Public Works Department
Government of Meghalaya

Design of Roads in the State of Meghalaya (EAST)

under Meghalaya Integrated Transport Project

• Shillong Diengpasoh Road

Environmental Assessment Report

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LIST OF ABBREVIATIONS

CPCB	-	Central Pollution Control Board
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Monitoring Plan
ESZ	-	Eco-Sensitive Zone
GoI	-	Government of India
IFC	-	International Finance Corporation
IRC	-	Indian Road Congress
MDR	-	Major District Road
MoEF&CC	-	Ministry of Environment and Forests & Climate Change
MoRT&H	-	Ministry of Road Transport and Highways
MPWD	-	Meghalaya Public Works Department
NBWL	-	National Board for Wildlife
NGO	-	Non-government Organization
NH	-	National Highway
OP	-	Operational Policy
PAF	-	Project Affected Person
PMGSY	-	Pardhan Mantri Gram Sadak Yojana
RF	-	Reserve Forest
ROW	-	Right of Way
SPCB	-	State Pollution Control Board
TOR	-	Terms of Reference

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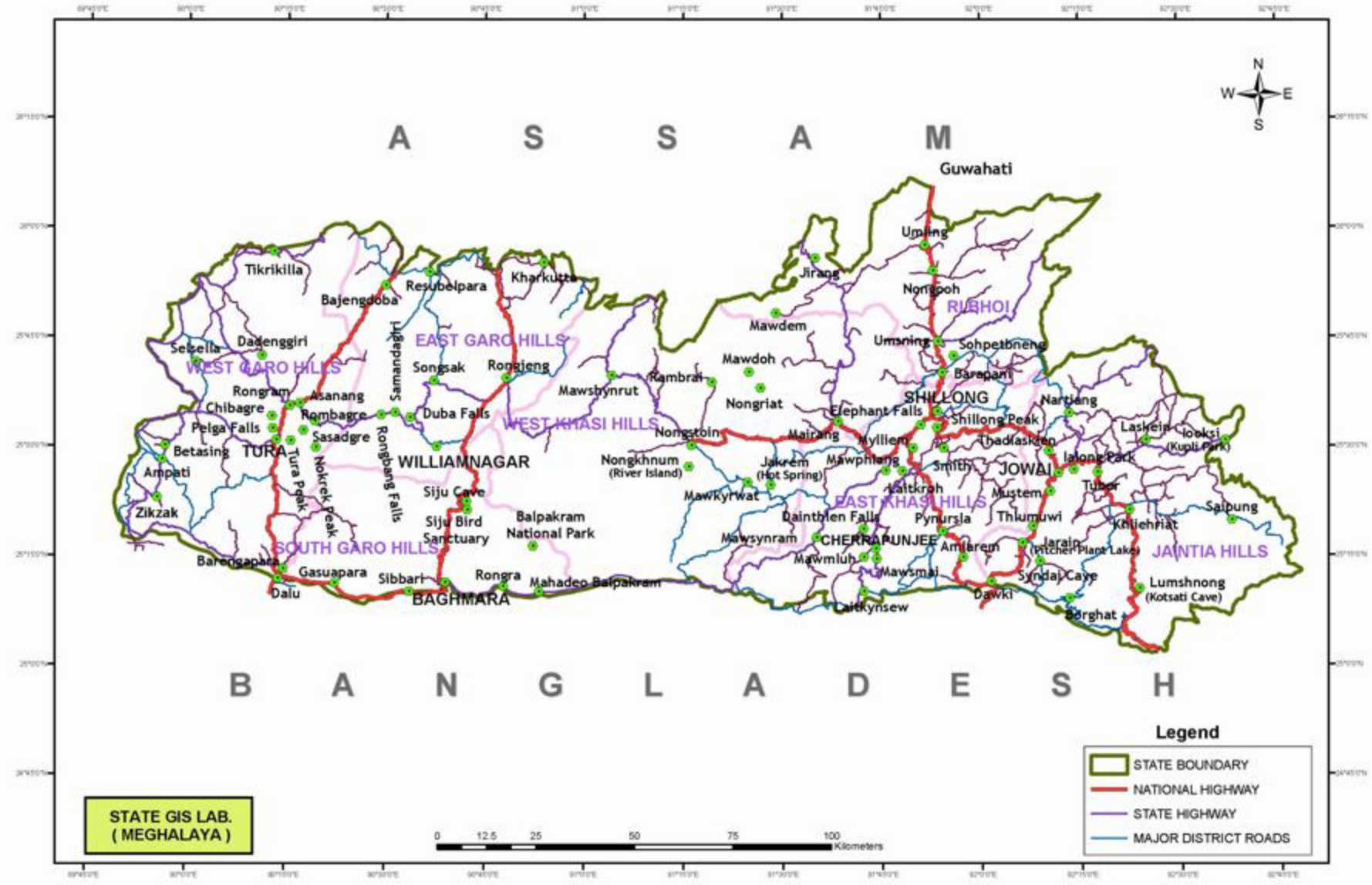

EXECUTIVE SUMMARY

1. Meghalaya Integrated Transport Project (MITP) is an ambitious project of the Government of Meghalaya (hereinafter refer to as GoM) under which it intends to strategically transform the Core Road Network of 2000 km road length. In the project, State Road Network roads of 650 km road length will be widened, and 1350 km road length will be provided periodic maintenance besides other institutional, development activities. The Project shall follow a Multiphase Programmatic Approach (MPA). Up-gradation of 266.82 km road length will be carried out in Phase-I. The Department of Economic Affairs (DEA) and The World Bank (WB) has accorded in-principle approval of Tranche-I of MITP for US$ 110 million (loan assistance of US$ 82 million and State Share of US$ 28 million), under which State Road Network roads measuring 128 km length will be upgraded along with certain other institutional development activities. There are total 10 road sections selected under Phase-I, 5 road sections in East Meghalaya and 5 road sections in West Meghalaya.

