for plant site operate.

Table 79: Environmental monitoring plan

Env. Indicators	Project Stage	Parameters	Method/ Guidelines	Location	Frequency and Duration	Standards	Approximate cost (₹)	Implementation	Supervision
Air Quality	Construction stage	PM 10 PM2.5 SO2, NOX, CO	High volume sampler to be located 50 m from the selected locations in the downwind direction. Use method specified by CPCB	Active construction site, HMP site and representative sample 1 each for residential, commercial/Industrial and 2 Sensitive Locations (Total 6 Locations)-	24 hr. continuous, 3/year for 2 years	Air quality standard by CPCB	6x5600x3x2=Rs 201600	Contractor through approved monitoring agency	Environment Expert-AE
	Operation stage			Representative sample 1 each for residential, sensitive, commercial and industrial area (4 Locations)-	24 hr. continuous, 3/year for 2 year	Air quality standard by CPCB	4X5600x3X2 =Rs 168000	through NABL approved monitoring agency	P I U
Water Quality	Construction stage	Ground water: (IS: 10500:1991) and Surface water criteria for freshwater classification	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Groundwater at 4 location (Construction Camps, HP of residential area) and Surface water of Perennial Rivers/Ponds (4 Samples) -	3/year for 2 years	Water quality standard by CPCB	8x 5000x3X2 =Rs 240000	through NABL approved monitoring agency	P I U
	Operation stage			Groundwater at 4 locations and surface water at 4 locations and pond developed due to Borrows areas – (Total 8 Samples)	3/year for 1 year	Water quality standard by CPCB	8X3x5000X2 =Rs 240000	through NABL approved monitoring agency	P I U

Env. Indicators	Project Stage	Parameters	Method/ Guidelines	Location	Frequency and Duration	Standards	Approximate cost (₹)	Implementation	Supervision
Noise levels	Construction stage	Equivalent Noise levels on dB (A) scale for day and night	IS:4954-1968 as adopted by CPCB for Identified Study Area CPCB/IS:4954-1968Using Noise level meter	Construction sites, Construction Camp and 1each at residential, commercial and 2 sensitive locations along the alignment. (6 Locations) -	24 hr. continuous, 3*/year for 2 years	National Ambient Noise Standard specified in Environment Protection Act, 1986	6x700x3x2=Rs. 25200	through NABL approved monitoring agency	P I U
	Operation stage			Near Sensitive and residential/Commercial areas(5 Locations)	3 / year for 2 year		5x700x3X2 =Rs 21000	through NABL approved monitoring agency	P I U
Soil Quality	Construction Stage	NPK (ICAR standard) and heavy metals	As specified by the site engineer BSRDC / CSC	Camp/ HMP sites Dumping Site and one random sample from agricultural Land (4 location)	Twice in a year for 2.5 years	ICAR standard	4x4500x3X2=75,000	through NABL approved monitoring agency	P I U
	Operation stage	Oil and grease		At oil spillage locations and other probable soil contamination location (4 Locations)	Twice for the first year of operation	CPCB standard	4x4500x3X2=20000	through NABL approved monitoring agency	P I U
Soil Erosion	Construction Stage	Visual check for Soil erosion and siltation		Throughout the Project Corridor especially at	After first rain	Visual Checks	Included in Engineering Cost	Contractor	PIU
	Operation Stage			River banks, bridge locations and river training structures	Once during operation of 1st year	Visual Checks	Included in Engineering Cost	Contractor	PIU
Drainage Congestion	Construction Stage	Visual Checks		Throughout the Project Corridor especially Probable drainage	Once in a year before rainy season	None Specific	Included in Engineering Cost	Contractor	PIU
	Operation				Once in a year	None	Included in	Contractor	PIU

Env. Indicators	Project Stage	Parameters	Method/ Guidelines	Location	Frequency and Duration	Standards	Approximate cost (₹)	Implementation	Supervision
	Stage			congestion areas	before rainy season	Specific	Engineering Cost		
Construction Sites and Labour Camp	Construction stage	Hygiene, drainage Medical Facilities Etc.	Rapid audit as per reporting format	Construction Sites and Camp	Quarterly during construction period	IRC guidelines	Part of the regular monitoring	Contractor	PIU
Tree Plantation	Construction Stage	Surveillance monitoring of trees felling		Throughout the Project Section	During site clearance in construction phase	As suggested by Forest Dept.	Refer to Table 70	Compensatory: Local Forest Departments Additional Plantation: through contractors of forest Dept	
	Operation Stage	Audit for survival rate of trees plantation		Throughout the Project Section	IRC: SP:2009			The Engineer will be responsible for monitoring up to the Defect Liability Period in any particular stretch. After this period PIU will be responsible for monitoring additional plantation	
Monitoring Costs: INR 1111800									

Table 80: Environmental Monitoring Budget

S. No	Parameters/ Components	Frequency	Total Samples	UnitCost/Sample(Rs)	TotalCost(Rs)
1	**AmbientAirMonitoring** Construction Stage	At 06 locations for three season in a year for 2 years **(Total 36 samples in 2 years)**	36	5600	201600
	Operation Stage	At 5 locations for three season for a year **(Total 30 samples in 2 year)**	30	5600	168000
2	**Ground WaterSampling** Construction Stage	At 4 locations for three season in a year for 2 years **(Total 24 samples in 2 years)**	24	5000	120000
	Operation Stage	At 4 locations for three season for a year **(Total 24 samples in 2 year)**	24	5000	120000
3	**Surface Water Sampling** Construction Stage	At 4 locations for three season in a year for 2 years **(Total 24 samples in 2 years)**	24	5000	120000
	Operation Stage	At 4 locations for three season for a year **(Total 24 samples in 2 year)**	24	5000	120000
4	**NoiseMonitoring** Construction Stage	At 06 locations for three season in a year for 2 years **(Total 36 samples in 2 years)**	36	700	25200
	Operation stage	At 05 locations for three season for a year **(Total 30 samples in 2 year)**	30	700	21000
5	**Soil Monitoring** Construction Stage	At 04 locations for three season in a year for 2 years **(Total 24 samples in 2 years)**	24	4500	81000
	Operation Stage	At 04 locations for for three season for a year **(Total 24 samples in 2 year)**	24	4500	81000
	TotalMonitoringCost				1111800

J. Proposed Institutional Arrangement

NHIDCL, as the Project Executing Agency, shall be responsible for overall implementation of the project, and shall perform, or cause to be performed, its obligations as set forth herein and the Project Agreement through Government of Meghalaya.

A dedicated safeguards team for implementation of safeguards for all projects under NHIDCL including the current project, shall be appointed. The team will be headed by the Member (Administration) and supported by a Deputy General Manager (DGM) and Manager at the headquarter level and an engineer from each Project Implementation Unit (PIU) at the field level.

NHIDCL shall establish field Project Implementation Unit (PIU) for implementing the project. PIU will oversee works for roads under the project. One of the engineers in PIU will be appointed as the safeguards focal person and be responsible for overseeing implementation of EMP.

A construction supervision consultant (CSC) firm will be recruited to supervise and administer civil works contracts and to ensure the works are executed in accordance with the drawings, technical specifications and contract conditions including implementation of EMP. The CSC team will include one environmental specialist and one wildlife specialist. Responsibilities for environmental safeguard implementation is described in below table;

Table 81: Responsibilities for Environmental Safeguards Implementation

S. No	Agency	Responsibility
1.	NHIDCL - HQ Level, Member (Administration), Deputy General Manager (DGM), Manager	• Ensure that project complies with GOI laws and regulations • Ensure that contract documents include all relevant parts of the environmental assessment and project agreements. • Ensure that sufficient funds are available to properly implement all agreed environmental safeguards measures • Obtain all statutory clearances and permissions. • Review and approve the Contractor's Implementation Plan with Supervision Consultant for the environmental measures, as per the EMP • Review the environmental performance of the project through an assessment of the periodic environmental monitoring reports submitted by the Supervision Consultants • overall project coordination and management through PIU supported by CSC • Formation of Grievance Redress Mechanism • Ensure updating of the EMP if any new or unanticipated environmental impacts occur during project implementation • due to design change or other reasons

S. No	Agency	Responsibility
2.	Project Implementation Unit (PIU) – Field Level	• Ensure that Project complies with GoI laws and regulations • Ensure that the environment checklist is completed on time by contractor, reviewed by CSC and submitted to NHIDCL • Participating in State and District level meetings to facilitate LA and R&R activities • Periodic appraisal of progress and reporting to the HQ on monthly basis, • Facilitating the contractor to obtain necessary permissions/ approvals and its submission to HQ • Directly interact with project affected persons and record their views and grievances and transmit the same to HQ • Settle grievances if any at field level. • Review and approve the package specific EMP's and EMOP's and make necessary modifications if required. • Facilitate the establishment of a grievance redress mechanism, to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances related to environment safeguards • Ensure that all mitigation measures as given in the EMP are implemented properly • Ensure proper conduction of environmental monitoring during pre-construction, construction and operation phases • Verify the monitoring checklists/reports prepared by the CSC • Ensure annual environmental monitoring reports are prepared • Identify environmental corrective actions and prepare a corrective action plan, as necessary
3.	Environment Specialist, Construction Supervision Consultant (CSC)	• Review and approve the contract package specific EMAP's prepared by the contractor • Daily on site supervision for implementation of environmental safeguards • Completion of monitoring checklists • Close coordination and communication with the contractor to facilitate implementation of all mitigation measures identified in EMP • Preparation of monitoring reports and submission to PIU • Provide technical support and advise for addressing complaints and grievances • Provide technical advice and on the job training to the contractors as necessary • Preparation of annual monitoring reports based on the monitoring checklists and submission to NHIDCL • Review and approve updated/revised contract specific EMP's if an new or unanticipated environmental impacts occur during project implementation due to design change or other reasons

S. No	Agency	Responsibility
4.	Contractor	• Responsible for the physical implementation of the mitigation measures proposed in the Environmental Management Plans (EMP) associated with the construction activities. • Responsible for implementation of the Environmental Monitoring Program (EMOP) on collection of environmental quality data. Prepare contract package specific (EMOP) for approval by the CSC and/or PIU before the start of physical works • Ensure that adequate budget provisions are made for implementing all mitigation measures specified in the EMP and EMOP • Participate in induction training on EMP provisions and requirements delivered by the PIU • Obtain necessary environmental license(s), permits etc. from relevant agencies for associated facilities for project road works, quarries, hot-mix plant etc. prior to commencement of civil works contracts. • Implement all mitigation measures in the EMP • Ensure that all workers, site agents, including site supervisors and management participate in training sessions delivered by CSC. • Ensure compliance with contractual obligations • Collect the baseline data on environmental quality before the start of physical works and continue collection of environmental quality data as given in the Environmental Monitoring Plan during construction • Respond promptly to grievances raised by the local community or and implement corrective actions

K. Reporting System

The Monitoring and Evaluation of the management measures envisaged are critical activities in implementation of the Project. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental Management Plan get implemented in the Project.

Project Monitoring Cell will be set up in the PIU, which will act as the Contract Management Unit (CMU) and will be responsible for execution of the Project. Project Execution Units will be set up under the supervision of the Contract Management Unit for the Contract Package.

L. Non Conformity To Environmental Management Plan (EMP)

The Contractor will implement necessary mitigation measures for which responsibility is assigned to him as stipulated in the EMP. Any lapse in implementing the same will attract the damage clause as detailed below:

- Any complaints of public, within the scope of the Contractor, formally registered with the PIU and communicated to the Contractor, which is not properly addressed within the time period intimated by the PIU shall be treated as a major lapse.
- Non-conformity to any of the mitigation measures like unsafe conditions, non-collection of excavated material (during laying of drainage pipes) regularly and other unattended

Environment, Health & Safety (EHS) issues, as stipulated in the EMP Report (other than stated above) shall be considered as a minor lapse.

- On observing any lapses, PIU shall issue a notice to the Contractor, to rectify the same.
- Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after ten days from the original notice date and first reminder date respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.
- If a major lapse is not rectified upon receiving the notice PIU shall invoke reduction, in the subsequent interim payment certificate.
- For major lapses, 1% of the interim payment certificate will be deducted, subject to a maximum limit of about 0.1% of the contract value.

M. Institutional/Capacity Building

To enhance the capacity of officials for effective implementation of proposed mitigation measures and monitoring the resultant effects, as well as create awareness amongst workers and public, the training and awareness program is planned and is given in Table 82. The institutions/agencies like regional office of MoEF, SPCB/CPCB, and Indian Institute of Technologies can be consulted for such trainings. Independent subject's experts/consultants (e.g., for the environmental awareness program, impact assessment specialist will be the resource person) can also be the resource persons to impart trainings. These experts /agencies shall be appointed based on specific need for the training. A separate budget for training has been allocated under the CSC budget.

Table 82: Outline Capacity Building Program on EMP Implementation

Description	Target Participants and Venue	Estimate (₹)[12]	Cost and Source of Funds
1. Introduction and Sensitization to Environmental Issues (1 day) - JICA environmental safeguard policy - Government of India and Meghalaya applicable safeguard laws, regulations and policies including but not limited to core labor standards, occupational health and safety, etc. - Incorporation of environmental management plan (EMP) into the project design and contracts - Monitoring, reporting and corrective action planning - Awareness programme for COVID -19	All staff and consultants involved in the project At project management unit (PMU) (combined program for all subprojects)	-	Included in the overall program cost
2. EMP implementation (1/2 day per alternative month for 24 month = 12 mandays) - EMP mitigation and monitoring measures -Roles and responsibilities - Public relations, -Consultations - Grievance redress - Monitoring and corrective action planning - Reporting and disclosure	All project implementation unit (PIU) staff, contractor staff and consultants involved in the subproject At PIU	₹120,000 Typical manday rate of an JICA Consultant 20,000/-. (20,000x0.5 x12)= 120,000/-	Included in subproject cost estimates

[12] The rate are as per current market rate.

Description	Target Participants and Venue	Estimate (₹)[12]	Cost and Source of Funds
- Construction site standard operating procedures (SOP) -- Chance find (archeological) protocol - AC pipe protocol - Traffic management plan - Waste management plan Site clean-up and restoration			
3. Contractors Orientation to Workers (1/2 day) - Environment, health and safety in project construction	Once before start of work, and thereafter regular briefing every month once. Daily briefing on safety prior to start of work All workers (including unskilled laborers)	-	Contractors cost

N. Environmental Budget

The environmental budget for the various environmental management measures proposed in the EMP is detailed in table below. The budget has been worked out on the basis of market rates.

Table 83: Mitigation and enhancement cost in construction and operation phase

Sl. no	Environmental Components	Particulars	Unit	Rate In (Rs.)	Approx. Quantity	Total Cost In (Rs.)
		Mitigation / Enhancement Cost				
2		Construction Stage				
2.1	Air	Dust Management with sprinkling of water, covers for vehicles transporting construction material	62.000 Km	Cost included in Total Civil Cost		
2.2	Water	Provision of Taps	No.	Included in utility shifting and replacement cost.		
	Water Bodies	Enhancement of Road side Ponds (13 big ponds as per EMP Table 78Total length of water bodies proposed for enhancement	No.	Retaining wall has been proposed to protect this water bodies. Cost of retaining wall is included in total Civil Cost.		
		Oil trap at parking/servicing of construction vehicles (at three location every 14km)-	No.	Ref: Project Cost Estimate		

Sl. no	Environmental Components	Particulars	Unit	Rate In (Rs.)	Approx. Quantity	Total Cost In (Rs.)
2.3	Environmental Enhancements	Enhancement of traffic sign outside of most sensitive locations mentioned in EMP, by planting of traffic sign and planting of 1 row of trees at a distance of 3m c/c and as per directions of the Engineer	No.	At this location proper traffic sign has been proposed. The cost of traffic sign is included in total civil cost.		
2.4	Flora	1. Compensatory Afforestation @ 1:10 ratio (Number of trees to be cut =6185) Compensatory Afforestation (Greenbelt) will be provided within the ROW along the roadside at available locations and especially in some of the project section where roadside plantation (greenbelt) does not exist or found very few, including watering and maintenance of Planted trees for 5 years	Nos.	831 for per year for 1 year.[13]	61850	236427810
		Tree guarding (Making Tree Guard 53 cm dia and 1.3 m each 359.00 high as per design from empty bitumen Drum) Price details as per SoR, PWD, Meghalaya is attached in annexure 23	Nos.	359	61850	22,204,150
	Noise barrier	Provide the Noise barrier at sensitive areas like schools and hospitals. The noise barriers of hollow brick wall/reinforced concrete panels with height of 3.5m. The design of the noise barrier shall be approved by the engineer in charge**.**		Cost of noise barrier is included in Total Civil Cost.		
2.5	Silt Runoff Control	Slope stabilization, turfing, silt fencing etc		For slope stabilization turfing has been proposed on high embankment. Cost of slope stabilization is included in Total Civil Cost.		

[13] Considering typical 90% survival rate after 1 year.
Source:
http://www.indiaenvironmentportal.org.in/files/file/Green%20Highways%20(Plantation%20&%20Maintenance)%20Policy-2015.pdf

Sl. no	Environmental Components	Particulars	Unit	Rate In (Rs.)	Approx. Quantity	Total Cost In (Rs.)
2.6	Slope/ embankment protection measures	Stone pitching, Gabion, Retaining wall, Turfing at toe line, etc		For Slope/ embankment protection Retaining wall, Turfing has been proposed. Cost of Slope/ embankment is included in Total Civil Cost.		
2.7	Relocation of sensitive receptor	Relocation of 2 religious stracture, and 6 educational properties		Cost of relocation is included in Total Civil Cost.		
		Total Mitigation / Enhancement Cost				258631960
3		**Operation Stage**				
3.1	Soil erosion	Mitigation measure for soil erosion		included in Total Civil Cost		
3.2	Contamination from spills due to traffic and accidents	Clearing of spills at accident site			Average cost (detailed calculation is given in annexure 23)	700,000
3.3	Flora	Maintenance of planted trees	Already included in construction phase			
3.4	Safety	Traffic management and Traffic control	Part of project construction cost.			
		Total Mitigation / Enhancement Cost				700,000

Table 84: Summary of Environmental Management Budget

Sl. No.	Environmental Components	Cost (Rs.)
1	**Construction Phase**	
1.1	Total Mitigation / Enhancement Cost	258631960
1.2	Environmental Monitoring Cost	574800
Total Cost in Construction phase		**259206760**
2	**Operation Phase**	

Sl. No.	Environmental Components	Cost (Rs.)
2.1	Total Mitigation / Enhancement Cost	700,000
2.2	Environmental Monitoring Cost	537000
Total Cost in Operation Phase		**12,37,000**
3	**Miscellaneous Cost**	
3.1	Environmental Awareness and Training	120,000
3.2	Administrative Charges including logistics	4,00,000
Total Cost in Miscellaneous		**5,20,000**
TOTAL BUDGETED COST (1+2+3)		**260963760**

An environmental management budget at of INR **260963760**has been estimated for implementation of the environmental management plan. This budget includes cost of environmental monitoring and associated trainings.

9. GRIEVANCE REDRESSAL MECHANISM

A. Introduction

Grievance Redressal Mechanism is an integral part of the institutional arrangement in relation to social safeguard issues. At present, there is no established grievance redressal mechanism in PMU.A common GRM will be put in place to redress social, environmental or any other project and/or subproject related grievances. Public awareness campaign is being conducted to ensure that awareness on the project and its grievance redress procedures is generated. The campaign ensured that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements as per project entitlement matrix. PMU throughProject Construction Management Consultant (PCMC) ensure that their grievances areaddressed. Anticipated grievances from the environmental point of view could be;

- Affected persons missed out/ not enumerated during the survey,
- Social category and vulnerability incorrect,
- Difference in land area acquired/purchased and measured at site,
- Type and use of land acquired/purchased not considered correctly,
- Wrong measurement of structure/building affected,
- Wrong valuation of structure/building,
- Damage to adjoining property,
- Construction activities at the site, quality of works, safety, etc.
- Road safety ,
- Environmental hazards like dust, noise, air pollution etc.

In view of the above, a Grievance Redressal Committee (GRC) will be constituted by the Project Authority with the aim to resolve as many grievances as possible related to resettlement and rehabilitation and land acquisition/purchase through consultations and negotiation. Affected persons have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes or through telephone hotlines at accessible locations, by e-mail, by post, or by writing in a complaint register in Gram Panchayat office or PMU or PCMC office. Careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved is recorded. The name of the persons to be included in the field level GRM will be suggested shortly. The flow chart of grievance redress process is shown in Figure .GRM information sheet is attached in annexure 7.

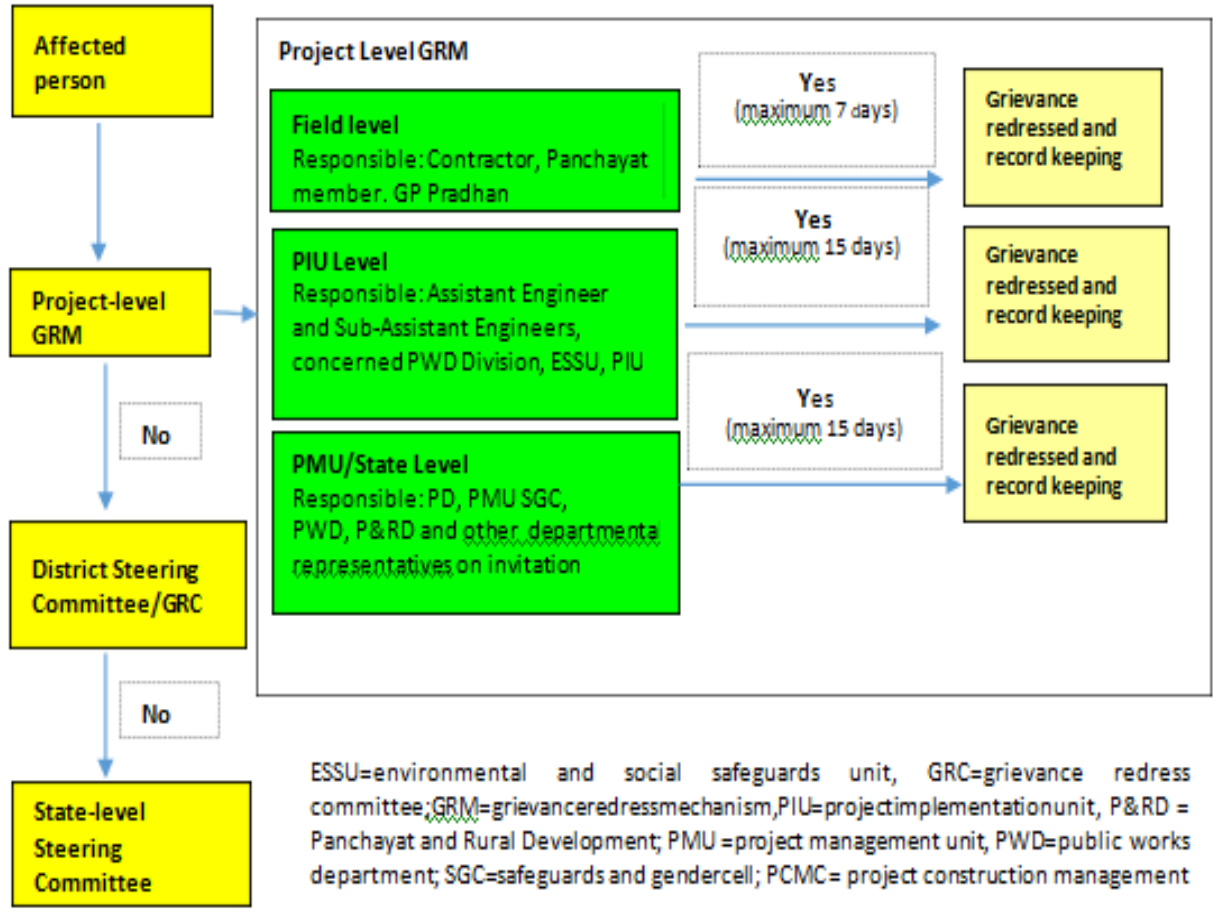


Figure 40: Grievance Redress Mechanism

- **JICA GRS**: Communities and individuals who believe that they are adversely affected by a JICA supported project may submit complaints to existing project-level grievance redress mechanisms or the JICA's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the JICA's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of JICA non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the JICA attention, and Bank Management has been given an opportunity to respond.
- A detailed process of Grievance Redressal Mechanism has been described in Chapter 11 of Supplementary Social Impact Assessment (SEIA).

10. CONCLUSION AND RECOMMENDATION

Generally the infrastructure projects are intended to improve the economic and social welfare of the people. At the same time, they may also create adverse impacts on the surrounding environment. The development and operation should, therefore, be planned with careful consideration of the environmental impacts. To minimize these adverse effects that may be created by the projects, the techniques of EIA become necessary.

The new National Highway 127B is one such corridor starting from Fakirganj in Assam-Meghalaya border and connecting to road near Rongram (Meghalaya). This road passes through the only one district namely West Garo Hills of Meghalaya. The total lengthof New NH-127B is 62.000 Km.