2. The main objective of the proposed consultancy assignment is to carry out the DPR for Construction of 122.68km of major district roads in East Meghalaya State under Phase-I of MITP. The Consultancy service for preparation of Detailed Project Report have been entrusted to M/s. Projects Consulting India Pvt. Ltd., for total design length of 122.68km of major road sectionsas listed in below Table.

List of roads in Meghalaya East under the project

S.No.	Division	Name of Road	Category	Total Length (km)	Proposed Length (km)
1	N.H. Bye Pass	Shillong - Diengpasoh Road	MDR	21.73	11.763
2	North Jowai	Pasysih - Garampani Road	SH	48	26.98
3	Shillong South	Mawmaram - Nongthliew Mawmih- Mawlyndep Road	MDR	44	41.488
4	N.H. Bye Pass	Laitkor-Pomlakrai - Laitlyngkot Road (5th -16th km)	MDR	15.52	11.358
5	Nongpoh	Umling- Patharkhmah Road	MDR	40	31.100
Total				**169.25**	**122.68**

3. This Major District Road starts from Itshyrwat Junction in Shillong and end at Shillong Bypass at km 19.00. The total length of road section is 21.73 km. However, in this scope of study 11.763 km of MDR is covered starting from km 2.200 of Shillong - Diengpasoh Road near Itshyrwat Village to km 13.983 of Shillong - Diengpasoh Road. The section from chainage km 13.983 to end point of MDR where it joins Shillong bypass is being rehabilitated under PMGSY program. The carriageway width varies from 5.m to 5.5m and right of way as was observed varies from 12m to 15m.

4. As part of the road improvement for the road section the existing single-lane road would be converted into 2-lane corridor (7.000m carriageway) with 0.9 m wide paved shoulder on either side, V-type Drain / Crash Barrier Hill / Valley side with 0.6m on each side. The total width

required will be 10.0m in rural areas and 11.2m in builtup areas, where both side drain is proposed.

5. This Environmental Impact Assessment Report is prepared for Shillong - Diengpasoh Road section in order to identify all relevant direct, indirect and cumulative environmental and social risks and impacts for construction and operational phase. For environmental studies and subsequently the assessment the Corridor of Impact is considered of 500m on either side of the proposed road and project influence zone is taken 10km on either side (Arial distance) from boundary of road.

6. The environmental assessment study was prepared between the months of October-December 2019 as part of detailed project report. This is draft Environmental Impact Assessment (EIA) report prepared to fulfil the requirements of the Operational Policy 4.01 for World Bank funded Project.

7. The environmental baseline study was carried out within the corridor of impact by the consultants during November-December 2019. Samples for ambient air quality, ambient noise level, water quality (Ground and surface) and soil quality were collected and analysed from NABL accredited laboratory. The primary data is established through field survey and monitoring results. The monitoring results are found within the prescribed limits for air, water, soil and noise level at the monitored locations in the project area.

8. Climate of Meghalaya plateau is influenced by elevation and distribution of physical relief. On the basis of weather condition, the Meghalaya plateau has 4 distinct seasons. The project road is within the East Khasi Hills District of Meghalaya state. The general topography of East Khasi Hills district is hilly with deep gorges and ravines on the southern portion. The proposed Shillong - Diengpasoh Road is located in north-eastern part of East Khasi Hills District, mostly elevation is in range of 1170-1462m.

9. The proposed project road falls under the Seismic Zone V, which is susceptible to major earthquakes as per the seismic zone map of India (IS 1893 - Part I: 2002). Considering high hazard seismic zone of the project road section area, design standards for structures stipulated in the clause under IRC: 6-2014 has been taken into account.

10. Land use pattern abutting the project road section is mainly open vegetation and built up areas in between including Mawdiangdianag, Mawkasiang, Siejong, Tynring and Mawpdamg Nongthmmai habitation areas.

11. There are no National Park, Wild Life Sanctuaries within 10 km of the site. Also, there are no protected forest which would interfere with the alignment. However, during construction chances of small animal stray into the construction area and fall into the excavation. To prevent such accidents from happening temporary woven wire mesh guards of about 2.4 m (8 ft.) high will be put around the excavated areas. Further, if any stray animal falls in an excavation. No harm would be done to the trapped animal. The contractor in association with PIU and Forest Department would ensure safe release of the animal.

12. There is Itshyrwat reserve forest running along the road section of Shillong – Diengpasoh on RHS, approx. 3km length. Right of way is available for widening on left hand side and no forest clearance is required for improvement proposal of this road section. It is estimated 85 trees need to be felled for this project. All cut trees will be compensated at the rate of 1:10 with preference to fast growing local species that are more efficient in absorbing emissions.

13. Approximately 61075 cum of excavated soil from hill cutting and about 19136 cum of BT and Non-BT material will be scarified from existing carriageway are expected to be generated

form scarified bitumen, dismantling and excavation of existing culvert. The excavated material will used in backfilling in the project and balanced quantity will be disposed of at approved designated site.

14. The estimated 24553 cum of granular sub-base, 2655 cum of bituminous concrete and 4898 cum of Dense Bituminous Macadam would be used for the project. The construction activities e.g. earthwork, concreting of structure and labour camps, would require 90 KLD of water and may result in conflicting situations with local communities. The material will be taken after due approvals from concerned state authorities.

15. In addition, to the above specific measures to mitigate construction related impact the Environmental Management Plan has also suggested mitigation measures and action plans which would be implemented during the construction and operation stage of the project. A management system has also been developed to ensure that these measures are effectively implemented.

16. Climate resilient measures are also considered for designing of the road section such as Design of cross-drainage structures (44 nos.) based on rainfall data of the project area, accommodation of improvement proposal within existing right of way following existing alignment, to avoid impacts on trees, land and existing structures, tree plantation on valley side and application of Bio-engineering and bio technology on hill side, dumping areas for muck disposal has been identified, protection (1256m) and breast walls (1040m) has been proposed at required locations with steep hill and construction of side drains to minimize soil erosion and water pollution.

17. The Environment Management Plan for the project road section has been prepared to detail out the mitigation measures which has been identified during the impact assessment in the EIA Study. It furthers detail out the mitigation measures discussed earlier during the Pre-Construction, Construction and Operation Phases of the project. This will ensure that environmental issues are properly addressed during road upgradation. This Environment Management Plan would be included as part of the Bidding Document and shall at a later date used by the Contractor for developing the Contractor's EMP.

18. The institutional arrangement for the implementation of the EMP in the project road section has been mentioned to identify the role and responsibility of each parties involved in the project implementation. PMU for overall project is headed by the Chief Engineer, PWD who will be responsible for the successful implementation of the Project. The Chief Engineer would be assisted by an Environmental Officer. The team at the PMU would be assisted by the Environmental Officer of Project Management Consultant (PMC). The actual responsibility of implementation of the EMP would be with the Contractor.

19. The Contractor's Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards. The roles and responsibilities of each of these officials have also been detailed out in the EMP. Training and capacity building would be required especially for the PMU staff associated with the project as the Environmental Safeguards would be a relatively new areas which staff are required to handle. The training and capacity building would not only be project specific but would target and developing long term capacities in PWD.

20. An Environmental Monitoring Program has been drawn up to essentially monitor the day to day activities in order to ensure that the environmental quality is not adversely affected during the implementation. The monitoring programme consists of Performance Indicators and Process Indicators. The performance indicators would identify the components which have to be

monitored and reported on a continuous basis during the stage of the implementation. These would help identify the level of environmental performance of the project. In addition, there would be Process Indicators which would help in assessing the effectiveness of the system which has been instituted for the program.

21. For the purpose of reporting of environmental performance, a reporting framework has been defined. This include:

- Daily Monitoring Report: by the contractor to the PMC on the environmental actions which has been implemented.
- Fortnightly and Monthly Monitoring Report: by the PMC to PMU
- Quarterly Auditing by the PMU to the Management
- Annual Audit by an External Agency of the entire process of EMP Implementation and reporting to the PMU for onward reporting to the World Bank

1. INTRODUCTION

1.1 Project Background

22. Meghalaya is a hilly state in northeastern India, bounded by another state Assam in the North and the East, and Bangladesh in the South and the West sharing a 443 kms international border.

23. The Road transport is the backbone of the state's socio-economic development. More than 80 percent of freight and almost cent percent of passenger movement within the state depends on roads. Yet, about half of the habitations lack all-weather road access. Further, many semi-permanent timber bridges are in dilapidated condition, limiting maxiumallowabe axle load on them. The problem is further compounded by difficult terrain and extreme climatic condition, leading to high maintenance cost of the roads.

24. Similarly, rapid urbanisation has created a huge gap between demand and supply of urban services and infrastucture. It has been assessed that other than Shillong, urban mobility at other cities and towns of the state are less than satisfactory[1]. In most of the towns due to narrow roads, lack of parking facilities and yearly growth of vehicles, traffic congestion is often evident. Further, in most cases the major highway passes through the city center as a result of which regional traffic comes in conflict with the local traffic.

25. To overcome the abovementioned challenges in a holistic and all-inclusive manner, the Government of Meghalaya, with financing and technical support from the World Bank, is preparing a project titled "Meghalaya Integrated Transport Project". The objective of the project is to "provide a well-connected efficient, good quality and safe transport network on long-term basis in a cost-effective manner maximizing economic and social outcomes". This will involve taking a whole-of-the-state approach of the entire transport sector and introduce innovations, efficiency, and new ways of doing business at various stages of service delivery, ensuring value for money. This will involve:

- Integrating transport and development agenda thus resulting in more job-creation, better incomes, and realization of the SDGs;
- Integrating various modes of transport – such as roads, ropeways, waterways, and urban transport to operate as part of one system for optimal performance;
- Integrating climate resilience, green growth, asset management, and safety in the transport sector thus making the sector more resource efficient, reducing carbon footprint, minimizing GHG and contributing to health outcomes.

26. MITP is an ambitious project of the Government of Meghalaya (hereinafter refer to as GoM) under which it intends to strategically transform the Core Road Network of 2000 km road length. In the project, State Road Network roads of 650 km road length will be widened, and 1350 km road length will be provided periodic maintenance besides other institutional, development activities. The Project shall follow a Multiphase Programmatic Approach (MPA). Up-gradation of 266.82 km road length will be carried out in Phase-I. The Department of Economic Affairs (DEA) and The World Bank (WB) has accorded in-principle approval of Tranche-I of MITP for US$ 110 million (loan assistance of US$ 82 million and State Share of US$ 28 million), under which State Road Network roads measuring 128 km length will be upgraded along with certain other

[1]Planning Department, GoM, http://megplanning.gov.in/MSDR/urban_development.pdf

institutional development activities. There are total 10 road sections selected under Phase-I, 5 road sections in East Meghalaya and 5 road sections in West Meghalaya.