A. Significant Findings:

The report was prepared after thorough interaction with the engineering section of the consultants, interaction with Govt. officials, public consultations, baseline surveys, collection of primary and secondary datas, so that the negative impacts on the environment and human population could be avoided as far as possible. Some of the important findings of the study are as follows: -

1. There will be no loss of bio-diversity as no rare plant or animal species are going to be affected by the present project.
2. Total 2 of religious stracture, 5 numbers of school and no health care center will be affected due to this project.
3. Approximately 6185 trees will be cut down due to the proposed project improvement and 67850 (10 times) of trees will be planted as part of the compensation.
4. There is no wildlife migrant route in the project section, which could be affected.
5. Temporary impact on land and air environment due to locating construction camp;
6. The proposed road alignment for NH127B from Fakirganj to Rongram (near Tura) is more than 5 km away from the ESZ boundary.
7. No monuments protected by the Archaeological Survey of India (ASI) are located within the ROW of highway.
8. The project road traverses through a flood prone area, hence soil erosion & flooding is a major issue, for which suitable management measures like sufficient CD structures, increased height of embankments etc.are provided in the design report.
9. Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
10. Impact on land and water environment due to disposal of waste materials; and
11. Impact on occupational health and safety due to all on-site and off-site construction works.

Besides, series of mitigation measures have been proposed that are described in the EIA Report and addressed comprehensively in the environmental management plan. These include provision of bioengineering applications for stabilizing slopes, use of spoil disposal areas to minimize destruction of forests down-slope of the alignment, proper sizing of hydraulic

structures to assure adequate capacity and prevent destruction of adjacent land, provision of sign boards along migratory paths of animals and other precious ecological zones, provision of bridges and culverts designed especially for facilitating the movement of animals, identificationof vulnerable community infrastructure that must be preserved or replaced under constructioncontracts, limits on location and access of workers and other provisions regarding constructionto assure minimum impact, and other basic provisions found in the EMP. All the aboveobservations and mitigation measures will be included in the tender documents for contractworks.

Potential adverse effects during operations of the roadways have been minimized by aligning the road in optimal locations in relation to roadway safety and community impact, through provision of designs and budgets for superior roadway drainage structures.

ANNEXURES

Annex 1:JICA Scoping Matrix for Environmental Impact Assessment and Environmental Screening checklist

Item	No.	Impact	Scoping			Rationale
			Pr e construction stage	construction Phase	Operation Phase	
Pollution Control	1	Air Quality	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** - Minimum dust dispersion will be expected. - Maintenance of machinery will be conducted regularly, resulting in reducing exhaust gas emissions. **Operation phase:** - Air pollution caused by exhaust gas generated as the more vehicles traffic predicted.
	2	Water Quality	D	B-	B-	**Pre Construction phase: Nil** **Construction/Operation phase:** For wastewater accompanying concrete construction and wastewater containing oil, the muddy stream caused by embankment at the time of rainy weather.
	3	Waste	D	B-	D	**Pre Construction phase: Nil** **Construction phase:** Generally C & D & hazardous waste generated during construction phase, suitable mitigation and disposal facility will be provided. **Operation phase:** No waste will be generated
	4	Soil Contaminatio n	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** There is chance of soil contamination due to leakage of oil from the operation and maintenance of equipments and machineries. Suitable measures like provision of oil interceptor, secondary containment will be provided along with suitable disposal. **Operation phase:** May occurred in case of any oil spill in the road and leaching to the surrounding.
	5	Noise and Vibration	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** Minor noise may be generated due to construction activity and movement of vehicles. Suitable mitigation measures will be adopted during construction phase and strict timeline will be followed in the residential and sensitive areas. **Operation phase:** Noise may be generated from the movement of vehicles and machineries, which is temporary.
	7	Sediment	D	B-	D	**Pre Construction phase: Nil** **Construction phase:** Sedimentation may occur due construction of cross drainage structures and bridges

Item	No.	Impact	Scoping			Rationale
			Pr e construction stage	construction Phase	Operation Phase	
						on river. Suitable mitigation measures will be provided. **Operation phase:** Nil
Natural Environment	8	Protected Areas	D	D	D	**Pre Construction phase:** No protected area falls within 10 kms of the project road. **Construction phase:** No protected area falls within 10 kms of the project road. **Operation phase:**No protected area falls within 10 kms of the project road.
	9	Ecosystem	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** Cutting of trees and habitat fragmentation may caused by the proposed project, which has some impact on the ecosystem. Mitigation measures like under passes, compensatory afforestation will be there. **Operation phase:** Temporary impact is there like Vehicular noise disturbs the hearing of animals and birds, lighting on animals and accidents road during crossing.
Natural Environment	10	Hydrology	D	B-	D	**Pre Construction phase: Nil** **Construction phase:** May alter the hydrological process during construction of bridges in the river. Sedimentation may also have some impact on it. Suitable measures will be provided. **Operation phase:** No impact
	11	Topography and Geology	D	B-	D	**Pre Construction phase: Nil** **Construction phase:** As the road is in plain and rolling terrain with section under hilly terrain, no major change will occur in the topography. Only the widening of road and new bypasses due to cutting and filling will slightly change the topography. **Operation phase:Nil**
	12	Soil Erosion	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** As the few portion project is in flood prone area and parallel to a river, soil erosion is common particularly in rainy season. Suitable mitigation measures will be provided during construction phase to avoid soil erosion and for embankment protection. **Operation phase:** During flood and heavy rain, soil erosion may take place. Suitable mitigation measures will be in place and monitored.
Social Environment	12	Resettlement and Land Acquisition	C	D	B+	**Pre Construction phase:** The project will require Resettlement and land acquisition, however the extent is yet to be finalised.

Item	No.	Impact	Scoping			Rationale
			Pr e construction stage	construction Phase	Operation Phase	
						Construction phase: Nil **Operation phase:** implementation of RAP is expected to generate beneficial impacts.
	13	Poor Classes	D	B+	B+	**Pre Construction phase: Nil** **Construction phase and Operational phase:** Envisage to have increase employment/ income generation opportunity.
	14	Tribal Peoples	D	C	C	**Pre Construction phase: Nil** **Construction phase and Operational phase :**It is known that the project road is passing through areas, inhabited by Schedule tribes. However, the extent of impact on STs will be determined upon receipt of DPR.
	15	Local Economy such as Employment and Livelihood, etc.	D	B+	B+	**Pre Construction phase: Nil** **Construction phase and Operational phase:** Envisage to have increase employment/ income generation opportunity.
Social Environment	16	Land Use and the Utilization of Local Resources	B	B-	B+	**Pre Construction phase:** It is envisage that proper utilization of local resources in project will be incorporated in the project design. **Construction phase:** Potential exploitation of local resources **Operational phase**: Due to better connectivity land use planning and utilization of local resources is expected to reap positive benefits.
	17	Water Usage and Water Rights	B	B-	D	**Pre Construction phase:** proper planning of the local water resources for road construction is expected to avoid any competing water usage and water right issues. **Construction phase:** here are potential contamination which may limit the water usage for other users. **Operational phase**: **Nil**
	18	Existing Social Infrastructure and Services	B	B-	A+	**Pre Construction phase:** Road alignment has been done in such a way to minimize adverse impacts on social infrastructures and services**.** **Construction phase:** Temporary access restrictions. **Operational phase**: Significant positive impacts due to enhanced social infrastructures (additional CPR) and services (improved connectivity).
	19	Local Communities and Decision-making Institutions	D	B-	B+	**Pre Construction phase: Nil** **Construction phase:** Community property resource (CPR) will be impacted during the construction of project by collective decision of the community which will be restored/rehabilitated/resettled during operation **Operational phase**: New CPR will be developed in Post construction phase.

Item	No.	Impact	Scoping			Rationale
			Pr e construction stage	construction Phase	Operation Phase	
	20	Unequal Distribution of Benefits and Damages	D	B	D	**Pre Construction phase: Nil** **Construction phase:** Vulnerable population will be given a special assistance of Rs. 25,000/- over and above all other compensation and assistance. Potential unequal wages to women workers. **Operational phase: Nil**
	21	Local Conflicts of Interest	D	B	D	**Pre Construction phase: Nil** **Construction phase:** Local community will be involved in construction works and petty contractors. **Operational phase: Nil**
	22	Cultural Heritage	B	B-	B+	**Pre Construction phase:** Road alignment has been done in such a way to minimize adverse impacts on cultural heritages properties. **Construction phase:** Religious places as well as cultural properties (local theatres, festival ground etc) may get damaged/impacted due to restricted access. **Operational phase:** This will be enhanced.
	23	Landscape	B	B-	B-	**Pre Construction phase:** Road alignment has been done in such a way to minimize change in existing land scape. **Construction phase and Operational phase:** There would be changes in land scape such as conversion of crop land in roads and other built up structures.
	24	Gender	D	B+	B+	**Pre Construction phase: Nil** **Construction phase**: Local females will be employed as unskilled/skilled worker and also play an important role in GRM. **Operational phase:** Training to the local people specially the women, will be provided for livelihood restoration.
	26	Children's Rights	B	B-	B+	**Pre Construction phase:** use of child labour in any of project activities will be strictly prohibited through contract. **Construction phase**: Potential exploitation of child labour. **Operational phase:** Better access to health and educational institutes for children.
	27	Infectious Disease such as HIV/AIDS	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** Because of influx of migrant labours probability of increase in HIV/AIDS. **Operational phase:** Due to improved road connectivity numbers of heavy vehicle (Trucks) will be increased. Therefore there is probability of increase of HIV/AIDS through truck drivers.
	28	Work Environment (Including Work Safety)	B+	B-	B+	**Pre Construction phase:** Improved design the existing road to enhance the work safety. **Construction phase:** During construction work environment and work safety can be affected.

Item	No.	Impact	Scoping			Rationale
			Pr e construction stage	construction Phase	Operation Phase	
						Operational phase: Because of improved design operation phase work environment and work safety is expected to be improved.
	29	Sunlight	D	D	D	There is no impacts is anticipated.
	30	Accidents	B+	B-	B+	**Pre Construction phase:** project is designed in such a way to minimize traffic accidents**.** **Construction phase:** there can be various construction related accidents**.** **Operation phase:** better road design will expected to reduce traffic accidents**.**
	31	Cross-boundary Impact and Climate Change	B+	B-	B-	No cross boundary impact is anticipated due to this project. **Pre Construction phase:** project design has been done in such a way to minimize all adverse impacts of climate changes. **Construction phase:** Construction instruments including hotmix plant, batching plant etc are potential source of GHG emission. **Operation phase:** Better road connectivity leads to increase traffic volume which will cause more GHG emission.
Others	32	Climate Change	D	B-	B-	**Pre Construction phase: Nil** **Construction phase:** The emission of GHGs from use of construction machines and operation of vehicles will have minor impact. Regular maintenance of vehicles and machineries will be done. New machineries and vehicles will be encourages for the project. **Operation phase:** The GHG emission will increase due to an increase in traffic volume.
	33	Natural Disaster	D	B-	B+	**Pre Construction phase: Nil** **Construction phase:** The project road is prone to flood and thus appropriate measures will be provided for the construction work to minimize the impact. **Operation phase:** Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.

Screening Checklist (As per TOR)

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) Main EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a) Y	(a) Previous EIA was prepared in February 2020
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	(b) Previous EIA has been submitted officially, yet to get any formal approval.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N	(c) Yet to receive any comment.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) N	(d) Approval in progress
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	(a) Focal group discussion along the project road has been conducted by the Environmental – Social Survey team. Further, formal disclosure has been prepared for sharing with local panchyat and other district authorities. Refer: Annexure 4.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b) Y	(b) Yes, it will be incorporated in SIEA. Post consultation with all stakeholders, panchyat and district authority
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	11. Reference: Chapter VII: Analysis of Alternates / Bypass Options This will be further reviewed upon receipt of the DPR.

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken? (b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a) Y (b) N	(a) Based on secondary information and site observations, air quality parameters seemed mostly complying with CPCB standard. However, this will be further validated during the present study and appropriate mitigation measures will be incorporated in SEIA. (b) There is no industrial area along the project road.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater? (c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a) Y (b) Y (c) Y	(a) Since a significant stretch of the project road is in flood prone area, cutting and filling will be involved in this project.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	(a) Y	
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a) Y	
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	The project road is not located in or near any protected area and hence, there is no possibility that the project will affect the protected areas
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	a) project site does not encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs,

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
				mangroves, or tidal flats)
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) N	b)project site does not encompass any protected habitat of endangered species.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) Y	c) Although certain numbers of roadside trees will be felled and some cropland will need to be converted for this project but these trees being indigenous to the area, significant ecological impacts are not anticipated due to this project.
		(d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?	(d) Y	d) The project is not located in any known wildlife habitat or migration route. Therefore, habitat fragmentation or impact to migration route is not anticipated due to this project. However, there is potential for traffic accidents involving livestock. Accordingly, mitigation measures such as fencing, pedestrian crossing, underpass, service roads, etc. have been included in road design.
		(e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(e) Y	e) There is no possibility that project road will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas. However, there is potential for disturbance of

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
				ecosystems due to introduction of exotic (non-native invasive) species during compensatory plantation for felled roadside trees. In order to prevent such possibility, specific guidelines for planting of indigenous species only will be incorporated in the supplementary EIA report.
		(f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(f) N	f) Asthe project site is located in predominantly developed areas, it is unlikely that the new development will result in extensive loss of natural environments.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) Y	The widening and upgrade of the project road may adversely affect drainage, in particular surface water flows. Accordingly, adequate numbers of cross-drainage structures are being proposed.
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) Y (b) Y (c) Y	Appropriate mitigation measures will be incorporated in EMP, part of SEIA

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) Y	a) Resettlement Plan, Option Study during DPR
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) Y	b) Public Consultation Conducted (Ref: Annexure 3)
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) Y	c) Entitlement Matrix depict the eligibility and entitlements.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) Y	d) Compensation to be paid before mobilizing the Civil Contractor
		(e) Are the compensation policies prepared in document?	(e) Y	e) The Legal and Policy Framework has been prepared
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) Y	f) Special Vulnerable assistance of Rs. 25,000 will be given above other assistance
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) Y	g) Agreement with the Title Holders are in process
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) Y	h) Organizational Framework already discussed with appoint of NGO for implementation
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) Y	i) Plans are there for both Internal and External Monitoring
		(j) Is the grievance redress mechanism established?	(j) Y	j) Plans are there for establishing Grievance Redressal Mechanism
	(2) Living and Livelihood	(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?	(a) N	a) Engineering Team visited and noted the natural flow of water. Culverts have been provided for the natural flow of water. There is no impacts both temporary or permanent regarding the

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
				hindrance of accessibility.
		(b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary?	(b) N	b) There will be positive impact of the project other than the target population
		(c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(c) N	c) Awareness campaign about HIV/AIDS and STDs will be taken up by the NGO
		(d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)?	(d) N	d) The widening and upgrading of the road will reduce the traffic congestion and road accident
		(e) Is there any possibility that roads will impede the movement of inhabitants?	(e) N	e) There will provide places to cross over at all major and minor junctions
		(f) Is there any possibility that structures associated with roads(such as bridges) will cause a sun shading and radio interference?	(f) N	f) Possibility is very less
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	Care had been taken so that no archaeological, historical, cultural, and religious heritage are impacted
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	Local landscape beyond the road will remain same
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a) Y (b) Y	Special Plan for Indigenous is being developed and no land or structure is impacted which is associated with the beliefs of the IP community

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) N	a) None of the Country's Law is Violated
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b) Y	b) Country's Acts, Rules and Policies and regarding safety to be followed
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c) Y	c) Heath and Road Safety campaign are to organised by the NGO. Safety Campaign and training will be the part of the Contractor
		(d) Are appropriate measures being taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(d) Y	d) Security guard who will be recruited should be trained to give respect to the local community.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a) Y	Appropriate mitigation measures will be incorporated in SEIA
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) Y	
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c) Y	
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	(a) Appropriate monitoring plan will be incorporated in EMP as part of SEIA.
		(b) What are the items, methods and frequencies of the monitoring program?	(b) Y	(b) For baseline environmental monitoring refer Chapter X. However for construction and operational phase monitoring it will be part of EMP of SEIA.
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the	(c) Y	(c) It is part of EMP

Category	Env. Item	Check Items	Yes: Y No: N	Confirmation of Env. Considerations (Reasons, Mitigation Measures)
		monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d) Y	(d) If hotmix plant, batching plant and generators capacity more than 10 kw, are utilized for this project NOC, CTE and CTO is required from SPCB and the associated conditions includes periodic reporting as per SPCB guideline.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) Y (b) Y	Not Applicable Not Applicable
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	Not Applicable

Annex 2: Conversation with PWD official regarding ESZ of Nokrek national park

Good morning
The proposed alignment of 127B do not fall within the Nokrek Biosphere reserve.
As discussed with the JICA technical team, Meghalaya PWD had already reverified at site where curves are below absolute minimum and have shared details with the DPR consultant where improvement is possible.
The final DPR was to be completed by 31st July. but as informed by the DPR consultant their office in DELHI has been closed as one of their staff has been unfortunately detected with Covid.
The DPR consultant is to mark the centre-line of the road as per their design, however, their team from Delhi is unable to come as there are strict inter-state travel restrictions.
We will share with you the land details as soon as the final DPR is ready and the State PWD is willing to assist the DPR consultant for fixing the centreline.
Thank you and regards
Bruce

From: Noriko KONO <nkono@padeco.co.jp>
Sent: Thu, 23 Jul 2020 06:46:51
To: chief engineer engineer <cenhpwd@gmail.com>, bruce marak <brucem@rediffmail.com>
Cc: Swarnabha Bandhopadhyay - Environment <swarnabhab@yahoo.com>, Suman Sarkar <sumaan.sarkar@gmail.com>, "anayak@cetestindia.com" <anayak@cetestindia.com>, Jiro IGUCHI <jiguchi@padeco.co.jp>, Yohei SOMA <ysoma@padeco.co.jp>, Hiroshi AOKI <haoki@padeco.co.jp>
Subject: Inquiry from NH127B JICA Survey Team: environmental clearances matter

Annex 3:GoI Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient air (□g/m^3)	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas
Sulphur Dioxide (SO2)	Annual Average*	50	20
	24 hr**	80	80
Oxides of Nitrogen (as NO2)	Annual Average *	40	30
	24 hr**	80	80
Particulate Matter: PM10 (<10 µm)	Annual Average *	60	60
	24 hr**	100	100
Particulate Matter: PM2.5 (<2.5 µm)	Annual Average *	40	40
	24 hr**	60	60
Lead	Annual Average *	0.5	0.5
	24 hr**	1.0	1.0
Carbon monoxide mg/m3	8 hr	2.0	2.0
	1 hr	4.0	4.0

Annual Arithmetic mean of minimum 104 measurement in a year taken for a week 24 hourly at uniform interval.
24 hourly or 8 hourly or 1 hourly monitored values should meet 98 percent of the time in a year

Source: MoEF notification Central Pollution Control Board (1997) National Ambient Air Quality Monitoring Series, NAQMS/a/1996-97

Annex 4:GoI Ambient Noise Level Standards

Area Code	Category	Limits in Decibels (dB A)	
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence Zones	50	40

Note: (1) Daytime: 6 AM to 10 P.M., Night-time 10 PM to 6 AM;
Silence zone is an area up to 100 m around premises as hospitals, educational institutions and courts. *Source: Central Pollution Control Board, New Delhi*

Annex 5:Indian Standard Drinking Water Specification: IS 10500:1991

Sl. No.	Substance/ Characteristic	Desirable Limit	Permissible limit	Remarks
1	Colour, Hazen units, Max	5	25	Extended to 25 if toxicsubstance are not suspected in absence of alternate Sources
2	Odour	Unobjectionable		a) Test cold and when heated
				b) Test at several dilution
3	Taste	Agreeable		Test to be conducted only after safety has been established
4	Turbidity NTU, Max	5	10	
5	pH value	6.5 to 8.5	No relaxation	
6	Total Hardness (as $CaCO_3$ mg/lit)	600	600	
7	Iron (as Fe mg/lit, Max	0.3	1.0	
8	Chlorides (as Cl mg/lit Max	250	1000	
9	Residual Free Chlorine, mg/lit Max	0.2		To be applicable only when water is chlorinated. Treated at consumer end. When protection against viral infection is required, it should be Min 0.5 mg/lit
10	Dissolved Solids mg/l, Max	500	2000	
11	Calcium (as Ca) mg/l, Max	75	200	
12	Copper (as Cu) mg/l, Max	0.05	1.5	
13	Manganese (Mn) mg/l Max	0.1	0.3	
14	Sulphate (As SO_4), Max	200	400	May be extended up to 400 provided (as Mg) does not exceed 30
15	Nitrate (as NO_3) mg/l, Max	45	100	
16	Fluoride (as F) mg/l, Max	1.0	1.5	
17	Phenolic Compounds (as C_6H_6OH) mg/l Max	0.001	0.002	
18	Arsenic (as As mg/l	0.05	No relaxation	To be tested when pollution is Suspected

19	Lead (as Pb) mg/l	0.05	No relaxation	
20	Anionic Detergents (as MBAS) mg/l	0.2	1.0	
21	Chromium (as Cr) mg/l	0.05	1.0	To be tested when pollution is Suspected
22	Mineral Oil mg/l	0.01	0.03	
23	Alkalinity mg/l	200	600	
24	Total Coliform	95% of the sample should not contain coliform in 100 ml. 10 coliform /100 ml		

Annex 6: Record of Public Consultations

List of Consulted Person & Issues Discussed During Field Visit

Sl no	Meeting Location	Chainage	Name & Contact Details	Date	Issues raised	Respond
1	PABOMARI	2+000	YUSUF ALI	10/09/2020		
2	PABOMARI	2+000	MUSTOFA MIA	10/09/2020		
3	PABOMARI	2+000	SOHIT ALI	10/09/2020		

Issues which are need to discuss

- Major problem with the road **Very bad condition**
- Local environmental issues e.g. flood, noise, dust, etc.(v,×,v)
- Presence of Wild animal along the project road (×)
- Congestion and traffic jam along the project road (×)
- Issues in street crossing (×)
- Traffic density along the project road (×)
- Need for the upgradation- What they think (opinion of the local people) (Hoping for new road)
- Road Side Water logging issues and Duration (Yes,nearly 6 month)
- Safety of Local traffic andpedestrian in Built-up Zone (Yes, during the new construction)
- Effect of Noise and Dust Pollution (×)
- Relocation of Road Side Religious Structure (if any) (×)
- Noise and dust pollution in environmental sensitive zone (×)
- Impact on the road side structures due to Upgradation of the project road (Shop/House during the new double lane construction)
- Health issues of the local people during construction (×)
- Adequate traffic signal and signs along the project road (v)
- Any major festival or public gathering along the project road (during EID)

List of Consulted Person & Issues Discussed During Field Visit

Sl no	Meeting Location	Chainage	Name & Contact Details	Date	Issues raised	Respond
1	SYAMNAGAR	16+400	TROYLLINE MARAK	10/09/2020		
2	SYAMNAGAR	16+400	DROYOVER MARAK	10/09/2020		
3	SYAMNAGAR	16+400	CHOTO MARAK	10/09/2020		

Issues which are need to discuss

- Major problem with the road **Very bad condition**
- Local environmental issues e.g. flood, noise, dust, etc.(v,×,v)
- Presence of Wild animal along the project road (×)
- Congestion and traffic jam along the project road (×)
- Issues in street crossing (×)
- Traffic density along the project road (×)
- Need for the upgradation- What they think (opinion of the local people) (Demanding Zebra crossing and Speed breaker after new NH complete)
- Road Side Water logging issues and Duration (Yes,nearly 4 month)
- Safety of Local traffic andpedestrian in Built-up Zone (Yes near Church and School)
- Effect of Noise and Dust Pollution (v)
- Relocation of Road Side Religious Structure (if any) (×)
- Noise and dust pollution in environmental sensitive zone (×)
- Impact on the road side structures due to Upgradation of the project road (Church boundary and gate if Double lane)
- Health issues of the local people during construction (×)
- Adequate traffic signal and signs along the project road (v)
- Any major festival or public gathering along the project road (yes during Christmas)

Sl no	Meeting Location	Chainage	Name & Contact Details	Date	Issues raised	Respond
1.	Khilbhoi	39+600	Mohindra Koch	24/09/20		
2.	Khilboi	39+600	Chibendra Koch	24/09/20		
3.	Khilbhoi	39+600	Chunaki Koch	24/09/20		

Issues which are need to discuss

- Major problem with the road (Very bad condition)
- Local environmental issues e.g. flood, noise, dust, etc.(v,v,×)
- Presence of Wild animal along the project road (Elephant & Fox)
- Congestion and traffic jam along the project road (×)
- Issues in street crossing (Need Speed breaker & Zeebra Crossing near Church)
- Traffic density along the project road (×)
- Need for the upgradation- What they think (opinion of the local people)(Want Speed Breaker)
- Road Side Water logging issues and Duration (Nearly 3 month)
- Safety of Local traffic andpedestrian in Built-up Zone (v)
- Effect of Noise and Dust Pollution (×)
- Relocation of Road Side Religious Structure (if any) (×)
- Noise and dust pollution in environmental sensitive zone (×)
- Impact on the road side structures due to Upgradation of the project road (v)
- Health issues of the local people during construction (×)
- Adequate traffic signal and signs along the project road (v)
- Any major festival or public gathering along the project road(During Christmass)

List of Consulted Person & Issues Discussed During Field Visit

Sl no	Meeting Location	Chainage	Name & Contact Details	Date	Issues raised	Respond
1.	Mokbolkholgre	55+800	Nongseng D Sangma	25/09/20		
2.	Mokbolkholgre	55+800	Premison Marak	25/09/20		
3.	Mokbolkholgre	55+800	Rangen Marak	25/09/20		
4.	Mokbolkholgre	55+800	Warjong Sangma	25/09/20		
5.						
6.						
7.						

Issues which are need to discuss

- Major problem with the road (Good condition,PMGSY road)
- Local environmental issues e.g. flood, noise, dust, etc.(×,×,×)
- Presence of Wild animal along the project road (Elephants ,Fox, King Kobra,Gram,Reti,Colingsak)
- Congestion and traffic jam along the project road (×)
- Issues in street crossing (Need Speed breaker At starting & ending point of weekly market)
- Traffic density along the project road (×)
- Need for the upgradation- What they think (opinion of the local people) (Want Speed Breaker & Zeebra crossing)
- Road Side Water logging issues and Duration (×)
- Safety of Local traffic andpedestrian in Built-up Zone (v)
- Effect of Noise and Dust Pollution (×)
- Relocation of Road Side Religious Structure (if any)(×)
- Noise and dust pollution in environmental sensitive zone (×)
- Impact on the road side structures due to Upgradation of the project road (×)
- Health issues of the local people during construction (×)
- Adequate traffic signal and signs along the project road (v)
- Any major festival or public gathering along the project road (During Weekly Market day)

Annex 7: GRM Information Sheet

SAMPLE GRIEVANCE REGISTRATION FORM

(To be available in Asamese and English)

The_____Project welcomes complaints, suggestions,queriesandcommentsregardingprojectimplementation.Weencouragepersonswithgrievance toprovidetheirnameandcontactinformationtoenableustogetintouchwithyouforclarification andfeedback.
Should you choose to include your personal details but want that information to remain confidential,pleaseinformusbywriting/typing*(CONFIDENTIAL)*aboveyourname.Thankyou.

Date	Place of registration	Project Town Project:			
Contact information/personal details					
Name		Gender	* Male * Female	Age	
Home address					
Place					
Phone no.					
E-mail					
Complaint/suggestion/comment/question Please provide the details (who, what, where, and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
Mode of communication: Note/letter/e-mail/verbal/telephonic	
Reviewed by: (Names/positions of officials reviewing grievance)	
Action taken:	
Whether action taken disclosed:	Yes No
Means of disclosure:	

Annex 8: Road Strip Plan

Land use	Water bodies	Trees	Commercial structure	Religious place	Health Care Facility	Education institute	Chainage	Education institute	Health Care Facility	Religious place
Left Hand Side (LHS)										

Land use		Water bodies		Trees		Commercial structure		Religious place		Health Care Facility		Education institute		Chainage	Education institute		Health Care Facility		Religious place		
Chn.	Dist(m)	Chn.	Dist.(m)	Chn.	Dist.(m)	Chn.	Dist.(m)	Chn.	Distance(m)	Chn.	Dist(m)	Chn.	Dist(m)		Chn.	Distance (m)	Chn.	Dist(m)	Chn.	Distance (m)	Chn.
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		Pond 25m												54+300	
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Annex 9: HDM 4 Output- Emissions by different types of Vehicles

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Emissions Summary

Study Name: **NH127B Meghalaya**
Run Date: **08-03-2022**

Section: NH127B Meghalaya S1
Alternative: Base Case - Without Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S1 Road Class: Primary or trunk
Length: 26.00m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	243.21	487.04	164.43	19.45	17,436.23	60.78	0.00
2022	263.71	528.10	178.30	21.09	18,906.31	65.91	0.00
2023	297.74	596.23	201.30	23.81	21,345.52	74.41	0.00
2024	345.78	692.40	233.76	27.65	24,788.69	86.42	0.00
2025	381.05	763.01	257.60	30.47	27,316.85	95.24	0.00
2026	409.16	819.30	276.60	32.72	29,332.05	102.26	0.01
2027	439.76	880.58	297.29	35.17	31,525.63	109.91	0.01
2028	473.10	947.33	319.82	37.83	33,915.51	118.24	0.01
2029	509.45	1,020.13	344.40	40.74	36,521.78	127.33	0.01
2030	549.14	1,099.60	371.23	43.91	39,366.91	137.25	0.01
2031	592.87	1,187.16	400.78	47.41	42,501.47	148.17	0.01
2032	642.32	1,286.19	434.21	51.37	46,046.93	160.53	0.01
2033	697.47	1,396.61	471.49	55.78	50,000.17	174.32	0.01
2034	759.47	1,520.77	513.40	60.74	54,444.93	189.81	0.01
2035	829.90	1,661.80	561.01	66.37	59,493.98	207.42	0.01
2036	910.13	1,822.43	615.24	72.78	65,244.81	227.47	0.01
2037	997.16	1,996.70	674.07	79.74	71,483.95	249.22	0.01
2038	1,086.52	2,175.66	734.48	86.89	77,890.70	271.55	0.01
2039	1,215.74	2,434.42	821.85	97.22	87,154.28	303.85	0.02

2040	1,338.85	2,680.96	905.08	107.07	95,980.61	334.62	0.02
2041	1,510.10	3,023.90	1,020.88	120.76	108,258.01	377.41	0.02
2042	1,694.23	3,392.66	1,145.39	135.49	121,459.62	423.43	0.02
2043	1,890.89	3,786.50	1,278.37	151.21	135,559.05	472.58	0.03
2044	2,059.56	4,124.32	1,392.41	164.70	147,652.69	514.74	0.03
2045	2,402.33	4,810.85	1,624.14	192.11	172,229.66	600.40	0.03
2046	2,425.18	4,856.63	1,639.59	193.94	173,868.33	606.11	0.03
2047	2,408.45	4,823.13	1,628.28	192.60	172,669.05	601.93	0.03
2048	2,392.41	4,791.01	1,617.43	191.32	171,518.86	597.92	0.03
2049	2,377.04	4,760.23	1,607.03	190.09	170,416.73	594.08	0.03
2050	2,362.32	4,730.75	1,597.08	188.91	169,361.39	590.40	0.03

HDM-4 **Emissions Summary**

Section: NH127B Meghalaya S1
Alternative: Improvement Case - With Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S1 Road Class: Primary or trunk
Length: 26.00m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	243.21	487.04	164.43	19.45	17,436.23	60.78	0.00
2022	260.53	521.73	176.15	20.83	18,678.20	65.11	0.00
2023	270.95	542.60	183.19	21.67	19,425.39	67.72	0.00
2024	281.95	564.79	190.78	22.54	20,217.71	70.46	0.00
2025	303.55	608.05	205.39	24.27	21,766.11	75.86	0.01
2026	326.89	654.81	221.18	26.14	23,439.82	81.69	0.01
2027	352.30	705.71	238.38	28.17	25,261.85	88.04	0.01
2028	379.98	761.14	257.10	30.38	27,246.37	94.96	0.01
2029	410.15	821.56	277.50	32.79	29,408.95	102.50	0.01
2030	443.07	887.49	299.77	35.43	31,769.16	110.72	0.01
2031	479.05	959.55	324.11	38.30	34,348.74	119.71	0.01
2032	518.40	1,038.37	350.73	41.45	37,170.14	129.55	0.01
2033	561.48	1,124.66	379.87	44.90	40,259.03	140.31	0.01
2034	608.69	1,219.21	411.80	48.67	43,643.42	152.11	0.01
2035	660.46	1,322.89	446.82	52.81	47,354.89	165.05	0.01
2036	728.05	1,458.25	492.53	58.21	52,200.59	181.94	0.01
2037	800.54	1,603.03	541.30	64.02	57,388.82	200.07	0.01
2038	910.43	1,823.01	615.49	72.81	65,265.32	227.54	0.01
2039	985.80	1,973.92	666.43	78.83	70,668.09	246.38	0.01
2040	1,068.09	2,138.67	722.06	85.42	76,566.45	266.95	0.01
2041	1,157.95	2,318.60	782.80	92.60	83,008.14	289.40	0.01
2042	1,256.13	2,515.18	849.16	100.45	90,045.64	313.94	0.02
2043	1,363.42	2,730.00	921.69	109.03	97,736.58	340.76	0.02
2044	1,480.71	2,964.85	1,000.97	118.41	106,144.27	370.07	0.02

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HDM-4 **Emissions Summary**

2045	1,608.97	3,221.66	1,087.67	128.67	115,338.24	402.13	0.02
2046	1,749.27	3,502.56	1,182.51	139.89	125,394.98	437.19	0.02
2047	1,902.77	3,809.91	1,286.27	152.17	136,398.44	475.56	0.02
2048	2,070.77	4,146.29	1,399.82	165.60	148,440.91	517.55	0.03
2049	2,256.25	4,517.67	1,525.19	180.43	161,736.63	563.90	0.03
2050	2,461.72	4,929.07	1,664.07	196.87	176,465.20	615.25	0.03

HDM-4 **Emissions Summary**

Section: NH127B Meghalaya S2
Alternative: Base Case - Without Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S2 Road Class: Primary or trunk
Length: 22.00m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	65.68	131.89	44.56	5.25	4,719.25	16.41	0.00
2022	70.49	141.55	47.82	5.63	5,064.51	17.61	0.00
2023	76.30	153.22	51.77	6.10	5,482.30	19.06	0.00
2024	84.42	169.54	57.28	6.75	6,066.04	21.09	0.00
2025	97.37	195.53	66.06	7.78	6,996.16	24.32	0.00
2026	109.14	219.17	74.05	8.72	7,841.82	27.26	0.00
2027	116.81	234.59	79.26	9.33	8,393.38	29.18	0.01
2028	125.11	251.29	84.90	10.00	8,990.79	31.25	0.01
2029	134.12	269.39	91.02	10.72	9,638.27	33.50	0.01
2030	143.88	289.02	97.66	11.50	10,340.43	35.94	0.01
2031	154.47	310.32	104.85	12.34	11,102.32	38.58	0.01
2032	165.98	333.46	112.67	13.26	11,929.98	41.46	0.01
2033	178.60	358.83	121.25	14.27	12,837.62	44.61	0.01
2034	192.34	386.46	130.59	15.37	13,825.75	48.04	0.01
2035	207.30	416.55	140.76	16.56	14,902.23	51.77	0.01
2036	223.62	449.36	151.85	17.87	16,075.78	55.85	0.01
2037	241.42	485.15	163.94	19.29	17,356.04	60.29	0.01
2038	260.85	524.23	177.15	20.84	18,753.72	65.15	0.01
2039	282.08	566.92	191.57	22.53	20,280.69	70.45	0.01
2040	305.28	613.59	207.35	24.39	21,950.14	76.24	0.02
2041	330.68	664.66	224.61	26.42	23,776.87	82.58	0.02
2042	358.49	720.59	243.50	28.64	25,777.21	89.53	0.02
2043	388.96	781.88	264.22	31.07	27,969.48	97.14	0.02
2044	422.39	849.11	286.93	33.74	30,374.21	105.48	0.02

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HDM-4 **Emissions Summary**

2045	459.16	923.05	311.92	36.68	33,018.78	114.66	0.03
2046	500.61	1,006.40	340.09	39.99	36,000.41	125.02	0.03
2047	546.79	1,099.28	371.47	43.68	39,322.49	136.55	0.03
2048	598.59	1,203.45	406.67	47.82	43,048.33	149.48	0.03
2049	657.17	1,321.25	446.48	52.49	47,261.88	164.11	0.04
2050	723.28	1,454.21	491.41	57.78	52,017.63	180.62	0.04

HDM-4 **Emissions Summary**

Section: NH127B Meghalaya S2
Alternative: Improvement Case - With Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S2 Road Class: Primary or trunk
Length: 22.00m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	65.68	131.89	44.56	5.25	4,719.25	16.41	0.00
2022	70.49	141.55	47.82	5.63	5,064.51	17.61	0.00
2023	76.30	153.22	51.77	6.10	5,482.30	19.06	0.00
2024	84.42	169.54	57.28	6.75	6,066.04	21.09	0.00
2025	97.37	195.53	66.06	7.78	6,996.16	24.32	0.00
2026	109.14	219.17	74.05	8.72	7,841.82	27.26	0.00
2027	116.81	234.59	79.26	9.33	8,393.38	29.18	0.01
2028	125.11	251.29	84.90	10.00	8,990.79	31.25	0.01
2029	134.12	269.39	91.02	10.72	9,638.27	33.50	0.01
2030	143.88	289.02	97.66	11.50	10,340.43	35.94	0.01
2031	154.47	310.32	104.85	12.34	11,102.32	38.58	0.01
2032	165.98	333.46	112.67	13.26	11,929.98	41.46	0.01
2033	178.60	358.83	121.25	14.27	12,837.62	44.61	0.01
2034	192.34	386.46	130.59	15.37	13,825.75	48.04	0.01
2035	207.30	416.55	140.76	16.56	14,902.23	51.77	0.01
2036	223.62	449.36	151.85	17.87	16,075.78	55.85	0.01
2037	241.42	485.15	163.94	19.29	17,356.04	60.29	0.01
2038	260.85	524.23	177.15	20.84	18,753.72	65.15	0.01
2039	282.08	566.92	191.57	22.53	20,280.69	70.45	0.01
2040	305.28	613.59	207.35	24.39	21,950.14	76.24	0.02
2041	330.68	664.66	224.61	26.42	23,776.87	82.58	0.02
2042	358.49	720.59	243.50	28.64	25,777.21	89.53	0.02
2043	388.96	781.88	264.22	31.07	27,969.48	97.14	0.02
2044	422.39	849.11	286.93	33.74	30,374.21	105.48	0.02

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HDM-4 **Emissions Summary**

2045	459.16	923.05	311.92	36.68	33,018.78	114.66	0.03
2046	500.61	1,006.40	340.09	39.99	36,000.41	125.02	0.03
2047	546.79	1,099.28	371.47	43.68	39,322.49	136.55	0.03
2048	598.59	1,203.45	406.67	47.82	43,048.33	149.48	0.03
2049	657.17	1,321.25	446.48	52.49	47,261.88	164.11	0.04
2050	723.28	1,454.21	491.41	57.78	52,017.63	180.62	0.04

HDM-4 **Emissions Summary**

Section: NH127B Meghalaya S3
Alternative: Base Case - Without Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S3 Road Class: Primary or trunk
Length: 33.20m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	359.28	721.23	243.57	28.71	25,802.12	89.73	0.01
2022	384.45	771.83	260.66	30.72	27,611.44	96.02	0.02
2023	427.80	858.88	290.07	34.18	30,725.24	106.84	0.02
2024	495.11	993.95	335.68	39.56	35,558.11	123.66	0.02
2025	542.71	1,089.60	367.98	43.36	38,978.98	135.54	0.02
2026	572.83	1,150.23	388.46	45.77	41,146.29	143.06	0.02
2027	605.04	1,215.07	410.36	48.34	43,464.11	151.10	0.03
2028	639.52	1,284.49	433.82	51.09	45,945.54	159.70	0.03
2029	676.47	1,358.89	458.95	54.04	48,604.47	168.92	0.03
2030	716.09	1,438.69	485.90	57.20	51,456.58	178.81	0.03
2031	758.63	1,524.38	514.85	60.59	54,519.12	189.42	0.04
2032	804.36	1,616.49	545.97	64.24	57,811.23	200.83	0.04
2033	853.56	1,715.63	579.46	68.17	61,354.09	213.11	0.05
2034	909.74	1,828.81	617.70	72.65	65,398.98	227.13	0.05
2035	971.86	1,953.95	659.97	77.61	69,871.10	242.63	0.05
2036	1,040.91	2,093.03	706.95	83.12	74,841.84	259.85	0.06
2037	1,118.45	2,249.21	759.71	89.31	80,423.61	279.20	0.07
2038	1,206.57	2,426.69	819.67	96.34	86,767.10	301.19	0.07
2039	1,308.04	2,631.01	888.70	104.44	94,070.01	326.51	0.08
2040	1,416.29	2,849.06	962.37	113.08	101,863.06	353.52	0.09
2041	1,537.52	3,093.30	1,044.91	122.75	110,592.11	383.77	0.10
2042	1,659.10	3,338.39	1,127.73	132.45	119,349.52	414.10	0.11
2043	1,843.72	3,710.19	1,253.43	147.19	132,639.75	460.18	0.12
2044	2,006.47	4,038.27	1,364.32	160.18	144,363.19	500.78	0.13

HDM-4 **Emissions Summary**

2045	2,230.88	4,490.42	1,517.23	178.09	160,523.38	556.78	0.15
2046	2,500.03	5,032.70	1,700.66	199.57	179,905.44	623.94	0.17
2047	2,765.83	5,568.58	1,881.90	220.77	199,054.97	690.25	0.20
2048	3,040.73	6,123.12	2,069.47	242.70	218,868.39	758.83	0.22
2049	3,243.05	6,531.96	2,207.58	258.83	233,467.28	809.27	0.24
2050	3,686.36	7,427.04	2,509.73	294.19	265,439.06	919.82	0.29

HDM-4 **Emissions Summary**

Section: NH127B Meghalaya S3
Alternative: Improvement Case - With Project
Sensitivity: No Sensitivity Analysis Conducted

Sect ID: NH127B Meghalaya S3 Road Class: Primary or trunk
Length: 33.20m Width: 3.50m Rise+Fall: 1.00m/km Curvature: 100.00 deg/km

Year	Annual Emission Quantities in tonnes						
	Hydrocarbon HC	Carbon monoxide CO	Nitrous oxide NOx	Sulphur dioxide SO2	Carbon dioxide CO2	Particulates Par	Lead Pb
2021	359.28	721.23	243.57	28.71	25,802.12	89.73	0.01
2022	384.45	771.83	260.66	30.72	27,611.44	96.02	0.02
2023	427.80	858.88	290.07	34.18	30,725.24	106.84	0.02
2024	495.11	993.95	335.68	39.56	35,558.11	123.66	0.02
2025	542.71	1,089.60	367.98	43.36	38,978.98	135.54	0.02
2026	572.83	1,150.23	388.46	45.77	41,146.29	143.06	0.02
2027	605.04	1,215.07	410.36	48.34	43,464.11	151.10	0.03
2028	639.52	1,284.49	433.82	51.09	45,945.54	159.70	0.03
2029	676.47	1,358.89	458.95	54.04	48,604.47	168.92	0.03
2030	716.09	1,438.69	485.90	57.20	51,456.58	178.81	0.03
2031	758.63	1,524.38	514.85	60.59	54,519.12	189.42	0.04
2032	804.36	1,616.49	545.97	64.24	57,811.23	200.83	0.04
2033	853.56	1,715.63	579.46	68.17	61,354.09	213.11	0.05
2034	909.74	1,828.81	617.70	72.65	65,398.98	227.13	0.05
2035	971.86	1,953.95	659.97	77.61	69,871.10	242.63	0.05
2036	1,040.91	2,093.03	706.95	83.12	74,841.84	259.85	0.06
2037	1,118.45	2,249.21	759.71	89.31	80,423.61	279.20	0.07
2038	1,206.57	2,426.69	819.67	96.34	86,767.10	301.19	0.07
2039	1,308.04	2,631.01	888.70	104.44	94,070.01	326.51	0.08
2040	1,416.29	2,849.06	962.37	113.08	101,863.06	353.52	0.09
2041	1,537.52	3,093.30	1,044.91	122.75	110,592.11	383.77	0.10
2042	1,659.10	3,338.39	1,127.73	132.45	119,349.52	414.10	0.11
2043	1,843.72	3,710.19	1,253.43	147.19	132,639.75	460.18	0.12
2044	2,006.47	4,038.27	1,364.32	160.18	144,363.19	500.78	0.13

HDM-4 **Emissions Summary**

2045	2,230.88	4,490.42	1,517.23	178.09	160,523.38	556.78	0.15
2046	2,500.03	5,032.70	1,700.66	199.57	179,905.44	623.94	0.17
2047	2,765.83	5,568.58	1,881.90	220.77	199,054.97	690.25	0.20
2048	3,040.73	6,123.12	2,069.47	242.70	218,868.39	758.83	0.22
2049	3,243.05	6,531.96	2,207.58	258.83	233,467.28	809.27	0.24
2050	3,686.36	7,427.04	2,509.73	294.19	265,439.06	919.82	0.29

Annex 10: Guidelines for Tree Plantation and Management

Purpose

To develop eco-friendly road with participation of the community, farmers, NGOs, private sector, institutions, government agencies and the Forest Department. Documentation of species to be planted along road.

Objectives

- To reduce the impacts of air pollution and dust as trees and shrubsare known to be natural sink for air pollutants
- To reduce the impact of ever increasing noise pollution caused dueto increase in number of vehicles
- To arrest soil erosion at the embankment slopes
- Moderating the effect of wind and incoming radiation

Selection of Tree Species for roadside plantations

The planting species are decided based on the physical growth characteristics of trees, like form and shape, foliage pattern, growth rate, branching pattern, soil characteristics and conditions of the strip like water logged areas etc. While selecting the species of trees for landscaping a great care should be taken to choose the species, which already exist along the project corridor. On the other hand, if a pure avenue of single species is planted for a considerable length of the road, it gives a harmonious and pleasing look. It is, therefore, essential that mixtures of different species should be avoided and pure avenues of a single species be planted over long stretches of road.

Plantation Pattern

A concept should be evolved so as to maintain visual characteristics and uniformity interms of landscape along the stretch. In the absence of uniform land availability for the plantations,different schemes may be worked out in tune with the local variations inthe design. To achieve this, the entire stretch of the project corridorshould be divided into homogenous landscape sections based on similarityin terms of available width, soil conditions, climate (temperature andrainfall) and topography. A study on the local flora and vegetative covernative to these sections should be carried out as part of the field surveysto enable a choice of the suitable species for particular section. Dependingon the available ROW, plantation pattern should be worked out as follows:-

- The first row along the Highways will be of small to medium sized ornamental trees.
- Planting of shrubs in the median.
- Turfing with grass in the median, special landscapes, and embankment slopes
- The shrubs to be planted in the median should be of low or medium height for prevention of the headlight glare

Complianceto Forest Conservation Act and local laws

Before starting any plantation, the local forest department will be consulted for ensuring compliance to any regulation in force that mayaffect raising, maintenance, and harvesting of the raised plantation.Necessary modifications will be made in the plantation scheme, inconsultation with the forest department, to ensure compliance to law and toavoid complications at the time of harvesting and transportation of forestproduce. In case the State Government has any provision for registration ofsuch plantations, the same will be ensured under the relevant scheme

Guidelines for Median Plantation

One or two rows of flowering shrubs are recommended in accordance to the varying width of the median in different sections. In sections where median width is less than 1.5 meter, only grass turf is recommended. In median width of 3 meters, one row of shrub whereas in 5 meter median width, plantation of two rows of flowering shrubs are proposed. Only two rows of shrubs will be planted on median width of 5 meters and these plants will be at a spacing of 1.5 meters from the inner edge of the median. The plants will be at spacing of 3 x 3 meters and size of the pits for planting will be 0.6m dia and deep. Therefore, total no. of plants per km will be 333 in case where single row is proposed and 666 in case of two rows. The surface for the median plantation should be well prepared. The masses of loose derbies on the median and any convexities will be removed and similarly any concavities are to be filled by good soil. The surface should have sufficient layer of good quality soil so as to have a better growth and survival of grasses and shrubs.

Protection measures

The fencing of single row plantations will be done by using iron/brick/cement guards. Locally available bamboo guards or thorn fencing may also be used where protection can be ensured through these. The specifications for the iron guards are as per IRC-SP-21, 2009 The fencing of multiple row plantations will be done preferably by barbed wire. A five strand barbed wire fencing, with cross strands, stretched on angle iron poles fixed at a distance of 4 meter from one another; is recommended. Live fencing/bamboo fencing/thorn fencing may also be used where protection can be ensured through these. The specifications for barbed wire fencing are as per IRC-SP-21, 2009

Maintenance of Plantation

The scope of the maintenance work is as per Model Tor of plantation and maintenance, IRC-SP-21, 2009 and also as per adjoining forest schedule for those items which are not included in the model Tor/IRC guidelines.

Monitoring

- The Monitoring Agency will monitor progress of planting and status of plantations on continuous basis
- This agency shall carry out the site visit for field verification in respect of survival, growth and size of plantation and maintenance of the same

Annex 11: Guidelines for Borrow Area Management

Purpose

Borrow areas are generally required to provide material for road construction sites, can have significant adverse environmental effects, especially on ecologically sensitive areas. Borrow areas can become environmental hotspots and can significantly affect the visual appearance of an area. Special mitigation and management measures are often required to avoid or minimise the environmental and social impacts of borrow areas.

Scope

These guidelines for borrow areas cover:

- statutory approvals
- environmental and social impacts of borrow areas
- selection of borrow areas
- operation of borrow areas
- rehabilitation of borrow areas

The guidelines seek to ensure that Contractors:

- comply with the regulatory requirements in force at the time
- reasonably manage any impacts
- reinstate and rehabilitate the land appropriately
- consult with affected communities

Impacts

Some of the potential impacts of borrow areas are:

- trucks transporting materials to the site causing air pollution, and noise and vibrations
- ponds of stagnant water forming in excavated areas giving rise to the breeding of mosquitoes and the spreading of malaria and other mosquito-borne diseases
- natural beauty of the landscape being affected by excavations and the removal of vegetation
- natural drainage systems in the area being affected by excavations
- agriculture land and productive soils being lost, especially in paddy field areas

In IRC: 10 and Clause 305.2.2.2 of MoRTH Specification, exclusive guideline has been given for borrow areas located alongside the road and only some of the requirements have been indicated for borrow areas located outside the road land. Following guideline is proposed to supplement the existing stipulation in IRC:10 and Clause 305.2.2.2 of MoRTH Specification for Roads and Bridge Works:

Location

- Identify areas having present land use as barren land, riverside land. Otherwise, un-irrigated agriculture land or land without vegetation and tree cover;
- Prefer borrow areas on bed of irrigation water storage tank;
- Prefer areas of highland with respect to surroundings;
- Avoid locating borrow area close to any road (maintain atleast 30 m distance from ROW and 10 m from toe of embankment, whichever is higher);
- Should be at least 1.5 km away from inhabited areas;
- Maintain a distance of about 1.5km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, wetland etc.;
- Maintain a distance of about 1.5 km from school, hospital and any archaeological sites;
- Having adequate approach road with minimum length of earthen road;
- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult;

- Depth of excavation should be decided based on natural ground level of the land and the surroundings, and rehabilitation plan. In case higher depth of excavation is agreed with backfilling by unsuitable excavated soil (from roadway), then filling should be adequately compacted except topsoil which is to be spread on topmost layer (for at least 20cm thick).