1.2 Purpose of ESIA report

27. The main objective of the proposed consultancy assignment is to carry out the DPR for Construction of 122.68km of major district roads in East Meghalaya State under Phase-I of MITP. The Consultancy service for preparation of Detailed Project Report have been entrusted to M/s. Projects Consulting India Pvt. Ltd., for total design length of 122.68km of major road sections as listed in below Table-1.

Table 1:List of roads in Meghalaya East under the project

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5	Nongpoh	Umling- Patharkhmah Road	MDR	40	31.100
Total				**169.25**	**122.68**

28. The project road section on road network map of the state is shown in **Figure 1.**

29. ThisEnvironmentalImpact Assessment Report is prepared forShillong - Diengpasoh Road section in order to identify all relevant direct, indirect and cumulative environmental and social risks and impacts for construction and operational phase. Prepareation Environment and Social Management Plan for each road section to mitigate the potential impacts on the physical, biological and socio-economic parameters.

30. The environmental assessment study was conducted between the months of October-December 2019 as part of detailed project report. This is draft Environmental Imapct Assessment (EIA) report prepared to fulfil requirements of the Operational Policy 4.01 for World Bank funded Project.

1.3 Objective and Scope of the EIA Study

31. The objective of the present, EIA study is to identify potential environmental impacts of the proposedShillong - Diengpasoh Roadsection improvement measures and formulate strategies to avoid / mitigate the same. The scope of work to accomplish the above objective, comprise the following.

- Collecting primary and secondary environmental baseline data within the project boundaryand surrounding areas;
- Assessing potential adverse environmental impacts that might arise during operation of the project, after reviewing project information and using the environmental baseline studyconducted during the feasibility study;

- Suggesting appropriate mitigation measures to effectively manage potential adverseimpacts; and
- Analyse the alternatives in terms of alternative alignment, technology, design andoperation, including the “with project” and "without project" situationwere carried out to analyse the feasibility
- Consultation with the Public/Stakeholders and incorporate their concerns into the projectdesign;
- Developing an Environmental Management Plan (EMP) to implement suggestedmitigation measures and management plans to minimise adverse impacts through effectivemanagement systems including formulation of monitoring and reporting requirements;
- Conducting additional studies for the enhancement of the benefit to the local communityand the road users;

32. The environmental studies have been confined to the situation around the deemed areas of direct influence caused by constructional and operational facilities alongShillong - Diengpasoh Road, the proposed major district road section in the state of Meghalaya. The following sections of the report, discusses the methodology adopted by the consultant in conducting the study and presents the results of the same.

1.4 Approach and Methodology Adopted for EIA Study

33. The Environmental Impact Assessment has been carried out, in accordance with the requirements of the World Bank’s Operational Policy 4.01. The Government of India guidelines for Rail/Road/Highway project; EIA notification 2006 and its amendment of MoEFCC and Highway Sector EIA guidance manual 2010 has also been followed in the process of this environmental assessment. The study methodology has been adopted in such a manner to ensure that environmental concerns are given adequate weightage in the selection of alignment and design of proposed road improvements. The study in theroadsectionproject employ an iterative approach in which potential environmental issues have been examined at successive levels in detail and specificity, at each step in the process.

34. The Environmental impact assessment is based on the information collected from secondary as well as primary sources on various environmental attributes. Monitoring of air, water, noise and soil quality was also carried out along the road section alignment and significant issues were examined during field surveys to determine the magnitude of significant environmental impacts.

35. The major steps in the EIA process for the project were as follows:

(i) Screening of Project Road

36. As a part of the project feasibility study, Environmental Screening is undertaken in parallel withthe Preliminary Economic and Engineering studies to determine any significant social orenvironmental issues which could require further analysis (including the analysis of alternativealignments, improvement of junctions etc.) to resolve such issues.

37. The environmental screening typically identifies the natural habitats (e.g. national parks, wildlifereserves, sanctuaries, sacred groves, protected areas, forests, water bodies etc.), major rivers andwaterways, notified cultural heritage sites and any other potentially sensitive areas. Theinformation available from secondary sources along with the inputs from the site visits and consultation with local people are used to identify these issues and sensitive receptors which mightbe located along the corridor. The results of this analysis are communicated to the design team toresolve them (including recommendation for exclusion, analysis of alternative alignment

and/ormitigation) as a precursor to preliminary engineering design and undertaking the required forenvironmental assessment studies.

(ii) Delineation of Project Impact Zone

38. For carrying out further environmental studies and subsequently the assessment it was required todelineate the project influence zone. Depending on the severity of impact the Project influencezone has been classified as:

39. ***Corridor of Impact (CoI)***: The area of 500 m on either side of the proposed road centreline is considered as the corridor of impact. TheRoW i.e. 12 m to 15 m is thus included within the CoI. This area is more vulnerableto the project's direct impacts.

40. ***Project Influence Area (PIA):***In accordance with MoEF&CC's EIA Guideline Manual for Highways and as per guidelines ofEIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arialdistance) from boundary of road for collection of secondary data, including impacts due toancillary sites like borrow areas, quarry, material storage, disposal areas, etc.

(iii) Preliminary Engineering Surveys

41. With the information available from the screening the design team took the preliminary surveys ofthe project site to assess the engineering aspects of the road including the likely environmentalissues associated with the project. The survey carried out as part of the detailed design datacollection also provided valuable information regarding area adjacent to the proposed projectcorridor.