Operation

- Controlled operation as per agreed / approved plan;
- Preservation of topsoil at designated areas e.g. corners of the area etc.;
- Maintain necessary buffer zone in all directions and go for vertical cut within this area. Final cut slope should be maintained within the buffer zone;
- Step-wise excavation if borrow area is located on inclined area having more than 2% slope;
- Restricting excavation up to 2m for each stages of operation if allowed depth is more;
- Avoid cutting of any tree of girth size > 30cm16. if any tree cutting is inevitable, prior permission (written) from the competent authority should be taken and compensatory plantation has to be raised.

Rehabilitation

- Prior approval of Rehabilitation Plan considering terrain, land use and local need;
- Restricting operation as agreed by landowner and approved by the Engineer;
- Rehabilitation within agreed timeframe and before taking over;
- Integrate debris disposal and borrow area redevelopment.

Management Procedure

The important aspects of this procedure are:

- The first and foremost thing is to have tentative estimate of borrow material requirement chainage-wise. For this, BoQ quantity for earth work, which is given as total quantity for the entire package/milestone, has to be distributed chainage-wise. The requirement of borrow material chainage-wise then has to be estimated based on the suitability of roadway excavation material for reuse and BoQ.
- Contractor to site borrow areas fulfilling environmental requirements and obtaining one time approval of the Engineer both on quality as well asenvironmental consideration thereby integrating environmental safeguard measures into day-to-day activities;
- Contractor to submit environmental information in prescribed format for obtaining
- Engineer’s approval, as given in the following format (Borrow Area Identification).
- The format has been so designed that it stipulates the requirements as well as what is actual for each borrow areas and could be easily understood by any person, whoever in-charge of identifying borrow areas;
- Contractor to submit Borrow Area Layout Plan as attachment to the format showing the land use of the proposed and surrounding area along with the presence of other environmental features such as water bodies, forests, settlement, temple and any sensitive receptor i.e. health and educational institution, roads etc. within a radius of 1.5km area from the boundary of the borrow area;
- Contractor to prepare and submit Block Contour Map of each borrow area (especially which are located close to road and on undulating terrain) for deciding on operation and redevelopment plan;
- Contractor to prepare Operation Plan and submit as attachment to the format including cross sections on both directions (x,y) mentioning natural ground level, depth of topsoil (if any), total depth of excavation, cut side slope and bed slope;
- Contractor to prepare Redevelopment Plan and submit as attachment to the format include cross sections on both directions (x,y) mentioning natural ground level, excavated profile, finished profile after redevelopment etc.;
- Contractor to maintain Borrow Material Register;

- Periodic joint inspections of each borrow area until rehabilitation is complete as agreed and approved.

The checklist for periodic inspection is given in this Annexure.

Borrow Areas Identification

Construction Stage Report:One Time Date:
Location of Borrow Area (Ch. & Offset): Revenue Survey No.:

Sl. No.	Item / Requirement	Details as per Actual (to be filled by Contractor & checked by Engineer)
1	Date of Borrow Area planned to be operational	
2	Current Land use (preference to barren land, riverside land, otherwise, un-irrigated agriculture land or land without tree cover)	
3	Size (Sq.m) and area (m x m) of Borrow Area	
4	Proposed maximum depth of pit in m (IRC 10 & Clause 305.2.2 of MoRTH Spec.)	
5	Details of riverside borrow area (inner edge should not be less than 10m from the toe of the bank and bottom of pit should not cut the imaginary line of 1:4 from embankment top)	
6	Borrow area in cultivable land (should be avoided or restricted to total depth of 45cm including preservation of 15cm topsoil)	
7	Quantity Available (Cum)	
8	Quantity of top soil to be removed (Sq.m& depth in cm)	
9	Details of preservation (storage) and management (re-use / re-laid) of top soil	
10	Width of Haul road (m)	
11	Total Length of Haul Road (km)	
12	Length of Non-metal Haul Road (should be as minimum as possible)	
13	No of settlements within 200 m of Non-metal Haul Road (should be as minimum as possible)	
14	Distance from settlement (should be minimum 1500 m)	
15	Should be away from water bodies. Give details of water bodies within 250 m.	
16	Details of water sources for dust suppression	
17	Quantity of water required for dust suppression i.e. sprinkling at borrow area and on haul road (Cum)	
18	Availability of water required for dust suppression (Cum)	
19	Details of ecologically sensitive area i.e. RF, PF, Sanctuary etc. within 1500m (should be nil)	
20	Details of school, hospital and any archaeological sites within 1500m (should be nil)	
21	Distance from nearby road embankment, fence line / boundary (should be minimum 30m from ROW and 10m from toe of embankment, whichever is higher)	
22	No of Trees with girth more than 0.3 m (No tree should be	

	affected)	

Documents to be attached:

Site plan and layout plan of borrow area;

- Proposed borrow area operation and redevelopment plan;
- Written consent from competent authority for use of water for dust suppression
- Written consent of landowner on agreed operation and redevelopment plan
- Certified that the furnished information is correct and all relevant information as required is attached

Annex 12: Guidelines for Emergency Management System

All employees of the Construction Contractor shall immediately report all environmental incidents to their site supervisor who will investigate the incident with the Construction Contractor Manager.

It is a Construction Contractor requirement that all incidents are reported and investigated, such as:

- Any injury to any person, including first-aid,
- Any illness,
- Any damage to property or equipment,
- Any loss of containment of hazardous materials,
- Any environmental incident, and
- Any 'near-miss', that is, an incident with no injury, damage or loss but which could have resulted in significant injury, damage or loss.

No matter how minor, the employee is to report the incident immediately to the relevant supervisor. In every case the site supervisor is to document the incident using the Construction Contractor's Incident Management System.

All incident reports shall be discussed at toolbox meetings to ensure all site personnel learn from the incident.

Incidents that have the potential to cause localized environmental impacts need to be reported to the Project Manager and Environment Team within 24 hours. Incidents that cause or have the potential to cause environmental impacts external to the facility boundary need to be reported to Environment Team and the Project Manager immediately. Full copies of the report / incident investigation shall be provided to the Project Manager upon completion.

➢ First Aid / Spill Response Kits

The Construction Contractor will ensure that First Aid facilities (First Aid Kits) and spill response kits are available on the project site at all times. First Aid Kits shall be stored in the site office and/or the site supervisor's car. First Aid Kits shall also be audited on a regular basis by Construction Contractor and supplies re-ordered as required. The spill response kit shall be stored in the area where refuelling activities shall be undertaken as a priority. Re-fuelling should be limited to small equipment and on hardstand areas only where any spills can be cleaned up immediately. Spill trays should be used during refuelling to prevent spillage.

The Construction Contractor shall also ensure that at least ten percent (10%) of employees are trained in First Aid principles and spill response or site clean-up procedures, including the site supervisor. An emergency contact list shall also be posted on site, which will display the contact details for the nearest hospital and emergency services. This information shall also be covered in the start-up / site induction.

➢ Fire Emergency

The Construction Contractor will ensure that its work areas and facilities are equipped with firefighting equipment suitable for the work being performed. Employees shall also be made aware of the location of firefighting equipment available on site through signage and at the start-up site induction.

The Construction Contractor Manager shall also ensure that the firefighting equipment is checked on a regular basis by competent personnel.

The Construction Contractor Manager should be contacted to report any fires immediately. If it is a life threatening, emergency contact 101 or local fire services should be called first followed by call to Construction Contractor Manager.

➢ Wardens / Coordinators

The Site Supervisor is nominated as the senior coordinator for emergency procedures for the project. The Site Supervisor or delegate will take charge in the event of an emergency event and ensure that personnel get to the nearest muster point and that all personnel are accounted for.

➢ Site Specific Emergency Contact Details

Emergency Contact	Address / Contact Name	Telephone Number
Emergencies (Save 101 for emergencies)		
Police		
Closest Hospital		
Construction Contractor Manager		
Project Manager		
EHS Manager		

Annex 13: Guidelines for Waste Disposal and Management

Purpose

- To maximize re-use of material generated during construction and
- To avoid environmental hazards due to improper disposal of construction waste material.

Procedure

The following procedures should be followed for upkeep of storage and disposal sites:

- Contractor shall maintain register for keeping records on kilometer-wise quantities of material generated during grubbing, stripping, excavation and scarifying;
- Contractor shall re-use construction material to the extent possible based on engineering properties. Possible re-use areas are fill sections, embankment slope, village approach roads etc. Debris without bitumen could be used for backfilling of quarry / borrow areas as recommended by the Engineer. At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60mm thick layer of rammed clay so as to eliminate the possibility of the leaching of the wastes into the ground water. The contractor shall ensure that the filled area is covered with a layer of preserved topsoil layer of preserved topsoil.
- Contractor shall estimate the chainage-wise quantities of various waste material to be disposed of;
- Contractor shall restrict waste disposal strictly at approved site/s only;
- Contractor shall prepare a plan including detailed lay out plan and cross-section for disposal of debris and bitumen waste and get approval of the same by the Engineer;
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area;
- Contractor and Engineer shall ensure that disposal areas are properly treated as per agreed plan;
- Contractor and Engineer's representatives shall undertake joint weekly inspection to ensure compliance of various environmental requirements.
- Engineer's representatives shall issue non-compliance if disposal site is not managed as per agreed plan;
- All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the SC.

Site Inspection

Weekly joint site inspection shall be undertaken for all the storage areas. The details of attributes, which are to be inspected, are given as follows. The Contractor shall ensure compliance of the requirements.

Details to be inspected for Monitoring Construction Material Reuse & Disposal

Attributes	Requirements
Construction material generation and re-use	• Segregating debris and bitumen during generation; • Segregating re-usable portion of debris and bitumen and storing preferably near areas of re-use; and • Temporary storage of waste material at sites as directed by the Engineer.
Waste disposal	• Disposal of waste material at approved disposal site within a week of generation; • Disposal site should be properly demarcated; • Proper leveling / grading at disposal site/s; • Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented; • Recommended / agreed safeguard measures to avoid soil erosion are to be implemented; • Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.

Annex 14: Outline of an Environmental Monitoring Report

1. Introduction

- Overall project description andobjectives
- Environmental category of each subproject as per national laws andregulations
- Project SafeguardsTeam

Name	Designation/Office	Email Address	Contact Number
1. PMU			
2. PIUs			
3. Consultants			

- Overall project and sub-project progress andstatus
- Descriptionofsubprojects(package-wise)andstatusofimplementation(preliminary,detailed design, on-going construction, completed, and/or O&Mstage)

Package Number	Components/List of Works	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M)[a]	Contract Status (specify if under bidding or contract awarded)	If On-going Construction	
				%Physical Progress	Expected Completion Date

[a]If on-going construction, include %physical progress and expected date of completion.

2. Compliance Status With National/State/Local Statutory EnvironmentalRequirements[a]

Package No.	Subproject Name	Statutory Environmental Requirements[b]	Status of Compliance[c]	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Establish[d]

[a]Allstatutoryclearance/s,no-objectioncertificates,permit/s,etc.shouldbeobtainedpriortoawardofcontract/s. Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.
[b] Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.)
[c] Specify if obtained, submitted and awaiting approval, application not yet submitted
[d] *Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 5 trees for every tree cut, etc.*

3. Compliance Status With Environmental LoanCovenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

4. Compliance Status with the Environmental Management Plan (Refer to EMP Tables in ApprovedEIA/S)

- Confirm if EIA/s require contractors to submit site-specific EMP/construction EMPs.If not, describe the methodology of monitoring each package underimplementation.

Package-wise Implementation Status

Package Number	Components	DesignStatus (Preliminary Design Stage/ Detailed Design Completed)	Final EIA based on Detailed Design				Site-specific EMP (orConstruction EMP) approved by Project Director? (Yes/No)	Remarks
			Not yetdue(detailed design not yet completed)	Submittedto JICA (Provide Date of Submission)	Disclosed On project website (Provide Link)	Final EIAprovided to Contractor/s (Yes/No)		

- Identify the role/s of Safeguards Team including schedule of on-site verification of reports submitted by consultants andcontractors.
- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmentalsafeguards.
- Include as appendix all supporting documents including **signed**monthly environmental site inspection reports prepared by consultants and/orcontractors.
- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below
- Provide the monitoring results as per the parameters outlined in the approved EMP (or site-specific EMP/construction EMP whenapplicable).
- In addition to the table on EMP implementation, the main text of the report should discuss in details the followingitems:

(i) **Grievance Redress Mechanism.** Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-relatedissues/complaints.IncludeasappendixNotificationoftheGRM(town-wise ifapplicable).

(ii) **Complaints Received during the Reporting Period.** Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved EIA. Identify safeguards team member/s involvedin the GRM process. Attach minutes of meetings (ensure English translation isprovided).

- Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed forsite/s.
- Identifymuddywaterwasescapingsiteboundariesormuddytrackswereseenon adjacentroads.
- Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these were intact following heavyrain;
- Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of eacharea.
- Confirm spill kits on site and site procedure for handlingemergencies.
- Identify any chemical stored on site and provide information on storage condition. Attachphotograph.
- Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Providephotographs.
- Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Providephotographs.
- Provide information on barricades, signages, and on-site boards. Provide photographs.
- ProvideinformationonCheckingiftherareanyactivitiesbeingundertakenout of working hours and how that is beingmanaged.

5. Summary of Environmental Monitoring Activities (for the Reporting Period)

Impacts (List from EIA)	Mitigation Measures (List from EIA)	Parameters Monitored (As a minimum those identified in the EIA should bemonitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

[a]Attach Laboratory Results and Sampling Map/Locations

6. Overall Compliance with CEMP/ EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposedand Additional Measures Required

7. Approach and Methodology for Environmental Monitoring of the Project

- Briefdescriptionontheapproachandmethodologyusedforenvironmentalmonitoringofeach sub-project

8. Monitoring of Environmental Impacts on Project Surroundings (Ambient Air, Water Quality and NoiseLevels)

- Brief discussion on the basis formonitoring
- Indicate type and location of environmental parameters to bemonitored
- Indicate the method of monitoring and equipment to beused
- Providemonitoringresultsandananalysisofresultsinrelationtobaselinedataandstatutory requirements

As a minimum the results should be presented as per the tables below.

9. Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

10. Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

11. Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Monitoring Results)	
			Day Time	Night Time

12. Summary of Key Issues and Remedial Actions

- Summary of follow up time-bound actions to be taken within a settimeframe.

13. Appendixes

- Photos
- Summary ofconsultations
- Copies of environmental clearances andpermits
- Sample of environmental site inspectionreport
- Other

Annex 15: Guidelines for Siting and Layout of Construction Camp

Purpose

Campsite of a contractor represents the single potentially most polluting location during implementation of any road project. Air pollution may be caused by emissions from Crushers, Hot-Mix, and Concrete Batching Plants. Water pollution may be caused by discharge of sediment, oil & grease, and organics laden run-off from these plants and their ancillary facilities as well as workshops, residential quarters for the labor. Land may be polluted due to indiscriminate disposal of domestic waste or (accidental) release of hazardous solids from storage areas.

While the installation and operation of Crushers and Hot-Mix Plants are regulated by the respective Pollution Control Boards, the other sources described above usually do not appear to be causes of significant concern. Items to be considered for labor camps are mentioned briefly in Clause 105.2 (as part of 105: Scope of Work) of the Ministry of Road Transport and Highways (MoRTH) publication: Specifications for Road and Bridge Works. Some specific requirements for labor accommodation and facilities are to be met by the Contractor in line with Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Currently, there is no one-point guidance regarding the environmental management aspects of the Contractor's campsite. This guideline on Campsites is designed to fill this gap.

Scope

This guideline covers the Contractors' camp sites – whether used by in-house crew or by any sub-contractors'crew. It covers siting, operation, maintenance, repair and dismantling procedures for facilities for labor employed on project (and ancillary) activities as well as equipment and vehicles. ***It does not include siting, operation, maintenance, repair anddismantling of major plants – Hot-mix Plant, Concrete Batching Plant, Crusher or Wet Mix Macadam Plant.***

- ## Siting, Establishing, Operation and Closure of Construction Camp

Potential Environmental Impacts

Construction camps require large areas for siting facilities like major plants, storage areas for material, residential accommodation for construction labor and supervisors, and offices. Removal of topsoil and vegetation from the land to be utilized for camps is the first direct impact of any such establishment. In addition, local drainage may be impaired if proper drainage is not effected by grading. Other impacts may include damage to ecologically important flora and fauna, if campsites are located close to such areas. Water pollution because of discharge of sediment, fuel and chemicals is also a possibility. Pollution of land due to indiscriminate disposal of construction wastes including scarified pavement, concrete and even substantial quantities of domestic wastes from residential areas can also be potentially disastrous, especially if the site is reverted to its original use after the project (mostly agriculture).

Mitigation Measures

<u>Siting up Construction Camp</u>

The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1.5 km from boundaries of designated Reserved Forests,Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain 1.5 km from river, stream and lake and 500m from ponds
- Maintain 250 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses.
- Locate campsites in the (most prevalent) downwind direction of nearest village(s). The boundary of the campsite should be at least 1.5 km from the nearest habitation so that the incoming labor does not stress the existing local civic facilities.
- The ground should have gentle slope to allow free drainage of the site.
- Recorded consultations should be held with residents of the nearest settlement and/or their representatives to understand and incorporate where possible, what they would like to see within their locality.

Establishment, Operation, and Closure of Camps

The facilities within the camp site should be laid out so that the separation distances suggested in other guidelines are maintained. A notional lay-out of the facilities except the major plants is included in this guideline.

- Topsoil from the area of the plant shall be stored separately for the duration of the operation of the camp and protected from being washed away, unless agreed otherwise in writing with the owner. If stored, it will be returned on to its original location at the time of closure of the site.
- The Contractor shall prepare, make widely available (especially to staff responsible for water and material management), and implement a Storm water Management Plan (SWMP) for (all) the site(s) following approval of the same by the Engineer.
- The Contractor shall prepare an Emergency and Spill Response Plan as per the requirements
- The Contractor shall prepare a Waste Management Plan describing the types and quantities that are likely to be generated from within the camp site, with the period and duration during the construction schedule; methods to be adopted to minimize these; methods of removal, treatment and (on-site or off-site) disposal for each type; as well as location of final disposal site, if any.
- The Contractor shall provide safe ingress and egress for vehicles from the site and public roads and shall not impact existing through traffic.
- Water tankers with sprayers must be available at the camp site at all times to prevent dust generation.
- In case of stockpiles of stored material rising higher than wind-breaking perimeter fencing provided, sprinklers shall be available on site to prevent dusting from the piles during windy days.
- On completion of works, the Contractor shall restore the site to the condition it was in before the establishment of the campsite, unless agreed otherwise in writing with the owner(s) of the site(s). If such a written agreement has beenmade, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.

- **Equipment and Vehicle-related issues**

Potential Environmental Impacts

The maintenance and repair of equipment and vehicles in Contractor's camp are activities that can have significant adverse impacts if not carried out properly. The concern mainly arises from discharge of wash water contaminated with oil and grease, whether from washing of vehicles or degreasing of equipment and vehicle parts. Vehicle washing,

especially dirt from tires, also gives rise to sediment-laden run-off. No such discharges should be directly allowed into surface water bodies since they can be harmful to aquatic species.

Mitigation Measures

Vehicles

All vehicles used by the Contractor must have copies of currently valid Pollution Under Control Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract.

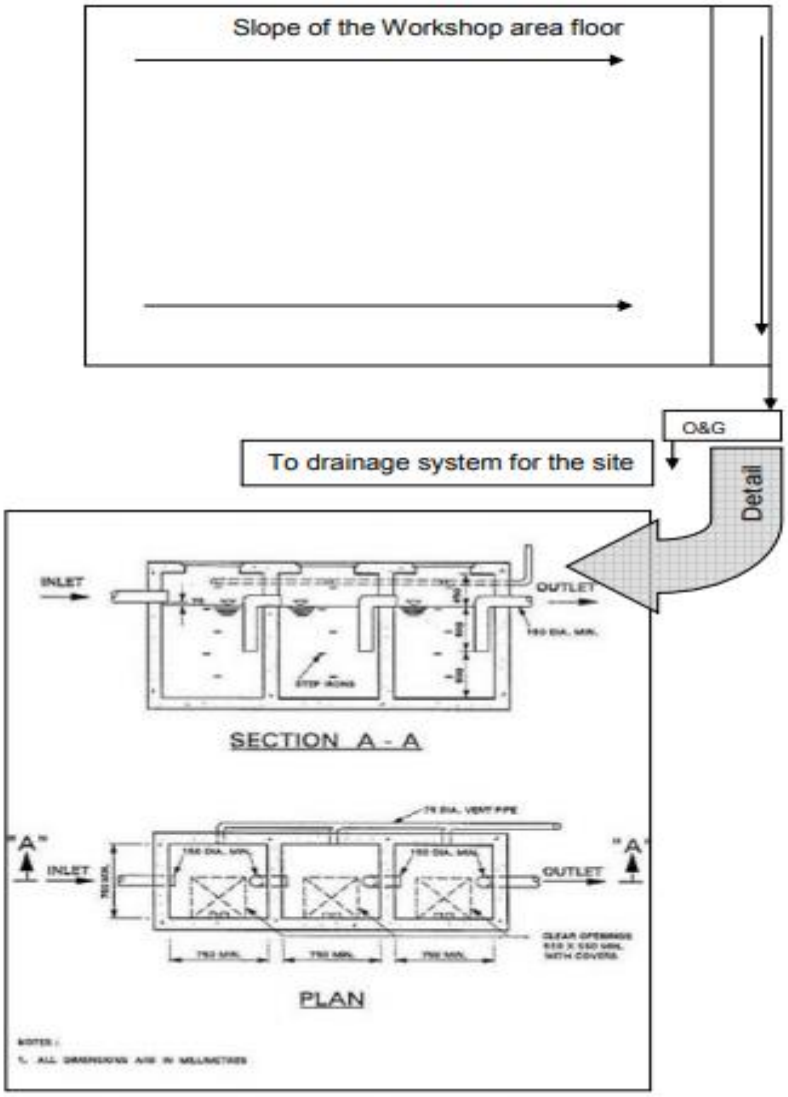
All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.

Workshop and Maintenance areas

These areas must have impervious flooring to prevent seepage of any leaked oilgrease into the ground. The area should be covered with a roof to prevent the entry of rainwater.

The flooring shall be sloped to from both directions to one corner where an oil-and-grease trap with sufficient capacity should be installed. All discharges from the workshop area must pass through the trap to remove the floating oil and grease before entering the drainage system of the site. The trap should be designed to provide a hydraulic residence time of about 20 minutes for the peak hourly discharge anticipated from the area (as per following figure).

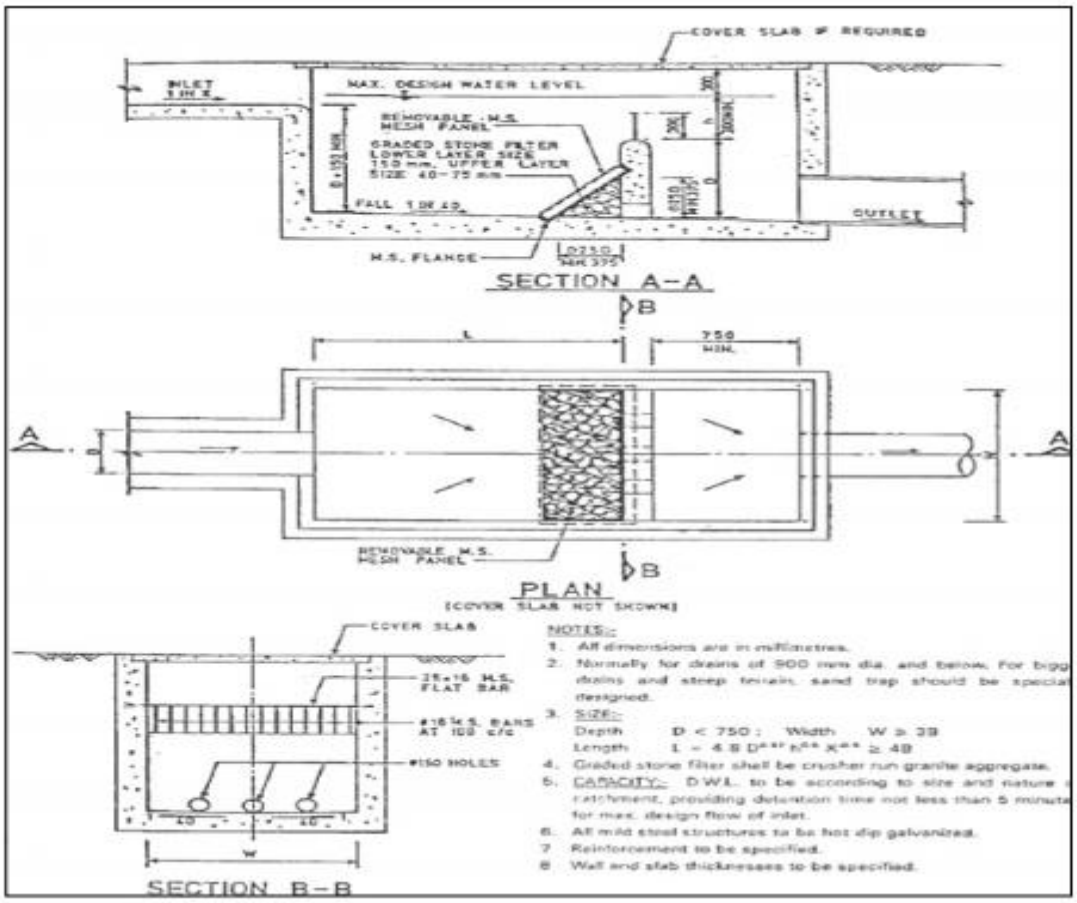
Alternatively, degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used as shown in the adjacent photograph. This arrangement will require some initial investment and running cost for the pump, but the payback period, in terms of the use of diesel, under Indian conditions, has been reported to be less than 1 year.



Workshop Area Pollution Control

All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. For this purpose, metallic drums should be used. These should be stored separately in sheds, preferably bunded. The advantage of this arrangement is that it allows for accurate accounting in case the waste material is sold to oilwaste recyclers or other users like brick-kiln owners who can burn such inferior fuel.

A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any, after each day's construction is over, or as required. This ramp should have an impervious bottom and it should be sloped so that it drains into a separate chamber to remove the sediment from the wash water before discharge. The chamber should allow for a hydraulic residence time of about 10 minutes for discharge associated with the washing of each truck. Following figure 2 shows an outline sketch for a sedimentation chamber.



Sedimentation Chamber for vehicle washing ramp discharge

Facilities for Labour

Potential Environmental Impacts

The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and may harm the crew themselves as well as local residents. Improper sanitation and inadequate health care also potential bottlenecks that the Contractor can eliminate with relatively little effort.

Mitigation Measures

It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as benchmark for improved environmental performance of road projects:

- The contractor shall provide free-of-charge temporary accommodation to all the labour employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for every 20 persons. More toilets and/or urinals may have to be provided if the Engineer decides that these numbers are insufficient. In case female labourers are employed, separate toilet and urinals will be provided in locations clearly marked “Ladies Toilets” in a language understood by most labourers.

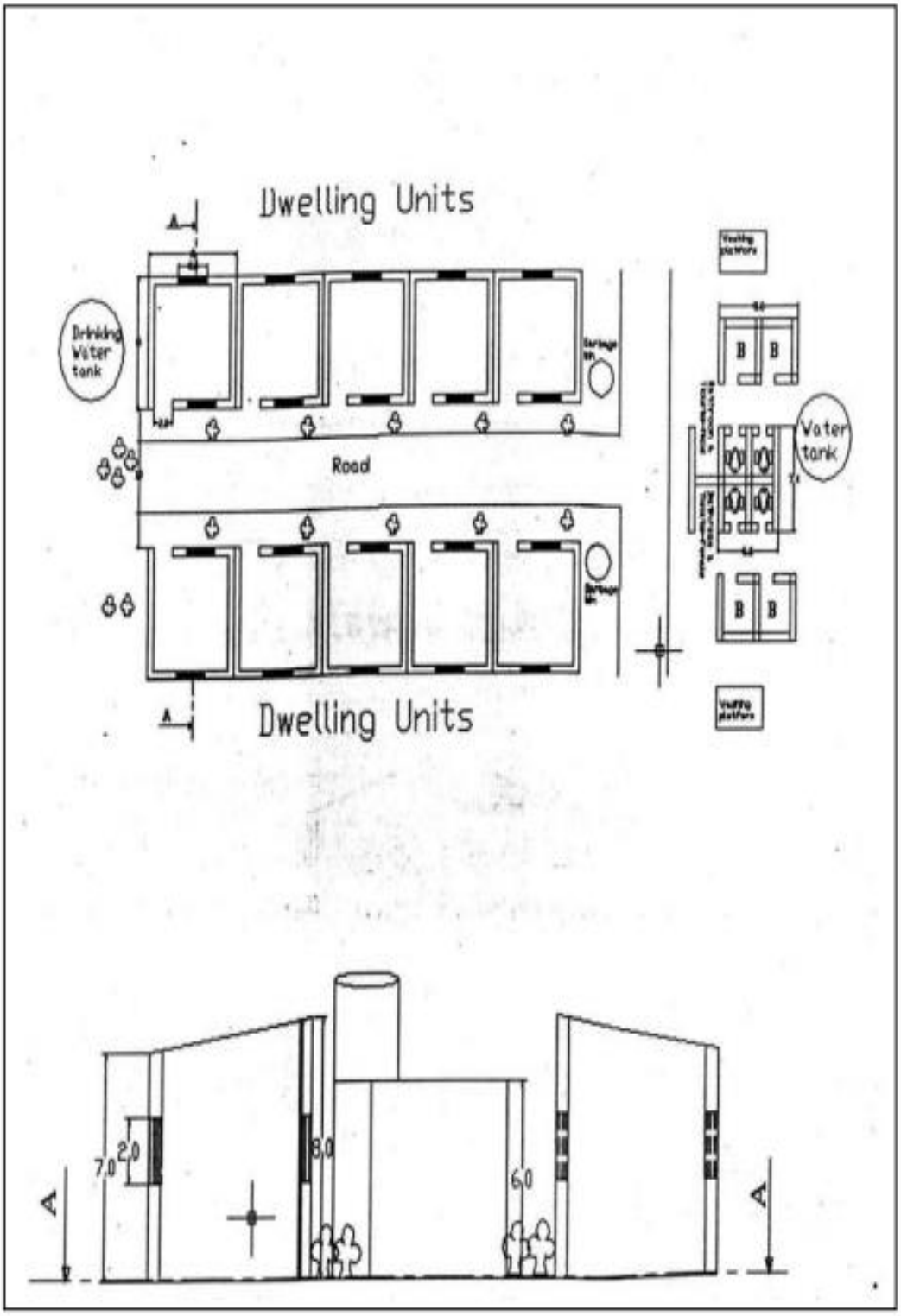
- The contractor shall ensure the supply of wholesome water for all the labour, including those employed by any other agency working for the contractor. These locations will be marked “Drinking Water” in the language most commonly understood among the labour. In hot season, the contractor shall make efforts to ensure supply of cool water. No water point shall be located within 15 m of any washing place, urinal, or latrine.

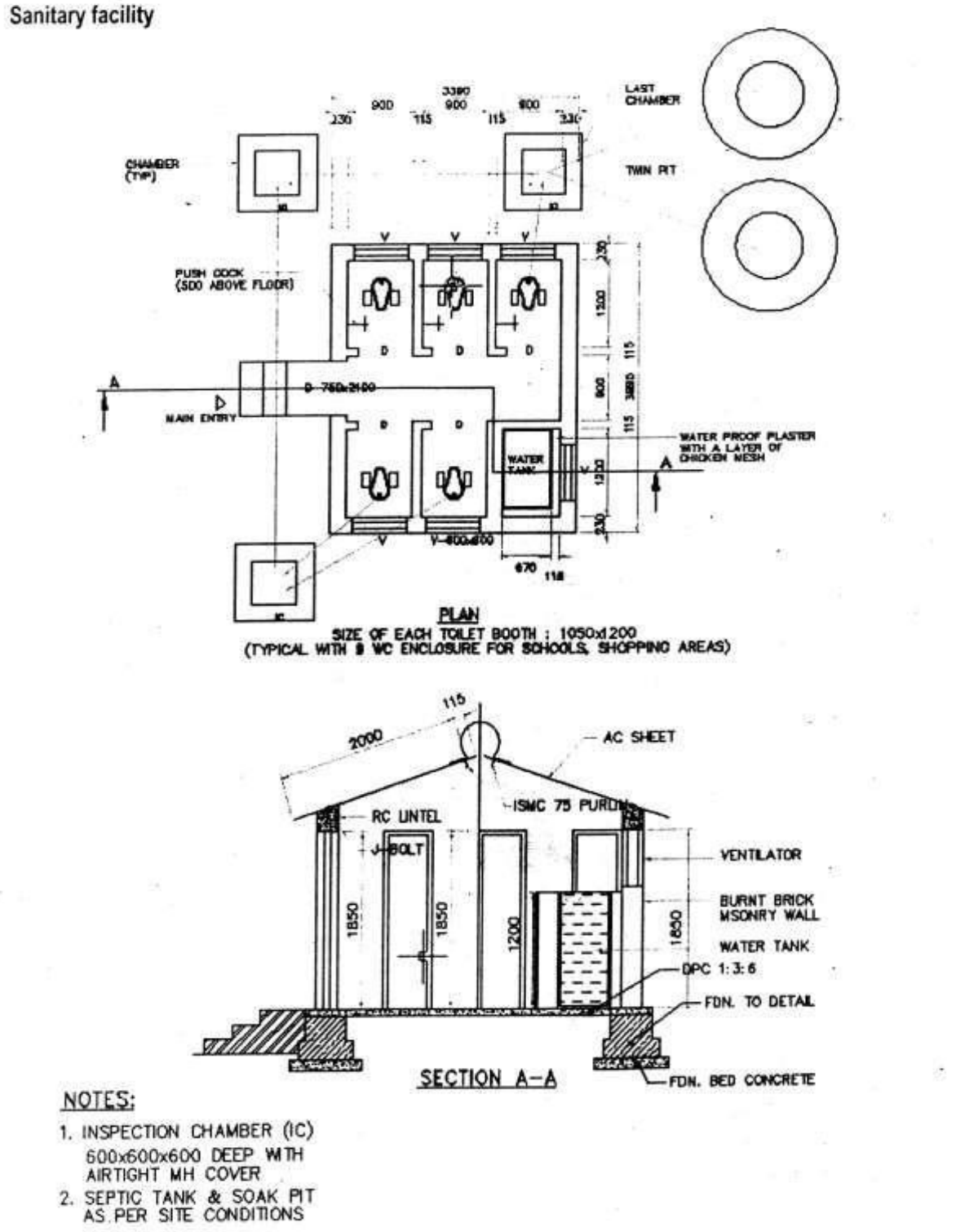
- The contractor shall ensure that adequate cooking fuel, preferably kerosene or LPG, is available on-site. The contractor will ensure that wood/ coal are not used as fuel on the site. Workers need to be made aware of this restriction. In cases where more than 250 labours are employed, canteen facility should be provided by the Contractor.

- A crèche must be provided in each campsite where more than 50 female labourers are employed, whether directly or indirectly, for the project or its ancillary activities.

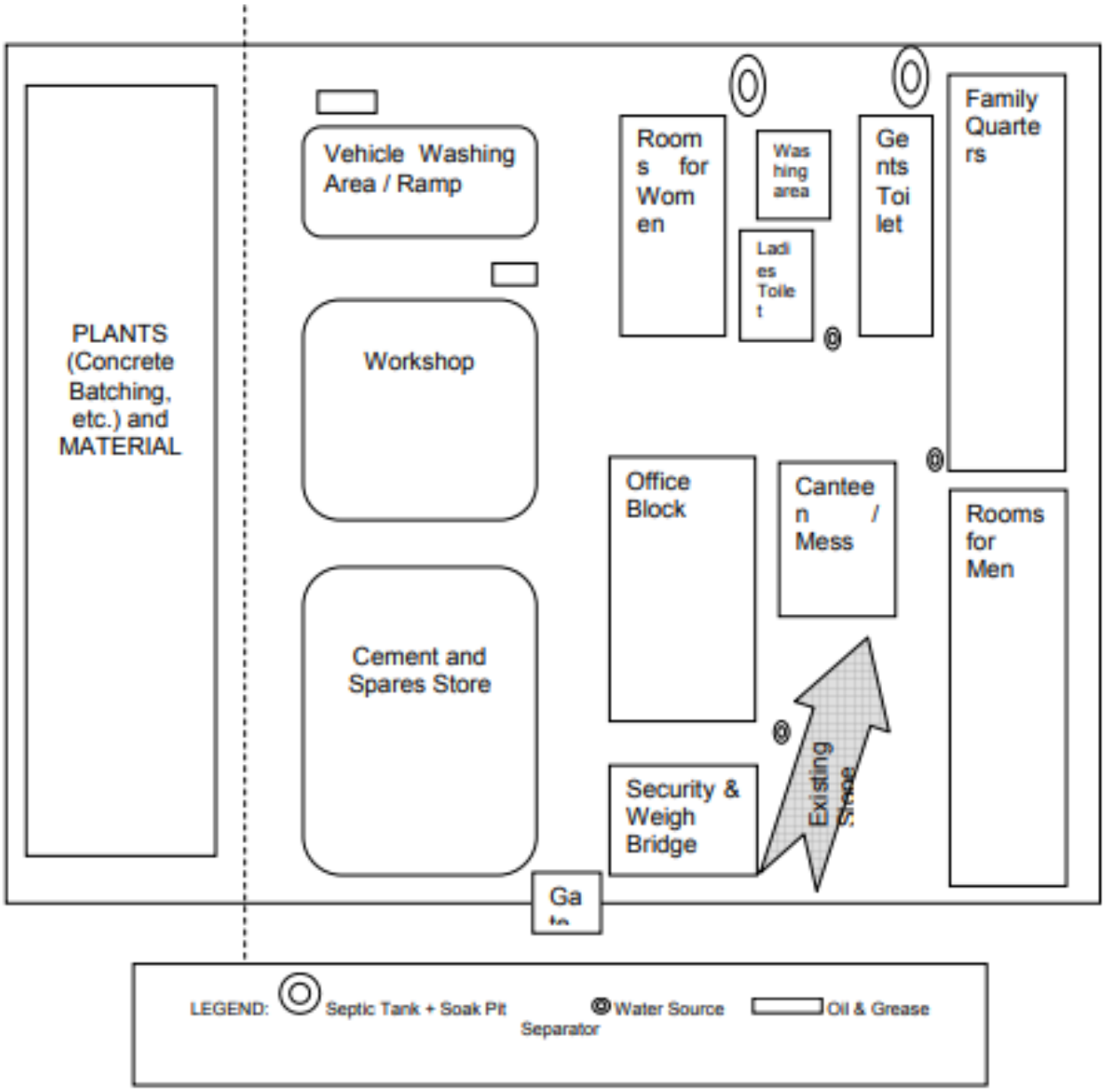
- Contractor must provide adequate facilities for first-aid treatment at the campsite. A doctor / ambulance should be available on call for the duration of project implementation.

- The contractor shall obtain the approval of the Engineer for these facilities within 30 days of mobilization.


Dwelling Units
Drinking Water tank
Road
Water tank
B
B
B
B
Dwelling Units
A
A
7.0
2.0
8.0
6.0



Typical Drawing of Workers' Camp Sanitary Facility



Layout of a Construction camp

Annex 16: Guidelines For Siting, Operation And Re-Development Of Quarrying And Stone Crushing Operations

Introduction

Name of quarry /village and approximate lead distances from project site are tabulated below:

Table 85: Location of Stone / Coarse Aggregate Material

Lead Charts			
Sl. No.	**Material**	**Place**	**Av.Lead (Km.)**
1	Sand (Fine)		
2	Lime		
3	Moorum/ Rubbish		
4	Stone Metal		
5	Stone Boulder		
6	Stone Chips, Aggregate		
7	Coarse Sand		
8	Cement		
9	Steel		
10	Tar, Bitumen		
11	Bitumen Emulsion		
12	Structural Steel		

Overview

A quarry is a type of open-pit mine from which rock or minerals are extracted for building materials, such as dimension stone, construction aggregate, riprap, sand, and gravel. Quarrying causes environmental damages like air and noise pollution, water logging etc. and requires permission from regulatory authorities like mining department, state pollution control board etc. It requires a careful approach in the site selection process, scientific method of quarrying and appropriate measures to redevelop it.

Criteria for Locating the Site/s

The selection of a quarry is sole responsibility of the contractor and should be undertaken in adherence to the rules & regulations of the authorities. Following criteria should be followed while selecting a quarry site:

- To the extent possible barren land or waste lands shall be preferred during site selection and fertile land and agricultural land shall be avoided.
- There shall be no quarrying of sand in any river bed or adjoining area or any other area which is located within 500 meters radial distance from the location of any bridge, water supply system, infiltration well or pumping installation of any of the local bodies or Central or State Government
- Department or any area identified for locating water supply schemes by any of the Government Department or other bodies.
- Quarry site shall be located at a minimum distance of 1km from any human settlements and 100 meters from any surface water body / natural drainage channel.
- Locate the quarry and crusher at a min. distance of 1.5 km away from forests / wildlife habitats / ecologically sensitive areas
- Access roads to quarry sites must be wide enough for heavy vehicle movement without inconvenience to local traffic.
- After identification of the site the Contractor should fill up the prescribed reporting format and submit the same for approval to the Sr. Environmental Specialist of the Independent Engineer without which any activity shouldn't be started on the site.

Finalization of Selected Site/s

The selected site/s shall be approved by IE and PIU, after considering the compliance with the EMP clauses. No agreements or payments shall be made to the land owner/s prior to receipt of a written approval from the IE and PIU. Any consequence of rejection prior to the approval shall be the responsibility of the Contractor and shall be made good at his own cost.

Setting up of quarrying and Stone Crusher

Quarrying involves not only extraction of material (rock) but also crushing and screening that makes the rock suitable for use as construction material. Following are the major parameters to be considered before the start of quarrying and stone crushing operations:

Site Preparation

The stripping, stacking and preservation of top soil will be mandatory and absolutely no activity should be allowed prior to the satisfactory completion of this conservation measure as per guidelines in EMP. The boundary of the quarry should be demarcated using barbed wire fencing in order to avoid the future dispute over land as well as to avoid accidental trespassing of people. There should be recorded documents of exact no of trees cut. Contour trenches should be dug along the quarry area boundary and at any other appropriate places considering the topography to reduce the surface run off and conserve soil and water. Side slopes shall be constructed with slope drains at applicable locations to provide drainage and avoid any landslides. All the drainage constructed should be linked to existing drainages in order to avoid flooding and water logging.

Setting up of a Quarry Site

The layout of a quarry should provide a gravity flow of material from the face to the crusher, from the crusher to the storage bin and from the bin to the hauling equipment. Adequate arrangements should be made for avoiding fugitive emissions from quarry and crusher premises. This will include:

- housing the noise and dust producing units of the crusher plant in a building with wall of minimum 23 cm thickness and with suitable roofing
- control of air pollution through provision of in-built dust extraction systems in thecrusher unit and all transfer points
- a chimney of appropriate height for the DG set (as specified by SPCB)

- water sprinkling facilities for the camp premises
- facilities to store water required for 3 days use

Consent to Operate the crusher unit should be obtained from SPCB under Air (Prevention and Control of Pollution) Act, 1981 before starting the operation.

Safety Aspects

- Blasting timings in quarry should be fixed avoiding the rush hours and these timings should be adhered to in order to avoid the conflict between the surrounding communities or population. Provide warning sirens 10 minutes before each explosion as a warning alarm to people in and outside the quarry. Damaged explosives must be disposed-off in a safe manner away from the operational area. Speed of the vehicles around the quarry should be restricted to a low speed in order to reduce the noise pollution and dust generation. Workers should not be exposed to sound of more than 85 – 90 dB for more than eight hours a day and shall be provided with adequate safety wears and personal protective equipment like ear muffs / plugs etc. Fire extinguishers should be provided in the site office
- Traffic movements should be restricted along the access road around times thatchildren walk to and from school. Proper first aid facilities should be providedwithin the site office and in case of an accident, quick access to nearby hospital/clinic should be provided.

Facilities for Workers

- Potable drinking water should be provided in the site office in a hygienicenvironment sufficient for all the people.
- Adequate no. of toilets shall be provided for the workers with adequate watersupply, proper drainage and effluent treatment system like septic tank with soakpit. Soak pit should have a sealed bottom, honey comb wall and 75cm thick,2mm sand envelope around that.
- The sewage system for the camp must be properly sited, designed, built andoperated so that no health hazard occurs and no pollution to the air, ground oradjacent watercourses takes place.

Waste Disposal

- The Contractor should provide separate garbage bins for biodegradable, nonbiodegradable and hazardous wastes in the camps and ensure that these are regularly emptied and disposed-off in a hygienic manner.
- No incineration or burning of wastes shall be carried out by the Contractor.
- The disposal of any biodegradable matter shall be carried out in pits covered with a layer of earth within the camp site. Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipe scrubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or sold /given out for recycling.
- POL (petroleum, oil and lubricants) waste shall be disposed-off by transfer only to recycler/ re-refiners possessing valid authorization from the State Pollution Control Board and valid registration from the Central Pollution Control Board.
- Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.
- Quarry areas should be protected from illegal dumping of waste by third parties. The overburden should kept as minimum to maximize the commercial efficiency of the quarry, it can be utilized for creating earth bunds to mitigate the noise and visual impacts and also for the site rehabilitation process.

- No quarry waste shall be dumped within a 100 m either side of the road. The overburden should be reused or disposed properly. Site for overburden disposal should be planned within the quarry site or any other appropriate site.

Training to Workers

- Workers shall be trained in smooth and safe operation of plants and equipment,their regular maintenance and various safety measures to be followed as well asabout the need and importance for adherence to these measures.
- All the drivers should be trained about safe driving and should be made awareabout the need to observe caution while plying through access roads, especiallyduring the time when children walk to and from school.
- Conduct education programs with the locals regarding the potential impacts ofblasting, blasting warning systems, schedules etc.

Information Dissemination

- There should be a sign board of size 6' x 4' mentioning the project details and contractor's details to disseminate the information to the public.
- There should be a second sign board displaying the latest air and noise monitoring data against the standards specified.
- Warning sign boards should be set up at the entrance gate for the public as well as at other required places for the workers to alert them about the nature of operation being undertaken.

Other Mitigation Measures

- The quarry should not damage any building, work, property or rights of other persons.
- The quarry should not alter any right of way, well or tank.
- Roads inside the crusher premises should be tarred or concreted.
- Water course, if any, from a higher slope should be properly drained out.
- Strom water drainage shall be provided to prevent water logging and flooding in and around the area.
- The possibility of collecting the storm water in a pit or a tank should be explored so that it can be reused for dust suppression and the dependence on other water sources could be reduced. If this is not possible, the water should be safely channeled out of the quarry without disturbing any nearby human settlement.
- A register should be provided in the camp site for public to record their grievances if any.
- Environmental monitoring (air, noise, surface & ground water) should be conducted on quarterly basis.
- The concerned authority – AE / PIU should regularly review the environmental, health and safety aspects. If any adverse effect on environment, habitat and concern of safety is noticed, appropriate measures should be taken as suggested by AE or should arrange an alternative for road construction materials.
- In the case of existing quarries and additional quarries, the contractor has to ensure that all actions in these quarries are in compliance with EMP.

Operation of Quarry Site and Stone Crushing Unit

- No quarrying operation shall be done without the approval from the concerned authority.
- The equipment used in quarry should be wear faced, which extends the equipment life and reduce the demand for spare parts.
- Adopt controlled blasting techniques and conduct quarrying in a skillful, scientific and systematic manner.

- All units should operate only between 6 am and 10 pm. or as specified by SPCB in the consent letter.
- Accessory facilities to be provided in the quarry includes sprinklers to spray water for dousing the dust generation, noise suppressers and rubberized mounting to reduce noise and vibration and tarpaulins or covers over material transporting vehicles.
- Provide sufficient water storage facility for 2 days' use.
- Measures have to be taken to reduce the dust generation during drilling operation. Deep wetting of drilling zones also to be done by water sprinkling and drilling machine shall be fitted with dust suppression, collection and disposal arrangements.
- To avoid spillage of fuel and lubricants, the vehicles and equipment should be properly maintained and repaired. Maintenance should be carried out on impervious platforms with spill collection provisions.

Following conditions regarding sound generation should be complied with in a quarry /crusher unit:

- The sound level (Leq) measured at a distance of 1 m from the boundary of the site shall not exceed 55 dB(A) during day time (6 a.m. to 6 p.m.) and 45 dB(A) during night time (6 p.m. to 6 a.m.).
- The DG set shall be provided with exhaust muffler /acoustic enclosure/acoustic treatment with an insertion loss of minimum 25 dB(A) and its emission levels should be within relevant SPCB guidelines.
- A proper, routine and preventive maintenance procedure for the DG set shall beset and followed in consultation with the DG set manufacturer.