(iv) Collection of Secondary Environmental Data

42. Secondary data was collected from various verifiable sources about different components e.g.climate, physiography, soil type, ecology, etc. The sources from which information is gathered ispresented in Table

Table 2: Source of information collected on environment features in the project area

S.No.	Aspects	Parameters	Source of Information
1	Climatic Conditions in theProject Influence Area	Climate, Temperature,Rainfal	Indian Metrological Department
2	Soil & Geology	Soil type and itsstability,Fertility of the soilpotentiality for soil erosion	Geological Survey of India,State MiningDepartment
3	Slopes	Direction of slope,Percentageof slope	Contour Survey,satellite image and Survey ofIndia topographic sheets
4	Drainage/ Flooding	Existing drainage mapandflooding level including itsextent of water spread.Identification ofdrainagechannel and its catchmentsarea around the Project stretch	Satellite Imagery/ Topo sheet/Hydrologystudy/State WaterResource Department.
5	Water Bodies and WaterQuality	Identification ofwater bodies/canal/drainagechannels where the run offsurface water will flow/due toerosion and also due tospillage oil and	Topographysheets/field study. Hydrologicaldata fromthe CGWB Reports

		otherhazardous materials.Status of surface water andground water quality	
6	Forest within Proposed ROWLegal Status – ProtectedAreas, Endangered Plant andAnimal, Ecological SensitiveArea, MigratoryCorridor/Route,	Status of the forests, Conservation of forest area, &endangered plant and animaland any other species	Department of Forest, Govt.ofMeghalaya, DFOs, Discussion with local community and localDFOofficers
7	Trees and Vegetation Cover	Identification of existing treespeciesin theprojectinfluence area	Forest Department, ResearchInstitution, Field Survey.
8	Settlements along the PROW	Settlements &itspopulation along the corridor.Its location & numbers	Population/ District Census Report2011. Topographic survey
9	Cultural / Heritage andAncient Structures	Conservation areas if any,Protected structures, monuments and heritagestructures.	Archaeological Survey ofIndia, State ArchaeologicalDepartment

(v) Collection of Primary Baseline Information

43. For gathering the baseline environmental information on along the project corridor baselines studieswere conducted. These baseline studies includes:

- Baseline environmental surveys for assessing the ambient air, water, soil and noise quality
- Enumeration of trees to identify the Location, number, types spread, girth etc. nos. of the trees within the proposed RoW
- Ecological surveys to identify the habitats and the flora and fauna
- Structure enumeration to identify the one likely to be impacted
- Socio-economic surveys to identify the condition of the impacted persons

44. In addition to the above survey interactions are carried out with the populations along the projectcorridor to gather local level information on the following:

- Local practices and traditions with respect to conservation and use of natural resources;
- Farming practices and Cropping pattern
- Perception of the people about the project
- Traffic surveys were used to estimate the present and future traffic
- Preliminary engineering surveys to identify the topographical features

45. These above informationswaswere used to develop the baseline environmental condition in the project area andidentify the environmental sensitivities which might still get affected by the proposed alignment.

(vi) Public consultation

46. At the beginning of the EIA process, a preliminary identification of probable stakeholders was carried out. An inventory of actual / potential stakeholders, including local groups and individuals, local institutions like village community which may be directly or indirectly affected by the project or with interest in the development activities in the region was made at a preliminary

stage. This inventory was arrived through discussions with local PWD official and also in consultation with members of the local community.

47. Consultations with the community is a continual process that was carried out during the EIA study and would also be continued during the construction and operation phases of the project. Issues like disturbance during the construction, severance and increased congestion, noise and air pollution, employment opportunities, need for development of basic infrastructure, safe drinking water, sanitation facilities in the villages adjoining to the corridor were discussed during the consultations so that they can be adequately addressed through the environment management plans. The consultations with community and local institution like village headman also helped in developing preliminary understanding of the requirement of people in the area and identification of the enhancement proposals.

(vii) Impact Identification and Evaluation

48. Potential significant impacts were identified on the basis of: analytical review of baseline data; review of environmental conditions at site; analytical review of the underlying physical, biological and socio-economic conditions within the project influence area.

(viii) Environmental Management and Monitoring

49. The final stage in the EIA Process is definition of the management and monitoring measures that are needed to ensure: a) impacts and their associated Project components remain in conformance with applicable regulations and standards; and b) mitigation measures are effectively implemented to reduce the effects to the extent predicted.

50. An Environmental Management Plan, which is a summary of all actions which the Project has committed to execute with respect to environmental/social/health performance for the Project, is also included as part of the Bidding Documents. The Environmental Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

1.5 Limitation of EIA Study

51. This report is based on the preliminary designs which were prepared. The final design would be developed by the Contractor before the initiation of construction. Even though no major changes are expected in the design the EIA report needs to be verified against the final engineering design. Further, the report has been developed on certain information available at this point of time, scientific principles and professional judgement to certain facts with resultant subjective interpretation. Professional judgement expressed herein is based on the available data and information.

52. The Report only deals with the environment health and safety aspects (both community safety and occupational health and safety) associated with the project during the construction and operations. The social impact and the resettlement and rehabilitation requirement of private and community property have been detailed in the Social Impact Assessment and Resettlement and Rehabilitation Plan. In case of common property structures the report only considers those structures where relocation is required and only enhancement is required either for the aesthetics or safety purpose.