Quarry Management Plan

Quarry Management Plan shall be documented as follows for each quarrying sites:

Sl. No.	Item	Unit	Details
1.	Name / identity of the location		
2.	Nearest project road Chainage		
3.	Name of the owner		
4.	Area involved	M^2	
5.	Existing land use (verification from land records with Revenue Dept.)		
6.	Land use of the area surrounding the proposed site including a Map		
7.	Access Roads– existing conditions, proposed development andmaintenance		
8.	Tree cutting and vegetation clearance if any, along withcompensation measures	Nos.	
9.	Arrangement with the owner (agreement with land owner should beattached as an annexure)		
10.	Quantity of material to be quarried	Cum	

Sl. No.	Item	Unit	Details
11.	Machinery and equipment to be used		
12.	Copy of the Consents to Establish and Operate should be attachedas an annexure		
13.	Copy of the license from Mining and Geology, Police and FireDepartment		
14.	Conditions laid down in the clearances / licenses and plans to ensurecompliance		
15.	Information on whether or not the quarry shall be closed under thisproject. If yes, the proposed closure and restoration plan.		
16.	Concern of the local people living in the immediate / near vicinity(through dialogue / consultation)		
17.	Photographs showing before and after conditions as well as duringoperations at regular intervals		
18.	Quarry Site Plan		
19.	Quarry Operation Plan		
20.	Quality Plan		
21.	Safety Plan		
22.	Waste Management Plan		
23.	Restoration and Rehabilitation Plan		
24.	Monitoring Plan		

Redevelopment of Quarry Area

The main objective of the redevelopment of quarries is to make the area safe and secure place and adapt it to a suitable land use like leisure place or fishing place etc. which is suitable for the physical environment as well as for the community around. Along with the preparation of quarry and crusher management plan the contractor should also prepare a re-developmentplan, which will be submitted for approval to IE who in turn will be responsible for approving andmonitoring these plans. The restoration plan should indicate following points:

List of structures to be demolished and list of the cleanup activities that needs tobe undertaken.

- Presence of facilities that could be put in use by the land owner if it is a leasedout private land or community in case of a public property
- The proposed use of the quarry site with a layout plan showing the proposedfacilities / improvement measures, list of local plant species that could be plantedetc.
- Photographs of the site before and during the quarrying process

Possible re-development options include the following:

- Re-vegetation of the quarry to merge with surrounding landscape with reuse oftop soil mixed together with farm yard manure.
- Development of exhausted quarries as water bodies, where the quarry pit isdeveloped into pond or a rainwater harvesting structure
- Pits created as a result of blasting could be filled with over burden which areremoved and stockpiled in other areas or with construction debris. Top soilshould be spread back and trees should be planted along the boundary.
- Tree plantation where ever possible depending on the proposed use, erosioncontrol measures etc. should be taken up as part of the redevelopment plan.

De-mobilization of the Site

- The contractor should clear all temporary structures; dispose all building debris, garbage, night soils and POL waste as per the approved debris management plan.
- All disposal pits or trenches should be filled in, disinfected and effectively sealedoff.
- Once the re-development plan is implemented and the site is restored, the sameshould be intimated to IE by the contractor.
- The IE shall ensure that all clean-up and restoration operations are completedsatisfactorily and written approval is given to the contractor before the ‘workscompletion’ certificate is issued / recommended.
- The PIU shall ensure through site inspection that the Contractor and IE havecomplied with all these provisions.
- The site can then be handed over to the concerned owner or local bodies or forlocal communities as the case may be.
- Certification / documentation pertaining to approval for clean-up and restorationoperations and thereafter handing-over to the owner shall be properly maintainedby the Contractor, Supervision Consultant and PIU.

Annex 17: Guideline for Siting and Management of Debris Disposal Site

Purpose

- To maximize re-use of material generated during construction and
- To avoid environmental hazards due to improper disposal of construction waste material.

Procedure

The following procedures should be followed for upkeep of storage and disposal sites:

- Contractor shall maintain register for keeping records on kilometer-wise quantities of material generated during grubbing, stripping, excavation and scarifying;
- Contractor shall re-use construction material to the extent possible based on engineering properties. Possible re-use areas are fill sections, embankment slope, village approach roads etc. Debris without bitumen could be used for backfilling of quarry / borrow areas as recommended by the Engineer. At locations identified for dumping of residualbituminous wastes, the dumping shall be carried out over a 60mm thick layer of rammed clay so as to eliminate the possibility of the leaching of the wastes into the ground water. The contractor shall ensure that the filled area is covered with a layer of preserved topsoil layer of preserved topsoil.
- Contractor shall estimate the chainage-wise quantities of various waste material to be disposed of;
- Contractor shall restrict waste disposal strictly at approved site/s only
- Contractor shall prepare a plan including detailed lay out plan and cross-section for disposal of debris and bitumen waste and get approval of the same by the Engineer;
- Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area;
- Contractor and Engineer shall ensure that disposal areas are properly treated as per agreed plan;
- Contractor and Engineer’s representatives shall undertake joint weekly inspection to ensure compliance of various environmental requirements.Engineer’s representatives shall issue non-compliance if disposal site is not managed as per agreed plan;
- All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the SC.

Site Inspection

Weekly joint site inspection shall be undertaken for all the storage areas. The details of attributes, which are to be inspected, are given as follows. The Contractor shall ensure compliance of the requirements.

Table 86: Details to be inspected for Monitoring Construction Material Reuse & Disposal

Attributes	Requirements
Constructionmaterialgeneration andre-use	• Segregating debris and bitumen during generation; • Segregating re-usable portion of debris and bitumen and storingpreferably near areas of re-use; and • Temporary storage of waste material at sites as directed by theEngineer.
Waste disposal	• Disposal of waste material at approved disposal site within a week ofgeneration; • Disposal site should be properly demarcated; • Proper leveling / grading at disposal site/s; • Recommended / agreed safeguard measures to avoid ground water contamination by leachate from disposal of scarified material are to be implemented; • Recommended / agreed safeguard measures to avoid soil erosion are to be implemented; • Recommended / agreed plan for surface treatment of waste disposal site/s are to be implement.

Annex 18: Guidelines For Top Soil Conversation And Reuse

The top soil from all sites including road side widening and working area, cutting areas, quarry sites, borrow areas, construction camps, haul roads in agricultural fields (if any) and areas to be permanently covered shall be stripped to a specified depth of 15 cm and stored in stock piles for reuse.

At least 10% of the temporary acquired area for construction purposes shall be earmarked for stockpiling of fertile top soil.
The locations for stacking will be pre-identified in consultation and with approval of Environmental Specialist of the Independent Engineer.
The following precautionary measures will be taken by the contractor to preserve thestock piles till they are re-used:

- Slop of the stockpiles should not exceed 1:2 (vertical to horizontal), and height isrestricted to 2m to retain soil and allow percolation of H2O.
- The edges of pile should be protected by silt fencing and allow percolation ofwater, which will help to retain soil
- Multiple handling kept to a minimum to ensure that no compaction occurs.
- Stockpiles shall be covered with empty gunny bags or will be planted withgrasses to prevent the loss during rains.

Such stockpiled topsoil will be utilized for

- Covering reclamation sites or other disturbed areas including borrow areas (notthose in barren areas).
- Top dressing and raising turfs in embankment slopes
- Filling up of tree pits
- For developing median plantation
- In the agricultural fields of farmers, acquired temporarily that needs to berestored.

Residual top soil, if there is any, shall be utilized for the plantations works along the road corridor. The utilization as far as possible shall be in the same area from where top soil was removed. The stripping, preservation and reuse shall be carefully inspected, closely supervised and properly recorded by the Environmental Specialist of the Independent Engineer.

Annex 19: Guidelines On Slope Stabilization

Introduction

Erosion Control on roads is fundamental for the protection of water quality. Soil stabilization and erosion control practices are needed and should be used in areas where soil is exposed. Bare ground should be covered, typically with grass seed and some form of matting or mulch. This will help prevent erosion and subsequent movement of sediment into river, streams, lakes and ponds. This movement of sediment can occur during and after road construction. Erosion control measures need to be implemented immediately following construction and every time an area is disturbed.

Soil Erosion Control

Soil erosion is the process of detachment and transportation of soil particles by wind, water principally. Normally non-cohesive soil particles are blown away by wind erosion. The kinetic energy of falling rain drops causes detachment of soil particles and subsequently carried away by surface run-off. Erodibility co-efficient of soil and impact of rain drops are determinant factors in the process. This is guided by the nature of soil (clay content), particle size distribution and soil condition like saturation, density, permeability, plasticity etc. Dislodged soil particles flow down the slope with the overland flow, eroding and destabilizing the soil-body. When the intensity of rainfall increases surface run-off velocity accelerates and facilitates carriage of subsequent particles and ultimately results in disorders in the form of rill to gully and finally to erosion ditches. These disorders will impair slope stability worst if not controlled with proper protective measures.

Ground cover is considered as the most suitable solution for erosion protection. Tress, grass and other plant species are natural soil-binders and provide the best natural solution against erosion. In bio-engineering, plants have mainly two functions viz. hydrological and mechanical. Hydrological effects of plants are many such as interception (rain drops strike the leaves first before striking the ground soil), storage (leaves and stems hold water for some time before it eventually reaches the ground), infiltration (stems and shoots roughen and loosen the ground, enabling water to infiltrate more easily) etc. Mechanical function of plant is to reinforce the soil by binding the loose soil particles with its fibrous root system.

Bio-engineering is the technique of utilizing vegetation in addressing geotechnical problems. Environmental uncertainties are prompting engineers to favour bioengineering measures. Vegetation as an aid to artificial methods in controlling surficial soil erosion is gaining larger acceptability among engineers all over the world. Growth of appropriate vegetation on exposed soil surface is facilitated by use of natural geotextiles such as Coir Geotextiles. Properly designed Coir Geotextiles laid on slopes or any other exposed soil surface provides a cover over exposed soil lessening the probability of soil detachment and at the same time reduces the velocity of surface runoff, the main agent of soil dissociation. Natural geotextiles bios-degrade quicker than man-made counterpart, but facilitate growth of vegetation quicker and better due to its inherent characteristics. Road slope stabilization can range from allowing native grass (Vetiver grass) to re-establish on a disturbed slope to building an engineered wall.

Role of Coir Geotextile in Slope Stabilization

Coir is a biodegradable organic fibre material which is coarse, rigid and strong. The constituents of coir have been found to be mostly cellulose and lignin. Coir fibre is weather resistant and resistant to fungal and bacterial decomposition. The rate of decomposition of coir is much less than any other natural fibre. These characteristics are attributed due to the high lignin content in the fibre. Coir in the form of woven mesh mattings or non-woven stitch

bonded blankets are used in engineering applications in the geotechnical field. Due to growing awareness to preserve environment, use of biodegradable natural material has gained popularity. The natural fibre, coir, which has been used in geotextiles for the past 20 years, has already proved its worth.

Coir geotextiles are made fromcoconut fibre extracted from the husk ofcoconut. Like other polymeric counterparts,coir geotextiles are developed for specificapplication in civil engineering like erosioncontrol, ground improvement, filtration,drainage, river bank protection, roadpavements, slope stability etc. Thisbiodegradable and environment friendlymaterial is virtually irreplaceable by any of themodern synthetic substitutes.

Coir geo-textiles specifications: Grade I- 400g/m^2

Advantages of Coir Geotextile

- The high tensile strength of coir fiber protects steep surface from heavy flows anddebris movement
- It can withstand considerable pedestrian movement and vehicular traffic withoutdeterioration
- Easy to install and huge contour of the soil surface due to its heavy weight andability to absorb water
- Totally Biodegradable, 100% natural
- Water absorbent, thus act as mulch on the surface and as a wick in the soilmantle
- Environmentally friendly and aesthetically pleasing and nonpolluting
- Provides excellent microclimate for plant establishment and healthy growth
- The thick and protruding fibers from the yarn render an extra protection againstsoil erosion and Provide roughness to the surface floor and hold the soil particlesin place.
- The coir geo textile gives the grass plenty of room to grow and at the same timeprovides large number of "CHECK DAMS" per square meter of soil media
- During the manufacturing process of coir yarn, non-chemicals are used

- Holds the seeds and saplings in place
- Allows sunlight to pass through

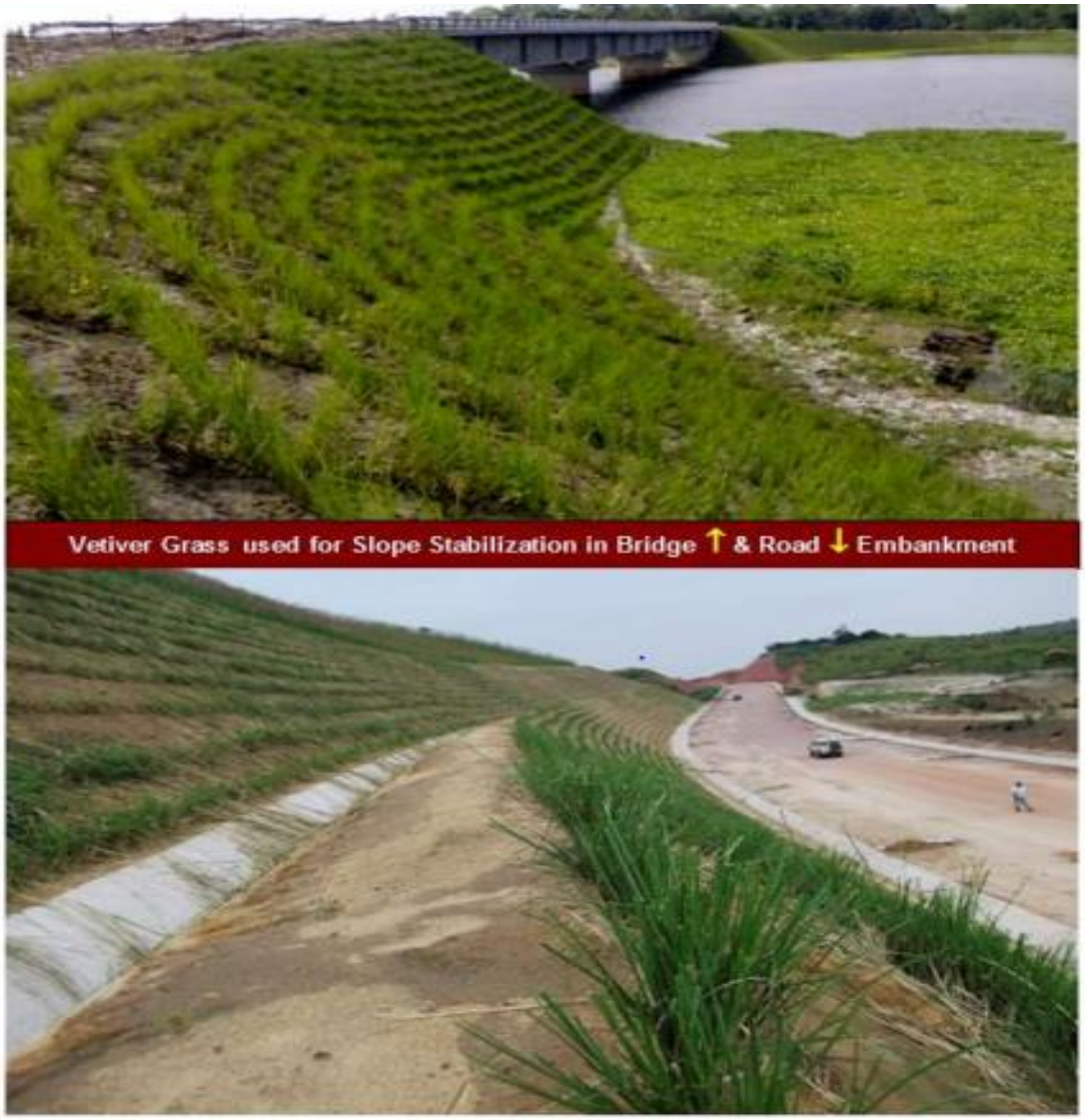
Coir Geotextile is laid on the shoulder and slope surface helped retain the soil particles and prevented detachment of soil particles from the prepared slope. Establishment of vegetation ensured stabilization of the soil on the slope surface. It is a bio-degradable natural geotextile, can conveniently be used for controlling surface soil erosion and help growth of vegetation as a bio-engineering measure. After biodegradation coalesces with the soil and adds nutrient to the soil and fosters growth of vegetation.

Role of Vetiver Grass in Slope Stabilization

Vetiver grass (Chrysopogonzizanioides) is native to India. It has been has been shown to be a simple and economical method to conserve soil by slowing the velocity of water and trapping sediment, filtering out nutrients, and stabilizing steep slopes. In western and northern India, it is popularly known as khus. Several aspects of Vetiver make it an excellent erosion control plant in warmer climates:

- Vetiver grass does not havestolons or rhizomes. It's massivefinely structured root system thatcan grow very fast; in someapplications rooting depth canreach 3 to 4m in the first year.This deep root system makesVetiver plant extremely droughttolerant and difficult to dislodgeby strong current.
- Stiff and erect stems, which canstand up to relatively deep waterflow
- Highly resistance to pests, diseases and fire
- A dense hedge is formed when planted close together acting as a very effective sediment filter and water spreader
- New roots grow from nodes when buried by trapped sediment. Vetiver will continue to grow up with the deposited silt eventually forming terraces, if trapped sediment is not removed.
- Tolerance to extreme climatic variation such as prolonged drought, flood, submergence and extreme temperature from -14°C to +55°C
- Tolerance to wide range of soil pH from 3.3 to 12.5 without soil amendment
- High level of tolerance to herbicides and pesticides
- Highly efficient in absorbing dissolved nutrients such as N and P and heavy metals in polluted water.
- Highly tolerant to growing medium high in acidity, alkalinity, salinity and magnesium

- Highly tolerant to Al, Mn and heavy metals such as As, Cd, Cr, Ni, Pb, Hg, Se and Zn in the soils
- As typical tropical grass, Vetiver is intolerant to shading. Shading will reduce its growth and in extreme cases, may even eliminate Vetiver in the long term. Therefore Vetiver grows best in the open and weed free environment, weed control may be needed during establishment phase. On erodible or unstable ground Vetiver first reduces erosion, stabilizes the erodible ground (particularly steep slopes), then because of nutrient and moisture conservation, improves its microenvironment so other volunteered or sown plants can establish later. Because of these characteristics Vetiver can be considered as a nurse plant on disturbed lands



- Vetiver is useful to treat pollution due to its capacity to quickly absorb nutrients and heavy metals, and its tolerance to elevated levels of these elements. Although the concentrations of these elements in Vetiver plants is often not as high as those of hyper-accumulators, it's very fast growth and high yield allows Vetiver to remove a much higher volume of nutrients and heavy metals from contaminated lands than most hyper-accumulators.

- When planted closely together, Vetiver plants form dense hedges that reduce flow velocity, spread and divert runoff water and create a very effective filter that controls erosion. The hedges slow down the flow and spreads it out, allowingmore time for water to soak into the ground.
- Acting as a very effective filter, Vetiver hedges help to reduce the turbidity ofsurface run-off. Since new roots develop from nodes when buried by trappedsediment, Vetiver continues to rise with the new ground level. Terraces form atthe face of the hedges; this sediment should never be removed. The fertilesediment typically contains seeds of local plants, which facilitates their reestablishment.

Cost Analysis

Cost of slope stabilization using Coir Geo-textile and Vetiver Grass is Rs. 450/- per square meter, which includes coir geo-textiles (erosion control blanket) 600 to 700 GSM woven or non-woven type (inclusive of transportation to site), GI hooks of 4 mm diameter U-Shaped point sharp edges of 300 mm length, installation charges, coir mat spreading, cutting, seeds mix broadcasting, over lapping, watering for 7-9 days twice per day and after complete installation of work get the quality certification from the authorized technical agency.

Annex 20: Guidelines To Ensure Worker's Safety During Construction

In order to ensure worker's safety while undertaking various operations / stages of construction many safety measures needs to be followed, which are listed down below:

Tree Felling

- Use hard hats during tree felling
- Ensure safe use and storage of tools such as axes, power chain saw, hand saw of different types, HDPE ropes of approved thickness to drag felled trees and logs.
- Keep the saw blades in proper lubrication and sharpened state for efficient workability.
- Determine proper foot and body position when using the implements for felling, cutting and dragging.
- Wear appropriate foot protection
- Avoid cutting overhead branches
- Keep first aid kits ready at the site.
- Determine possible hazards in the area, e.g. electrical or telephone or other utility lines, buildings, vehicles and domestic cattle that may create unsafe work situations.
- Prior to felling, determine the safest direction of fall and orient fixing of ropes and cutting positions accordingly.
- Determine the proper hinge size before directing the fall.
- Keep machineries and workers ready for speedy removal of the tree from the main traffic movement area.
- Keep flag men and warning signal signage at either end of felling area to control movement of traffic and warn passers-by

Plant Sites, Construction Camp and Quarry Areas

- Install perimeter fencing
- Ensure good visibility and safe access at site entrances
- Provide adequate warning signs at the entrance and exit, as necessary
- Provide adequate space / area for loading and unloading, storage of materials, plant and machinery
- Display emergency procedure and statutory notices at conspicuous locations
- Provide areas for collecting garbage and other waste material, and also arrange for their regular / periodic disposal.
- Arrange appropriate storage, transportation and use of fuel, other flammable materials and explosives in line with the license requirements obtained from concerned authorities
- Provide defined access roads and movement areas within the site
- Ensure availability of first aid facilities and display notices at various work places showing the location of first aid facilities and emergency contact numbers
- Provide and enforce use of PPE at plant and quarry sites

House Keeping Practices

- Provide proper slope in kitchen, canteens, washrooms, toilets and bathrooms for easy and immediate draining of water
- Keep all walkways and circulation areas clear and unobstructed at all times

- Ensure that spillages of oil and grease are avoided and in case of accidental spills, these should be collected immediately
- Use metal bins for collection of oily and greasy rags
- Stack raw materials and finished products out of walkways
- Do not leave tools on the floor or in any location where they can be easily dislodged
- Keep windows and light fittings clean
- Maintain the workplace floors dry and in a non-slippery condition
- Provide and maintain proper drainage system to prevent water logging and unhygienic conditions
- Ensure that protruding nails in boards or walls are moved or bent over or removed so that they do not constitute a hazard to people
- Store all flammable materials in appropriate bins, racks or cabinets with proper cover and labels as required for various products
- Make sure that hazardous / dangerous chemicals are kept in the goods stores with the appropriate labeling, display of the material-safety-data-sheet (MSDS) and other precautionary measures.
- Display 'no smoking' signs in areas with high risks of fire, (e.g. near fuelling areas, diesel /oils / lubricant /paint storage area, hessians, rubber, wood and plastic etc.) in and around working area

Safety during Excavation

- The risk of accidents involving people and vehicles remains high in excavated sites. All pits or excavations shall to be barricaded to warn the road users and residents and to avoid any unauthorized entry of persons, children, domestic cattle or wildlife. For deep excavations and culvert construction sites, painted GI sheets, delineators, lamps (as required) and retro-reflective signage shall be used.
- Excavation more than 1.5 m is to be done in steps of minimum 500 mm offsets with plank and stuttering support, as required under contract clauses.
- For excavation in slippery or water logged area, try to dewater the area and spread minimum 150 mm thick sand layer to avoid slipping.
- For excavation for drain, the area should be properly barricaded with sign boards and illumination / lamps for night time safety. In congested stretches, watchmen / guards can also be placed for vigil.
- Snake bites or Scorpion stings during excavation - in areas with vegetation, tall grasses and forest cover, the contractor shall provide the labour with gum boots and gloves. He shall also make snake antidotes available on site. Emergency vehicles should also be kept ready to rush the patient to the nearest hospital.

Safety during Some Typical Construction Work

Centering and Scaffolding

- Many a times ballies joined together give away due to weak joints. Use of metal scaffolding and centering plates with metal fasteners are the safest and highlyrecommended materials for use in all road construction works for ensuringsafety, stability and casting of structures. All such scaffolding should be placedon a firm and a level base on the ground for ensuring stability. No woodenscaffolding or bamboo scaffolding is to be used for any casting of heavy (RCC)structural construction as the risk to safety of workers is higher.

- Railings are to be provided along working platforms and ladders for better safety. Nets shall be hung below the scaffolding or structures where work is on-going to prevent fall of debris, stones, bricks, equipment and other heavy to retain soil objects and even workmen, which could be fatal.

Form-work for small/light beams and slabs

- The collapse of bottom of the beam that may bring down the slab as well is a risk in such operations, which may injure the labour or supervision staff. Slender ballies without bracing are not be allowed for such works. No concreting should be allowed without bracing at 300 mm above ground and at midway for normal beams and slabs. The bracings should be for the support of beams as well as the slabs.
- Direct ballies support from the ground and the practice of tying planks with binding wire to the steel reinforcement shall not be allowed. A temporary railing and properly based working platforms along the periphery of slab reduces risk to the life of labour and supervision staff

Dismantling of Scaffoldings

- Dismantled materials may fall on passer-by and workers. Workers could also get injured during the removal of such materials. Prior to dismantling of scaffoldings / working platforms, the area of operation should be closed for all outsiders. No one should be allowed within 50 m. from the place of demolition.
- Helmets, safety belts and other PPE must be worn by all the workers engaged in such a work. This work requires careful handling by an experienced supervisor / work force and should be executed with utmost caution. Gradual dislodging and use of PPE is required.

Column Reinforcements

- The tendency of bar-benders is to tie the vertical steel with coir rope or 8 mm steel rods as ties on all four sides of the column reinforcements. Reinforcement to columns shall be by welding MS rods with metal scaffolding to keep it in position till the final casting of RCC is done

Falling of Objects or Debris from a Height

- At bridges construction sites (or in work areas at a height above ground level) thick nylon net or hessian barriers shall be used to prevent any splinter, debris, mortar or concrete from falling onto the passersby or workmen around.

Site Cleaning

- Throwing of waste materials, broken concrete pieces, brick bats, sand etc. straight from the top of a structure onto the ground can injure a worker or a passerby. Such materials should be brought to the ground with the help of lift or the use of rope over pully with a bucket.

Operation of Excavators

- Ensure that excavators are operated by authorized persons who have been adequately trained.
- Prevent any unauthorized use of the excavators.
- Ensure that only experienced and competent persons are engaged in supervising all excavations and leveling activity.
- Check and maintain as per the manufacturer’s manual.
- Issue relevant information, including that related to instructions, training, supervision and safe system of work in writing and provides expert supervision for guidance.

- Ensure that the operation and maintenance manuals, manufacturer's specifications, inspection and maintenance log books are provided for the use of the mechanics, service engineers or other safety personnel during periodic maintenance, inspection and examination.
- During tipping or running alongside the trenches, excavators must be provided with stop blocks.
- Excavators must be rested on firm ground after field operation away from the road
- Locate and identify underground services including telephone cables, OFC cables, sewerage and drainage lines, water supply, electrical cables etc. by checking with all concerned underground utility providers.
- When reversing or in cases where the operator's view is restricted, adequate supervision and signaling arrangements shall be provided.
- Ensure that the type and capacity of the excavator are properly chosen for the intended purposes and site conditions. Never use a machine for any purposes other than it is designed for.
- Check and report for excessive wear and any breakage of the bucket, blade, edge, tooth and other working tools of the excavator and ensure replacement / repair to avoid mishap and break down.
- Check that all linkages / hinges are properly lubricated and linkage pins are secured. Never use improper linkage pins.

Operation of Trucks and Dumpers

- Ensure that only trained, authorized and licensed drivers operate the vehicles.
- Switch-off the engine when not in use to save fuel, prevent accidents and unnecessary noise and air pollution.
- Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall by fixing a sturdy support below.
- Carryout periodic servicing as per the manufacturer’s requirements
- All records of maintenance and repairs should be in writing and available for verification
- Keep the vehicle tidy and the cabin free from clumsy utilities, which might obstruct the controls and create hazards.
- Follow safe driving principles including speed limits as per traffic signage.
- Avoid carrying additional passengers in the cabin or on the body of the dumper, while in field operation other than the connected workers.
- Provide stop blocks when the vehicle is tipping into or running alongside excavations or when it is parked.
- Do not overload the vehicle.
- Carry only well secured loads and use proper covers and fasteners

Manual Handling and Lifting

- Avoid manual handling of heavy and hazardous objects and chemicals.
- Pre-assess the actual requirement of manpower in case of emergency situations.
- The hazardous and poisonous materials should not be manually handled without proper equipment /gears and prior declaration of the risks needs to be made to the involved workers.
- All concerned persons shall be trained in proper methods of lifting and carrying.
- In all manual operations where groups of workers are involved, a team leader with necessary training to handle the entire work force in unison has to be provided for.

- Watch and ward to control / supervise / guide movement of equipment and machineries, loading and unloading operations, stability of the stockpiled materials and irregularly shaped objects have to be provided for safety and security of workers
- Carriageway used by the workers must be free from objects, which are dangerous.
- Loading and unloading from vehicles shall be under strict supervision.

Gas Welding

- The welders and welding units should follow all the basic principles of welding for safety and security
- Use face shield to protect the eyes
- Use goggles, particularly when chipping slag and cutting strips.
- Use gloves long enough to protect wrists and forearms against heat, sparks, molten metal and radiation hazards.
- Use high-top boots / gum boots to prevent sparks, splinters, sharp edges of metal and hot welded strips, welding rods, electric cables etc. from injuring the legs.
- Avoid inhaling the noxious fumes and gasses from burning electrodes by using gas masks and screen of the work area to prevent the glare moving outside it.
- Keep the key hung from the regulator control for split seconds operations to stop the valve in case of any accidental damage or leakage to supply pipeline that may catch fire and cause accidents in case acetylene or LPG cylinder.
- The welding area should have sufficient openings with fixed exhaust ventilators or adequate air flow openings to remove poisonous fumes and gases.
- Take precautions of wearing hard hats or fiber helmets to prevent injury due to fall of any object and accidental injury from projections while welding.
- Welders operating above ground should have adequate safety belt secured to stable platform to prevent accidental fall or injury from the scaffold. All electrical and gas connection lines up to the welder should be sufficiently insulated and protected from sharp edges and sharp objects. These shall not come into contact with hot metal.
- Do not use gas cylinders for supporting work or as rollers. While using LPG or CNG cylinders for welding, follow all safety precautions as has been prescribed by the supplier company.
- Avoid fire hazards and accidents by posting safety supervisors to oversee the activities of workers.
- Do not store explosives, high inflammable materials, loose hanging overhead objects, hot welded strips etc. near gas cylinders.
- Close all valves, switches and circuits while leaving the work place under proper lock and key. In case of mobile units, proper carriage procedure have to be followed for safety and security of men and materials

Electrical Hazards in Construction Areas

- Statutory warning leaflets / posters are to be distributed / displayed by the Contractor in the vicinity of work sites for the benefit of all workers, officers and supervisors as well as the public, indicating the do's and don'ts and warning related to electrical hazards associated with operations to be executed / in progress.
- All wires shall be treated as live wires
- Report about dangling wires to the site-in-charge and do not touch them.
- Only a qualified electrician should attempt electrical repairs.
- Train all workers about electrical safety.
- Shut down the equipment that is sparking or getting over heated or emitting smoke at the time of operation, if it is not the normal way of working of such machines.
- Inform technical person/s for required maintenance.

- Never used damaged wires for electrical connection
- Demolition, tree felling and removal of overhead transmission lines shall be undertaken with strong, efficient and closely monitored arrangements to avoid accidents.
- Use and Storage of Gas (LPG)
- Store filled LPG cylinder in a secure area – mark this as a no smoking area.
- Transport, store, use and secure cylinders in upright position
- Ensure proper ventilation at the ground level in locations where LPG is in use.
- Avoid physical damage to the cylinders
- Never weld near the cylinder
- Store empty cylinders secured and upright
- Make sure that the cylinder is closed immediately after use
- Investigate immediately if there is the smell of LPG or gas
- Make sure that there is no other unrelated fire in the vicinity of the cylinder.

Fire Safety Practices

- Store flammable material in proper areas having adequate fire protection systems
- Display sufficient warning signs
- Install fire alarm wherever required and test regularly.
- Inspect fire extinguishers regularly and replace as necessary.
- Train selected personal on use of fire extinguishers
- Fire escape route should be kept clear at all times and clearly indicated
- Train workers about the escape route and assembly point/s.
- Carryout fire drill periodically
- When fire breaks out alert all persons through fire alarms or other methods.
- Put off the fire with appropriate fire extinguishers only when you are sure that you are safe to do so.
- Escape if you are in danger through the fire escape route to assembly point.
- Call-up Fire Service
- Fire officers to carryout head count at the assembly point.

Noise Hazards and its Control

- Plan camp lay-out in a manner that ensures barriers /buffers between residential / office units and high noise generating zones.
- Use sound meters to measure the level of noise and if it exceeds 75 dB(A), then ensure preventive measures.
- Make personnel aware of noisy areas by using suitable warning signs and insist on use of ear protectors / ear plugs to prevent excess noise affecting the workmen.
- Reduce noise at source by: use of improved equipment; regular and proper maintenance of the machinery as per the manufacturer's manual; by replacing rickety and noisy equipment and machineries.
- Screening locations with noise absorbing material; making changes in the process / equipment; controlling machine speeds; ensuring that two noise-generating machines are not running at the same time close to each other at same location; using cutting oils and hydraulic noise breakers; providing vibration and noise absorbing platform and firm embedding of equipment with fasteners.
- Appoint a competent person to carryout a detailed noise assessment of the site; designate ear protection zone/s; give training / instructions on the necessaryprecautionary measures to be observed by site personnel including using suitable type of ear protection equipment.

Personal Protective Equipment (General)

- Provision of personal protective equipment has to be made over and above all measures taken for removing or controlling safety hazards on a work site.
- Ensure that sufficient personal protective equipment are provided and that they are readily available for every person who may need to use them.
- The Contractor's Project Manager shall ensure that all persons make full and proper use of the personal protective equipment provided.
- Provide instruction/s and training for the proper use and care of personal protective equipment.
- Ensure that the personal protective equipment is in good condition.
- Train workers to report unintentional damages for replacement and to always keep the personal protective equipment clean. PPE includes, but may not be limited to, hard hats, goggles, ear plugs, gloves, air filters/masks, boots, ropes etc.

<u>Eye Protection</u>

- Road construction work sites, quarries and crushers are full of dust particles, sand, splinter, harmful gases, bright light and welding arc lights, which are injurious for the eyes. Therefore, eye protection and adequate lighting in work areas is required. All workers, supervisors and inspection officers and dignitaries coming over for study of works should be compelled to

wear eye protecting glasses /goggles properly fitting the eye sockets to prevent damage due to dust, gases and other particles.

Head Protection

- Hard hats are compulsory for all workers, supervisors and managers /officials while working and / or inspecting a work sites. Hard hat areas shall be demarcated clearly.

Hearing Protection

- Provide ear plugs or ear muffs to the workers and to those who need to get in and out of a high noise area frequently.
- Use re-usable earplugs when the reduction required (15-25 dBA) is not excessive.
- Use earmuffs where a large attenuation of up to 40 dBA is demanded.
- Do not use dry cotton wool for hearing protection because it doesn't provide any such protection.
- Provide disposable ear plugs for infrequent visitors and ensure that these are never re-used.
- Replenish ear plugs from time to time for those who need to work continuously for a long period in a high noise area/s.
- Use ear muffs with replaceable ear cushions because they deteriorate with age or may be damaged in use.
- Avoid wearing spectacles with ear muffs. Use soap and water or the recommended solvent for cleaning ear muffs.

Respiratory (Protective) Equipment

- Wear suitable masks for protection when there is a potential for small particles entering the lungs, e.g. emptying of cement bags, working at crusher sites etc.
- Provide training to all persons using the masks / respirators for their correct fitting, use, limitations and symptoms of exposure.
- Clean and inspect all respirators before and after use
- Store respirators properly when not in use

Safety Footwear

- Wear suitable footwear for work
- Wear suitable safety shoes or ankle boots when working anywhere where there is high risk of foot injuries from slippery or uneven ground, sharp objects, falling objects etc.
- All safety footwear, including safety shoes, ankle boots and rubber boots, should be fitted with steel toecaps.
- Avoid wearing flip flops, high heeled shoes, slippers, light sport shoes in situations where there is a risk of foot injury and keep shoelace knots tight.

Hand Protection

- Wear suitable gloves for selected activities such as welding, cutting and manual handling of materials and equipment.
- Do not wear gloves where there is a risk of them becoming entangled in moving parts of machinery.
- Wash hands properly with disinfectant soap and clean water before drinking or eating.
- Wash hands immediately after each operation on site when the situation warrants.

First Aid

- Provide first aid boxes at every work site in a cool and shaded place.
- Ensure that training on the use of the first aid box is provided to at least every supervisor on the site.
- Display the list of persons along with their contact numbers who are trained on providing first aid.
- Ensure that every first aid box is marked "First Aid" in English and in local language.
- Check for expiry dates and replace the contents, as necessary.
- Maintain a register on health records including injuries / accidents.

Accident Investigations

- Carryout the investigation/s as quickly as possible
- Investigation should be carried out both internally as well as through third party.
- Conduct interviews with as many witnesses as necessary including the affected persons and supervising officials.
- Do not rely on any one / limited source of evidence.
- Check all the log books, stock registers, issue registers and movement registers on site
- Safety regulations, traffic signals and signal men activities, signage, as well as other field positions and keep a record of all investigations through audio-visual and electronic medium for presenting an evaluation of the incident/s.
- After completion of the investigation / enquiry, a summary of the facts recorded, sequence of happenings, persons-in-charge, persons examined, equipment and machineries tested, follow-up of action as per legal requirements, copy of station diary entry, hospital entry, safety regulations etc. to be prepared with a comparative analysis for proper assessment.

Annex 21: Guidelines For Preparation Of Traffic Management Plan

The Contractor shall at all times carry out work on the road in manner creating least interference to the flow of traffic with the satisfactory execution. For all works involving improvements to the existing state highway, the Contractor shall, in accordance with the directives of the Sr. Environmental Specialist of the Independent Engineer (IE), provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the state highway. The Contractor shall take prior approval of the IE regarding traffic arrangements during construction.

Traffic Safety and Roads Works

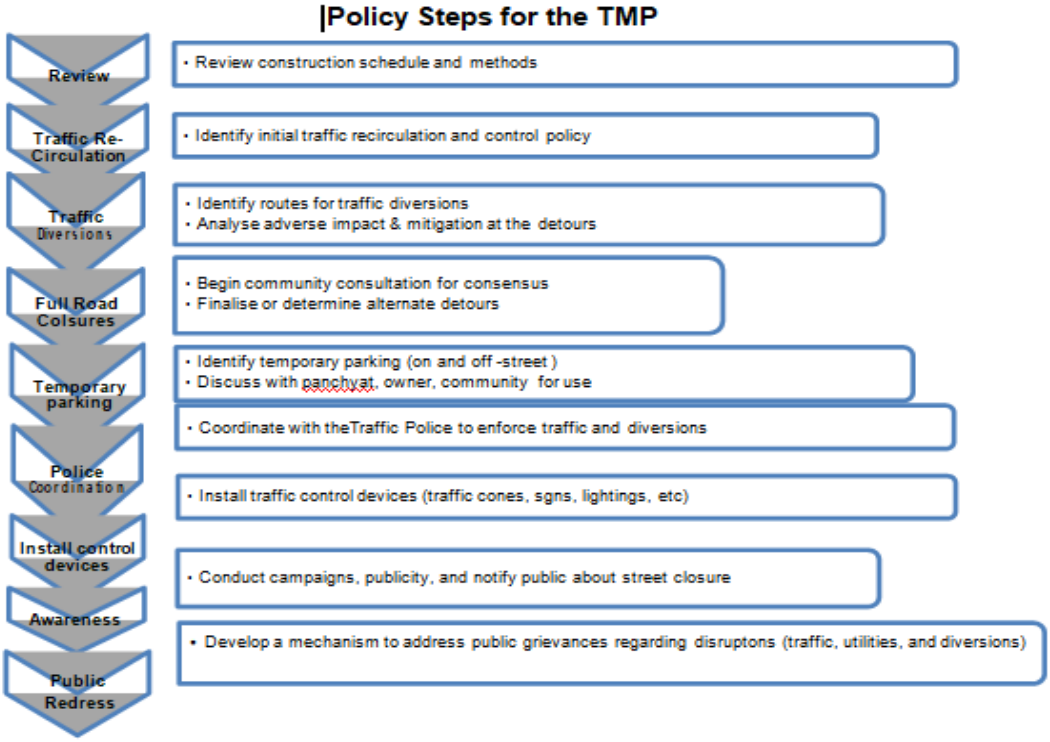
- Delineate advance warning zones, transition zones and construction zones at both ends of a work front. Use devices such as regulatory signs, delineators, barricades, cones, pavement markings, lanterns and traffic control lights, reflectors and signal men in appropriate manner round the clock.
- No work front should be 'touched' without putting appropriate safety measures in place. Sr. Environmental Specialist of the Independent Engineer will be responsible to ensure that the permission for any activity is not given without the required safety plan and practices in place.
- Put signage at appropriate locations as per the road construction activity plan to warn the road users, construction vehicles / equipment operators, pedestrians and local residents about the work in progress, speed controls, hindrances / blockages, diversions, depressions etc. in lines with contract requirements and IRC guidelines
- Signage has to be: (i) simple, easy-tounderstand and should convey only one message at a time; (ii) has florescent and reflective properties of the paints; (iii) broad, prominent and with appropriate size of letters and figures; (iv) placed at the appropriate 'point/s' as specified in the IRC guidelines to allow proper stoppage / reaction time to approaching vehicles.
- Express a regret signage for the inconvenience caused and alert about thedangers ahead on account of construction activity.
- Different sign boards shall have a mix of pictorial signs and messages in locallanguage, Hindi and English.
- While using barricades, ensure that traffic is keptaway from work areas and the road user is guided tothe safe, alternative movement track.
- Ensure that excavation sites are provided with effective barriers and reflecting signage to prevent any accidental approach by vehicles during the day or night.
- Provide proper uniform (light reflecting garments) to flagmen engaged in traffic control at diversions so that they can be singled out from the moving traffic.
- Prevent entry of cattle and wildlife through proper fencing / barricading around the excavation sites.
- Provide wide red and green flags or red and greenlights to flagmen for controlling traffic. In high trafficzones and congested areas, use of wirelesscommunication devices with protective headgearand shoes by flagmen has to be ensured toprevent confusion and minimize the risk of accidents.

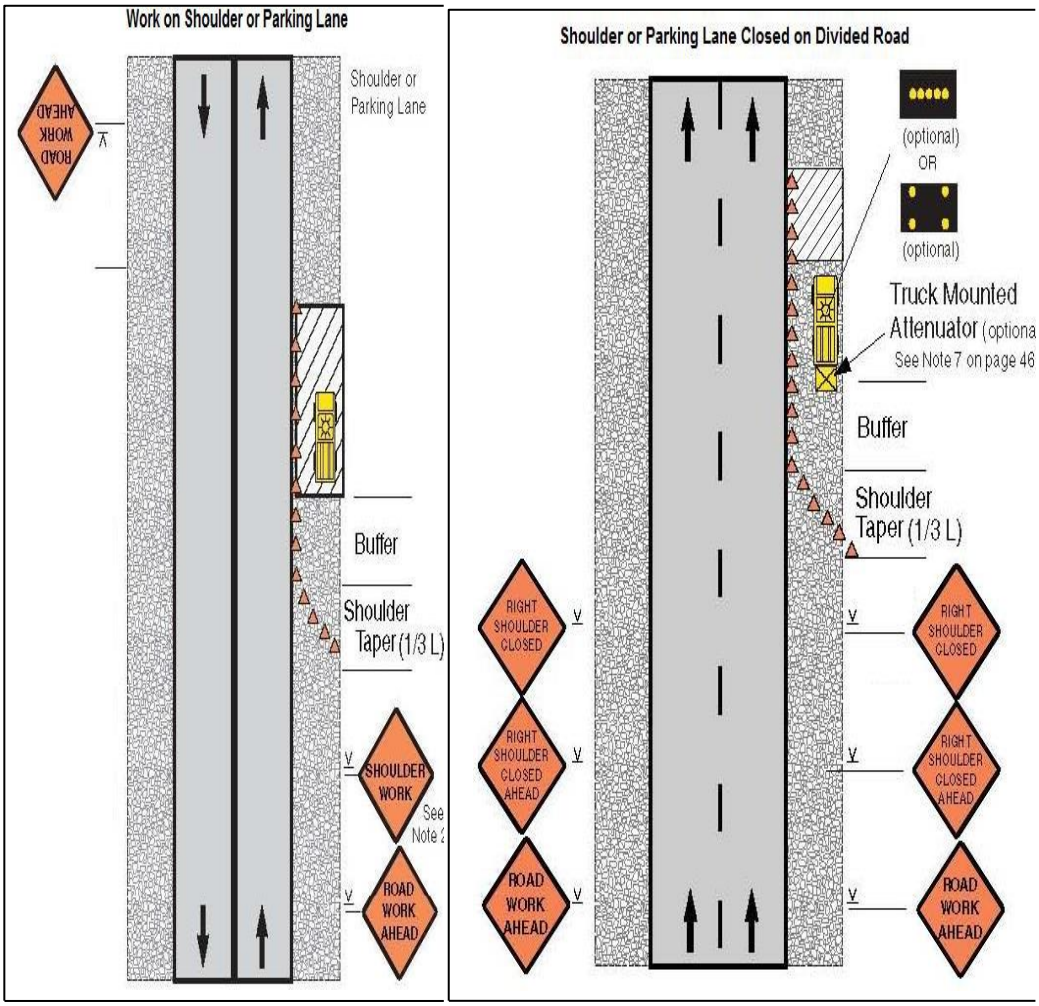
Ensuring Traffic Control

- Where the execution of the works requires temporary closure of road traffic use, the Contractor should provide and maintain temporary traffic diversions. The diversions should

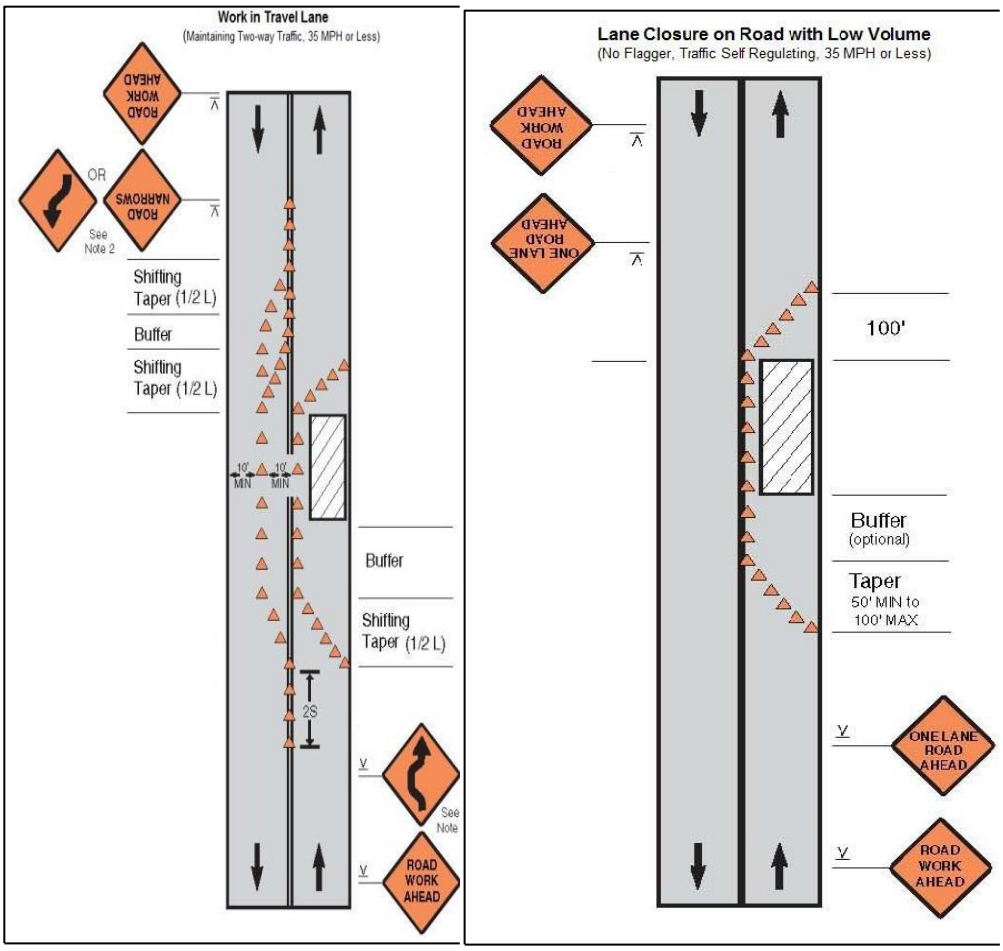
generally consist of 200 mm thickness of gravel laid directly upon natural ground and earthworks.

- Where the execution of the works requires single-lane operation on public road,the Contractor should provide and maintain all necessary barriers, warning signsand traffic control signals.
- At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the Carriageway) the lane width path for traffic should be clearly marked with the aid of pavement markings and painted drums or a similar device. At night, the passage should be delineated with lanterns or other suitable light source.
- One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This should be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen should be equipped with red and green flags and lanterns / lights.
- On both sides, suitable regulatory / warnings signs as approved by the IE shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs should be of design and of reflector type.
- Upon completion of the works for which the temporary traffic arrangements or diversions have been made, the Contractor should remove all temporary installations and signs and reinstate all affected roads and other structures or installations to the conditions that existed before the work started.

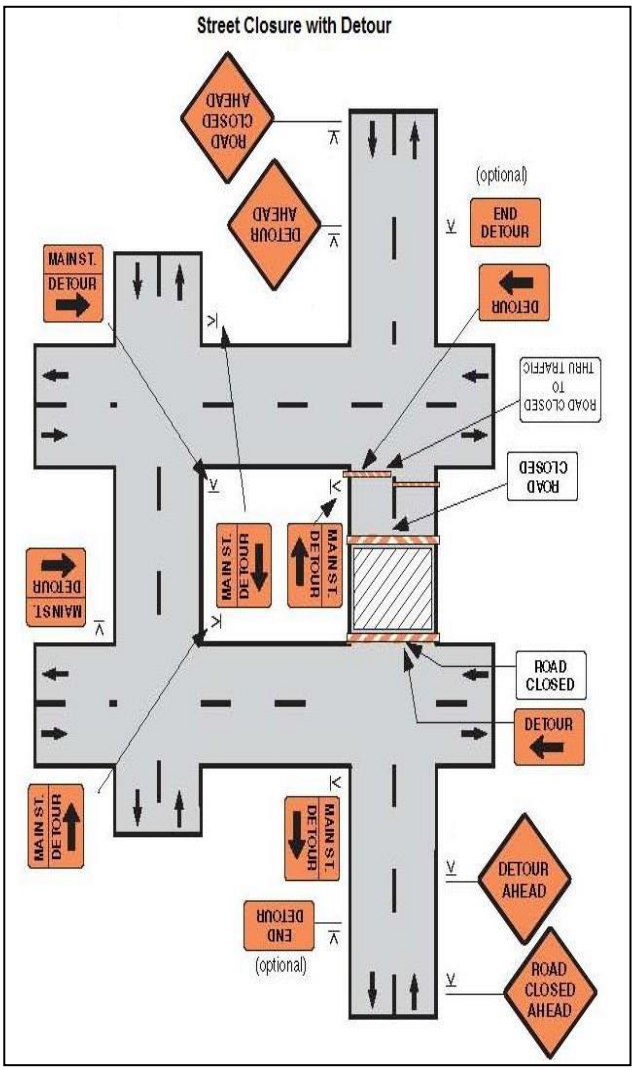




Work on Shoulder or Parking Lane and Shoulder or Parking Lane Closed on Divided Road



Work in Travel Lane and Lane Closure on Road with Low Volume



Street Closure with Detour

Annex 22: Guidelines For Sediment Control

Right at the initial stage of the work, the operations such as clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across, pavement courses and shoulders are undertaken. These activities generate huge wastes and debris, which should not find their way into drainage channels and water courses nor should remain exposed to wind at the site and allowed to erode and contaminate productive soils or generate windblown dust particles in the atmosphere.