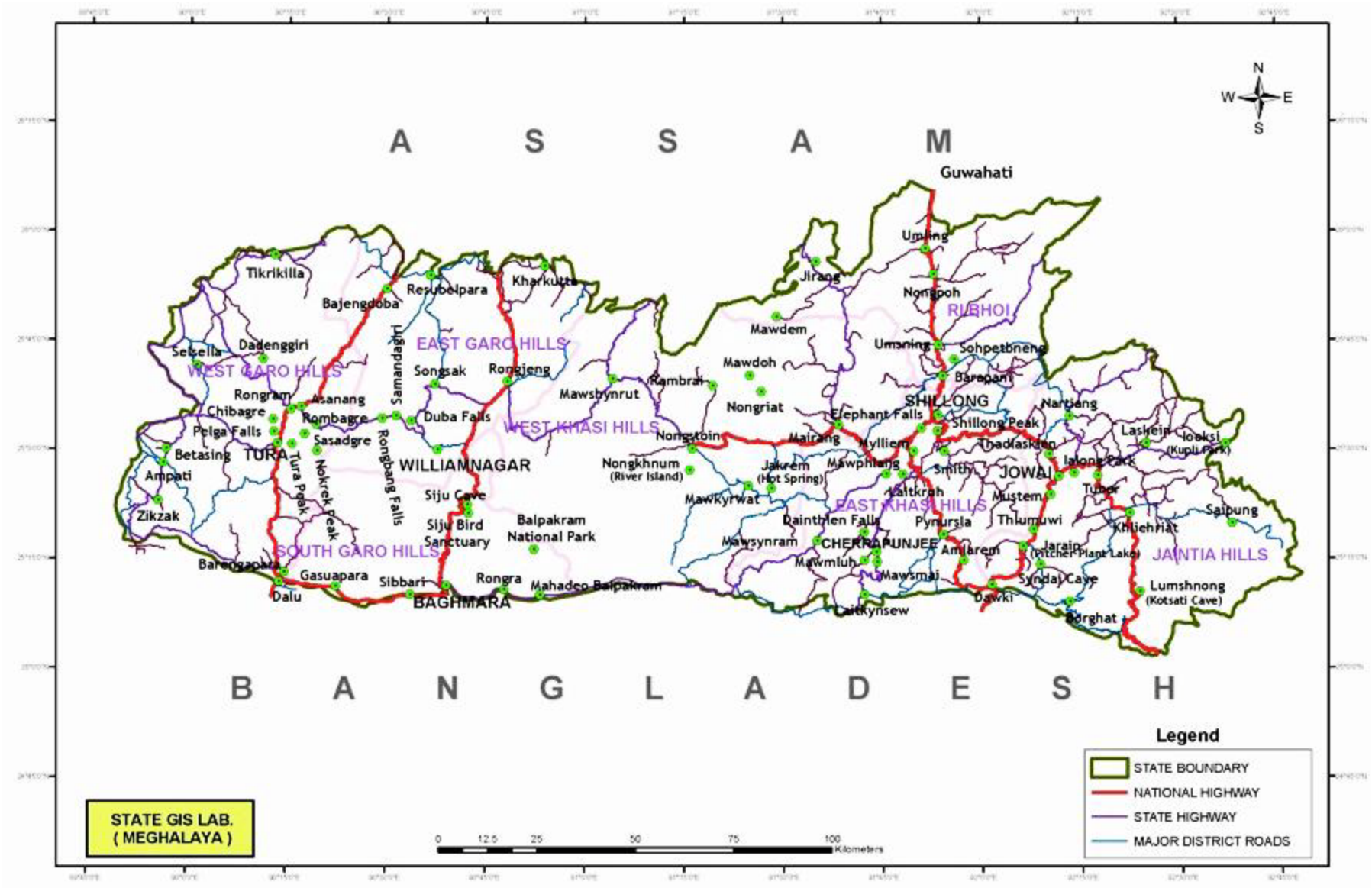
1.6 Structure of EIA Report

53. This EIA report has been presented as per requirements of the World Bank's Operational Policy 4.01. The report is organised into following ten chapters, a brief of each chapter is described below:

- ***Chapter 1 - Introduction***: Ihis section desribed the background information about the project and EIA study.
- ***Chapter 2 - Project Description***: This section presents the key features andcomponents of the proposed project.
- ***Chapter 3 - Policy, Legal, and Administrative Frameworks***: this section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment.
- ***Chapter 4 - Environmental BaselineStatus***: This section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed project.
- ***Chapter 5- Analysis of Alternatives***: This section covers analysis of various alternatives considered to minimise the overall impacts of proposed development and suggest most appropriate alternatives based of detailed analysis of impact and risk associated with each alternative.
- ***Chapter 6– Impact Assessment and Mitigation***: This section presents the environmental assessment of likely positive and adverse impacts attributed to the proposed project and concomitant mitigation measures.
- ***Chapter 7– Public Consultation and Discussion***: This section describing the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the Bank's Publication Policy and related national laws.
- ***Chapter 8 - Environmental Management Plan***: This section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into three sub-sections; mitigation, monitoring, and implementation arrangements.
- ***Chapter 9–Implementation Arrangements***: This section brief the institutional set up in the executing & implementation agency and contract for the execution of the project along wirh responsibilities on environmental management.
- ***Chapter 10- Conclusion and Recommendation***:*Thedocument summaries the environmental sensitivities in the project. The environmental safeguards, monitoring etc which need to be implemented is also summarised in the Chapter.*

54. An Executive Summary is also prepared and presented in the beginning of the report.

Figure 1: Road network on Meghalaya State Map



2. PROJECT DESCRIPTION

2.1 Type of Project

55. The project road is located in Eastern part of MeghalayaState traverse through hill-rolling terrain in the district of East Khasi Hills. The project of widening and improvement of about 11.763 km road section of Shillong – Diengpasoh major district road. The chapter describes the salient features of the road corridor.

2.2 Location and Features of the Project Road

56. This Major District Road starts from Itshyrwat Junction in Shillong and end at Shillong Bypass at km 19.00. The total length of road section is 21.73 km. However, in this scope of study 11.763 km of MDR is covered starting from km 2.200 of Shillong - Diengpasoh Road near Itshyrwat Village to km 13.983 of Shillong - Diengpasoh Road. The section from chainage km 13.983 to end point of MDR where it joins Shillong bypass is being rehabilitated under PMGSY program. The carriageway width varies from 5.m to 5.5m and right of way as was observed varies from 12m to 15m.

57. At present most of the length of project road is single lane carriagewaywith paved shoulders throughout the length. The project road is having poor to fair pavement condition in general, with few stretches having very poor pavement condition.

58. The proposed project road lies entirely in the East Khasi Hills district. The road section lies betweenItshyrwat(25° 35'24.93"N, 91°55'12"E) andMawlong(25°35'24"N 92°1'12"E). The existing alignment on the Google map is presented in Figure 2.Photos of the start and end point are alos presented in Figure 3.

Figure 2: Index Map Shillong – Diengpasoh Road section

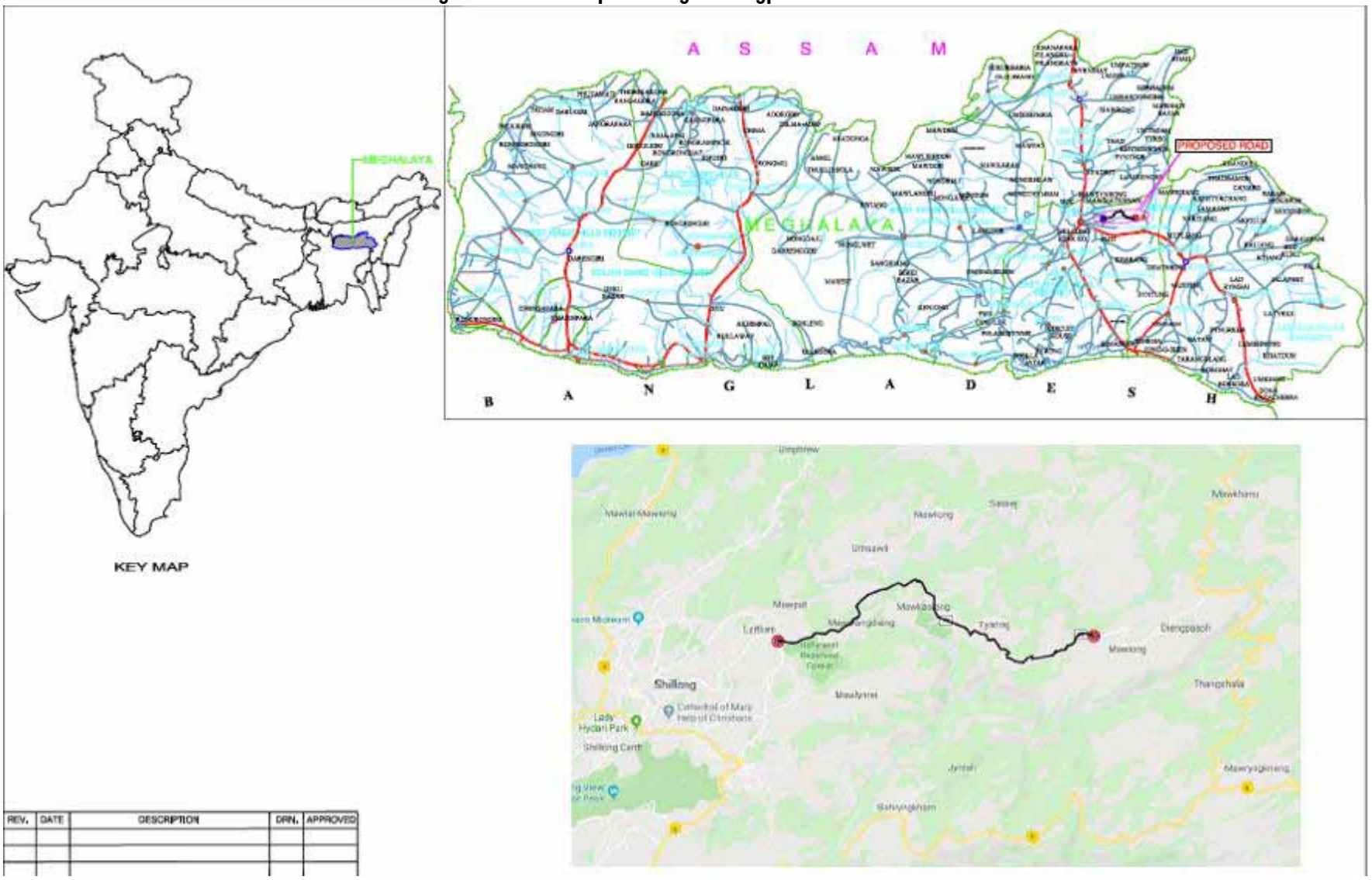


Figure 3: Photo of start and end point of the road section

Photo: Road section near start point (at km 2+510)

Photo: Road section at End Point

2.3 Project Features

59. The feature of the exiting road and the proposed road is presented in the following section.

2.3.1 Right of Way

60. The carriageway width in the road section varies from 5m to 5.5 m with paved shoulders and right of way as was observed varies from 12m to 15m.Details of existingRoW&width of proposed typical cross section in the project stretch are given in Table 3.