Erosion and sediment control measures shall, therefore, be planned to prevent soil erosion and sedimentation. These measures may involve temporary measures at construction stage, such as of temporary berms, dikes, sediment basins, slope drains, use of temporary mulches, fabrics, mats, seeding or other control devices .Permanent erosion control measures aim at preventing erosion during the project life cycle and should be planned as a part of the project design. These may involve turfing or pitching the embankment Slopes, turfing / mulching / vegetating the exposed areas, vegetating or reinforcing the cut slopes by appropriate methods such as shot-creting, rock bolting, soil-nailing, gabions etc.

Sediment control, whether temporary or permanent, would be mostly project and site specific. However, some of the generic measures shall be as follows.

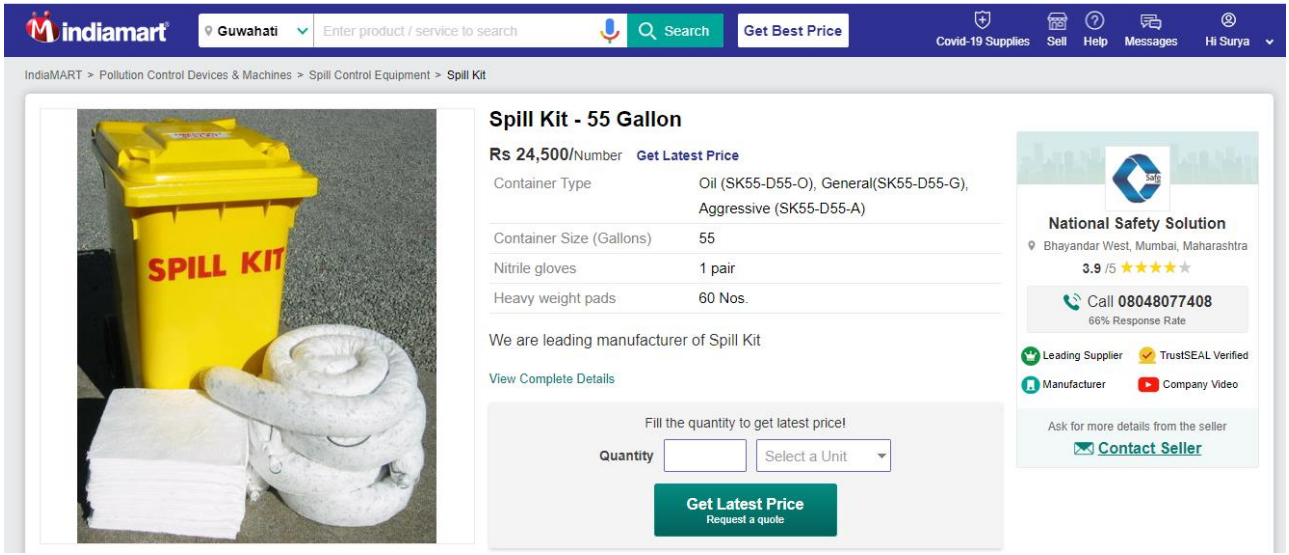
- Debris generated at construction site must be removed immediately and dumped at the designated dump sites after useful recyclable materials are sorted out, and properly stocked or stacked.
- The site cleared after removal of debris would usually be prone to erosion. These areas should be treated by mulching and other dust palliation measures.
- There could be many mulching options such as seeding top soil and spreading the mulch (organic) to permit growth of grass, or other methods like mulches of tiles, brick bats, stone chips, or any other non-erodible wastes, which cover the exposed soil, allow moisture to be retained within soil and prevent erosion.
- Dust palliation measures by any suitable commercially available dust palliatives, application of water, cement, lime or bitumen emulsion in thin application to bind the dust particles together.
- All slush at construction sites, which after drying up become erodible must be either dredged and removed or treated appropriately in-situ (say by mulching).
- Temporary drains combined with sedimentation tanks should be created at the periphery or edge of the work sites to arrest the sediments brought by rains or construction activities requiring water and discharge only sediment free water into the water courses.

Annex 23: Analysis of Rate

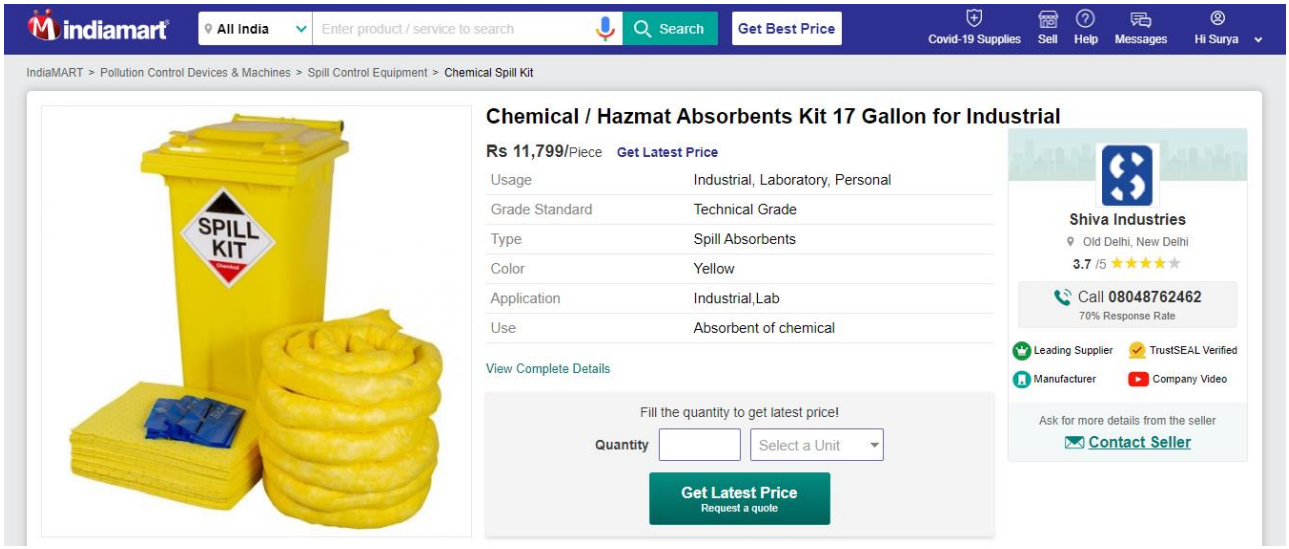
A. Rate of Scheduled items

B. Rate of nonscheduled items

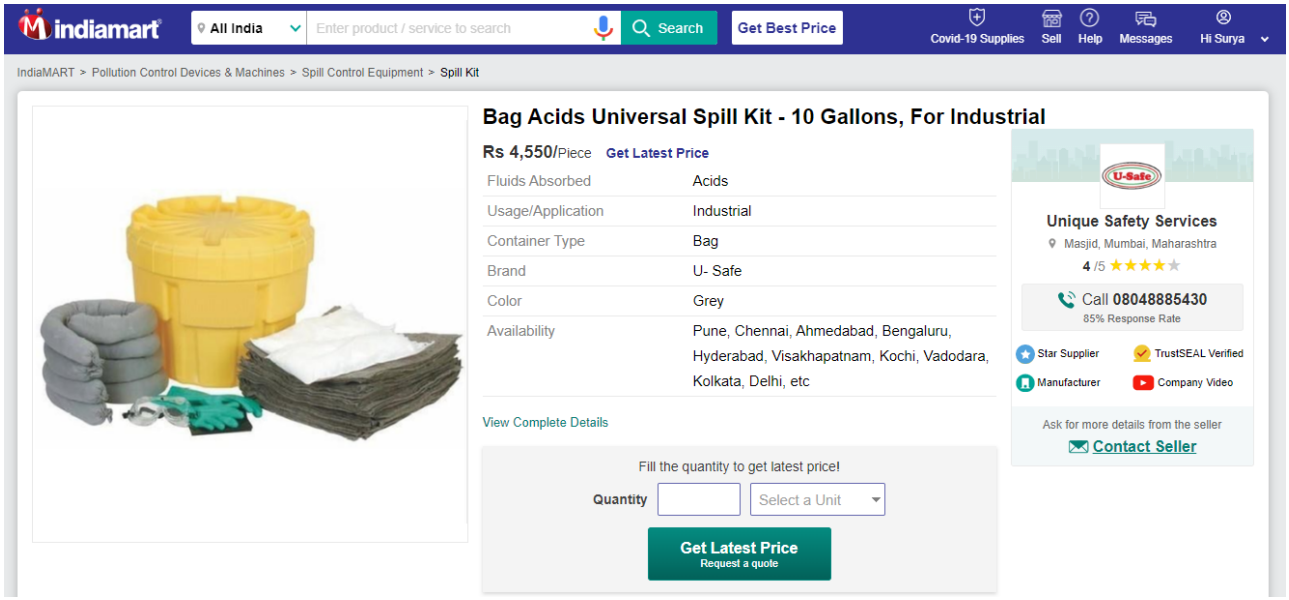
1. Quotation for spill kit



Quote 1 (55 gallon – 200 liter per kit)



Quote 2 (17 gallon – 65 liter per kit)



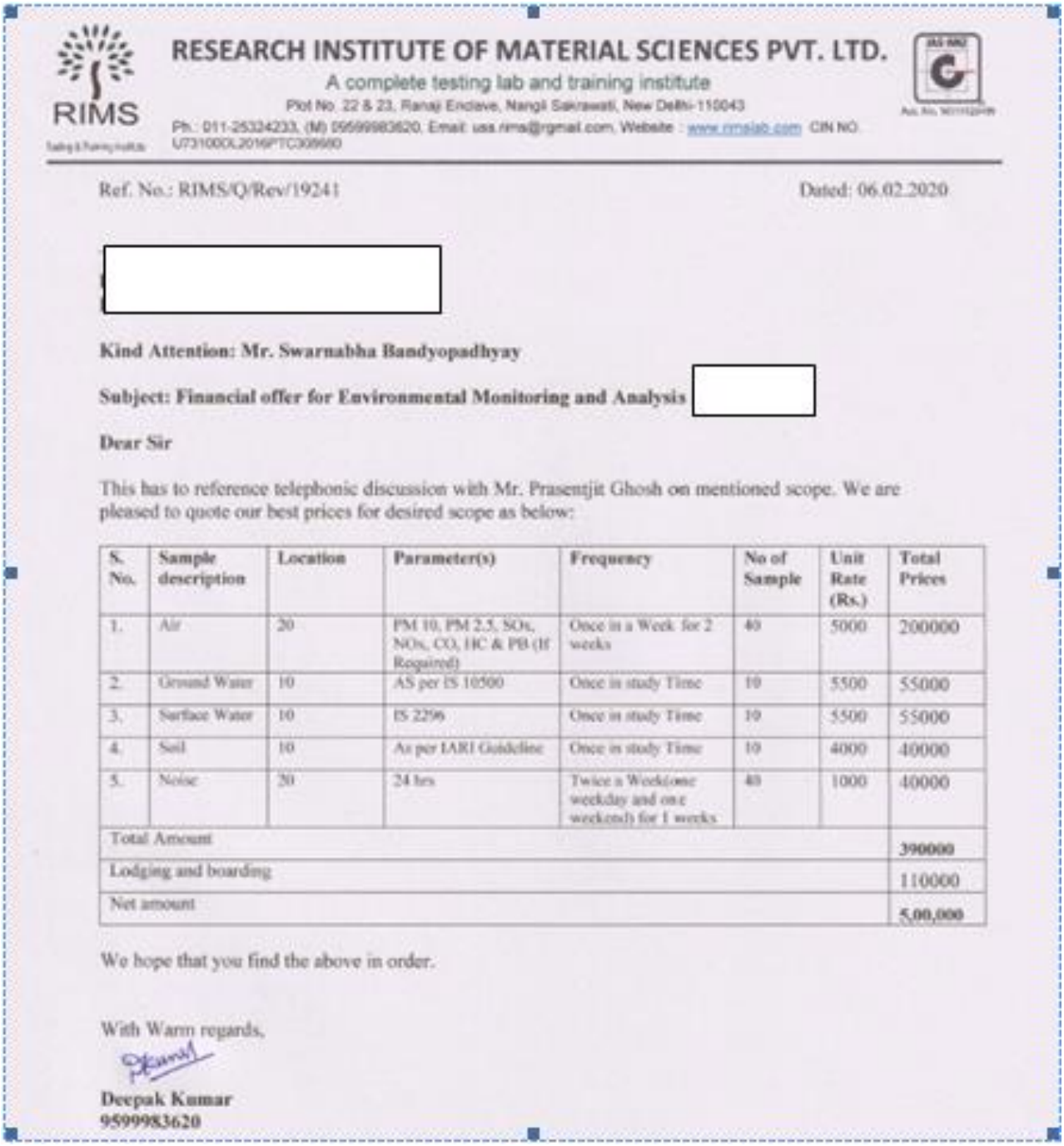
Quote 3 (38 liters per kit)

Calculation of average cost

Considering the accidental spill contamination kit for a medium size tanker (tanker capacity 5000 liter)

Quotations	Unit size	Requirement (considering for 5000 Liter tanker)	Unit cost (per piece)	Total cost
Quote 1	200 liter	(5000/200) = 25 nos.	24,500 /-	612,500/-
Quote 2	65 liter	(5000/65) = 77 nos.	11,800 /-	908,600/-
Quote 3	38 liter	(5000/38) = 132 nos.	4,550 /-	600,600/-
Approx average cost				700,000/-

2.Quotation for environmental monitoring



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Ph.: 011-25324233, (M) 09599983620, Email: uas.rims@gmail.com, Website : www.rmslab.com CIN NO. U73100DL2016PTC309980

Ref. No.: RIMS/Q/Rev/19241 Dated: 06.02.2020

[redacted]

Kind Attention: Mr. Swarnabha Bandyopadhyay

Subject: Financial offer for Environmental Monitoring and Analysis [redacted]

Dear Sir

This has to reference telephonic discussion with Mr. Prasentjit Ghosh on mentioned scope. We are pleased to quote our best prices for desired scope as below:

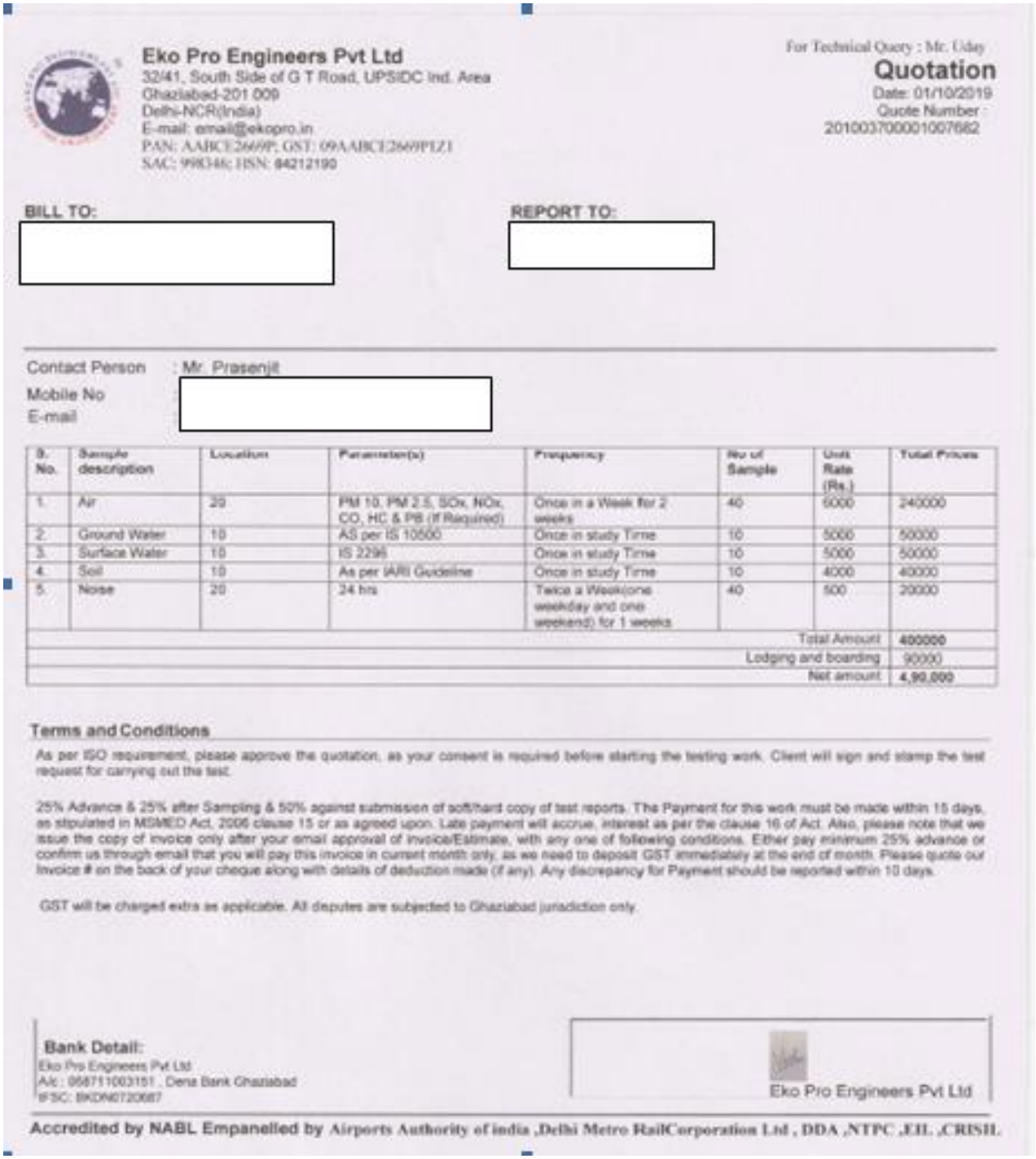
S. No.	Sample description	Location	Parameter(s)	Frequency	No of Sample	Unit Rate (Rs.)	Total Prices
1.	Air	20	PM 10, PM 2.5, SOx, NOx, CO, HC & PB (If Required)	Once in a Week for 2 weeks	40	5000	200000
2.	Ground Water	10	AS per IS 10500	Once in study Time	10	5500	55000
3.	Surface Water	10	IS 2296	Once in study Time	10	5500	55000
4.	Soil	10	As per IARI Guideline	Once in study Time	10	4000	40000
5.	Noise	20	24 hrs	Twice a Week(one weekday and one weekend) for 1 weeks	40	1000	40000
Total Amount							390000
Lodging and boarding							110000
Net amount							5,00,000

We hope that you find the above in order.

With Warm regards,

Deepak Kumar
9599983620

Quotation 1 for environmental monitoring



Eko Pro Engineers Pvt Ltd
32/41, South Side of G T Road, UPSIDC Ind. Area
Ghaziabad-201 009
Delhi-NCR(India)
E-mail: email@ekopro.in
PAN: AABCE2669P; GST: 09AABCE2669PIZ1
SAC: 998346; HSN: 84212190

For Technical Query : Mr. Uday

Quotation
Date: 01/10/2019
Quote Number :
201003700001007662

BILL TO:

REPORT TO:

Contact Person : Mr. Prasenjit
Mobile No
E-mail

S. No.	Sample description	Location	Parameter(s)	Frequency	No of Sample	Unit Rate (Rs.)	Total Prices
1.	Air	20	PM 10, PM 2.5, SOx, NOx, CO, HC & PB (If Required)	Once in a Week for 2 weeks	40	6000	240000
2.	Ground Water	10	AS per IS 10500	Once in study Time	10	5000	50000
3.	Surface Water	10	IS 2296	Once in study Time	10	5000	50000
4.	Soil	10	As per IARI Guideline	Once in study Time	10	4000	40000
5.	Noise	20	24 hrs	Twice a Week(one weekday and one weekend) for 1 weeks	40	500	20000
						Total Amount	400000
						Lodging and boarding	90000
						Net amount	4,90,000

Terms and Conditions

As per ISO requirement, please approve the quotation, as your consent is required before starting the testing work. Client will sign and stamp the test request for carrying out the test.

25% Advance & 25% after Sampling & 50% against submission of soft/hard copy of test reports. The Payment for this work must be made within 15 days, as stipulated in MSMED Act, 2006 clause 15 or as agreed upon. Late payment will accrue, interest as per the clause 16 of Act. Also, please note that we issue the copy of invoice only after your email approval of invoice/Estimate, with any one of following conditions. Either pay minimum 25% advance or confirm us through email that you will pay this invoice in current month only, as we need to deposit GST immediately at the end of month. Please quote our Invoice # on the back of your cheque along with details of deduction made (if any). Any discrepancy for Payment should be reported within 10 days.

GST will be charged extra as applicable. All disputes are subjected to Ghaziabad juriadiction only.

Bank Detail:
Eko Pro Engineers Pvt Ltd
A/c : 058711003151 , Dena Bank Ghaziabad
IFSC: BKDN0720587

Eko Pro Engineers Pvt Ltd

Accredited by NABL Empanelled by Airports Authority of india ,Delhi Metro RailCorporation Ltd , DDA ,NTPC ,EIL ,CRISIL

Quotation 2 for environmental monitoring

ENVIROCHECK

House of Environmental Pollution Monitoring and Analysis

Office : 63/B, Rastraguru Avenue, Kolkata - 700028
Lab : 189 & 190, Rastraguru Avenue, Kolkata - 700028
Phone : 2579-2889/2091/6459-1174 / Fax : 2529-9141
E-mail : envicheck@cal2.vsnl.net.in / Website - www.envirocheck.org

QUOTATION

ISSUED TO	:	Bonqs Preyukti International Pvt. Ltd.	ISSUE DATE	:	11.12.2018
Address	:	4-FR; FL-4B 323/A, Motilal Gupta Road, LP-109/2, Kolkata – 700 008	Ref. No	:	451/EC/Q/2018-2019
Your Ref. No.	:	Through e-mail dtd. 11.12.2018	GST Details:		
Site Details			GST No.	:	19AAAFE6997Q1ZE
Site Address	:	-	SAC Code SAC T.P.	: :	998346 998559
GST NO.	:	19AAGCB6246A1ZW	Services	:	Technical Testing & Analysis Services
PAN	:	-	Contact Person Details:		
Kind Attn.	:	Mr. Swarnabha Bandyopadhyay	Name	:	S.B.Chowdhury
[redacted]			Designation	:	CEO
Contact No.	:	8017668861	Contact No.	:	[redacted]
E-mail Id	:	[redacted]	E-mail Id		info@envirocheck.org
SUB.: ENVIRONMENTAL MONITORING WORK (Road Length – 200km, Starting point – About 80 km from Hyderabad)					

Sl.	Scope of Work	Frequency	Qty.	Unit rate (Rs.)	Amount (Rs.)
1.	**Ambient Air Quality monitoring and analysis.** **Parameters** : SPM, PM_{10}, $PM_{2.5}$, Sulphur dioxide, Carbon Monoxide, Ozone, Oxides of Nitrogen and Total Hydrocarbons Consultant will incorporate the revised National Ambient Air Quality Standards, 2009	10 locations twice a week for four weeks	80	6000	4,80,000.00
2.	**Meteorology** Wind speed, wind direction, maximum and minimum temperature, humidity, atmospheric pressure, relative humidity, rainfall	-	1	15000/-	15,000.00
3.	**Soil Quality** Parameters: pH, Electrical conductivity, sand (%), silt (%), clay (%), texture, moisture retention capacity (%), infiltration rate (mm/hour), bulk density (gm/cc), porosity (%), organic matter (%), nitrogen (mg/1000g), potassium (mg/1000g), phosphorous (mg/1000g), sulphates and sodium sulphates	2 locations once in study time	2	5000/-	10,000.00
4.	**Water Quality** Surface & Ground Water Quality Parameters: TDS, pH, Turbidity, Sulphate as SO4, Total alkalinity as calcium carbonate, Calcium as Ca, Magnesium as Mg, Nitrate Nitrogen as NO3, Fluoride (as F), Chloride (as Cl), Iron (as Fe), Zinc as Zn, Total Hardness (as CaCO3), Residual Free Chlorine , Total Coliform	5 nos. of surface water and 4 nos. of ground water samples once in study time	9	4500/-	40,500.00
5.	**Noise Levels** Equivalent Noise Level (Leq), L_{10} and L_{90} will be measured. The noise monitoring will be conducted during 'Day' time as well as 'Night' time on weekdays as well as weekends in accordance with CPCB guideline for ambient noise monitoring once during the monitoring season by installing a sound level meter at 12 locations.	12 locations once in study time	12	600/-	7,200.00
6.	Mobilization /demobilization expenses including transportation, Board & Lodging, Instrument booking charges etc.	-	-	L.S.	40,000.00

Quotation 3 for environmental monitoring