Table 3: Details of existing RoW and proposed formation width

CHAINAGE (Km)		LENGTH (m)	ROW	Width of TCS	TCS TYPE	Remarks
FROM	TO					
2+220	2+260	40	11.00	10.000	TYPE-1B	No additional land is required for proposed improvement
2+260	2+690	430	14.70	10.000	TYPE-1A	
2+690	2+760	70	14.70	10.000	TYPE-1B	
2+760	2+800	40	14.70	10.000	TYPE-1A	
2+800	2+840	40	14.70	10.000	TYPE-1B	
2+840	3+200	360	14.70	10.000	TYPE-1A	
3+200	3+775	575	15.60	10.600	TYPE-3A	
3+775	3+920	145	17.94	11.200	TYPE-2A	
3+920	4+115	195	17.94	10.600	TYPE-3A	
4+115	4+225	110	17.94	10.000	TYPE-1A	
4+225	4+270	45	17.94	10.600	TYPE-3A	
4+270	4+380	110	17.94	10.000	TYPE-1A	
4+380	4+440	60	17.94	10.000	TYPE-1B	
4+440	4+760	320	17.94	10.600	TYPE-3A	
4+760	4+900	140	17.94	10.000	TYPE-1B	
4+900	4+950	50	17.94	10.000	TYPE-1A	
4+950	5+025	75	17.94	11.200	TYPE-2A	
5+025	5+175	150	17.94	10.000	TYPE-1A	
5+175	5+225	50	18.50	10.600	TYPE-3A	

5+225	5+320	95	18.50	10.000	TYPE-1B	
5+320	5+400	80	18.50	10.000	TYPE-1A	
5+400	5+450	50	18.50	10.600	TYPE-3A	
5+450	5+700	250	15.86	10.000	TYPE-1A	
5+700	5+855	155	15.86	11.200	TYPE-2A	
5+855	6+015	160	15.86	10.000	TYPE-1A	
6+015	6+050	35	15.86	11.200	TYPE-2A	
6+050	6+100	50	15.86	11.200	TYPE-2B	
6+100	6+140	40	15.86	10.000	TYPE-1B	
6+140	6+410	270	15.00	10.000	TYPE-1A	
6+410	6+490	80	15.00	10.000	TYPE-1B	
6+490	6+825	335	15.00	10.000	TYPE-1A	
6+825	6+880	55	15.00	11.200	TYPE-2A	
6+880	6+920	40	15.00	11.200	TYPE-2B	
6+920	6+970	50	15.00	10.000	TYPE-1B	
6+970	7+060	90	15.00	10.000	TYPE-1A	
7+060	7+110	50	15.33	10.600	TYPE-3A	
7+110	7+150	40	15.33	10.000	TYPE-1A	
7+150	7+210	60	15.33	10.000	TYPE-1B	
7+210	7+290	80	15.33	10.000	TYPE-1A	
7+290	7+365	75	15.33	10.000	TYPE-1B	
7+365	7+420	55	15.33	10.600	TYPE-3A	
7+420	7+715	295	15.33	10.000	TYPE-1A	
7+715	7+900	185	13.72	11.200	TYPE-2A	
7+900	8+020	120	13.72	10.000	TYPE-1A	
8+020	8+110	90	13.72	11.200	TYPE-2A	
8+110	8+260	150	13.72	11.200	TYPE-2B	
8+260	8+330	70	13.72	11.200	TYPE-2A	
8+330	8+400	70	13.72	10.600	TYPE-3A	
8+400	8+580	180	13.72	11.200	TYPE-2A	
8+580	8+740	160	13.72	10.600	TYPE-3A	
8+740	8+890	150	15.63	11.200	TYPE-2A	
8+890	9+000	110	15.63	10.000	TYPE-1A	
9+000	9+100	100	15.00	11.200	TYPE-2A	
9+100	9+180	80	15.13	10.000	TYPE-1A	
9+180	9+420	240	15.50	11.200	TYPE-2A	
9+420	9+475	55	15.50	10.000	TYPE-1A	
9+475	9+615	140	15.50	11.200	TYPE-2A	
9+615	9+660	45	15.50	10.000	TYPE-1A	
9+660	9+750	90	15.50	10.000	TYPE-1B	
9+750	9+900	150	14.50	11.200	TYPE-2A	
9+900	9+930	30	14.50	10.600	TYPE-3B	
9+930	10+130	200	14.50	10.600	TYPE-3A	
10+130	10+320	190	14.50	11.200	TYPE-2A	
10+320	10+450	130	14.50	10.600	TYPE-3A	
10+450	10+540	90	14.09	10.000	TYPE-1A	

10+540	10+630	90	14.09	10.000	TYPE-1B	
10+630	11+000	370	14.09	10.000	TYPE-1A	
11+000	11+050	50	14.09	10.000	TYPE-1B	
11+050	11+495	445	14.09	10.000	TYPE-1A	
11+495	11+900	405	11.90	11.200	TYPE-2A	
11+900	12+080	180	14.00	10.000	TYPE-1A	
12+080	12+250	170	14.83	11.200	TYPE-2A	
12+250	12+330	80	14.83	10.600	TYPE-3A	
12+330	12+375	45	14.83	10.000	TYPE-1B	
12+375	12+430	55	14.83	11.200	TYPE-2A	
12+430	12+670	240	14.83	10.000	TYPE-1A	
12+670	12+720	50	14.83	10.000	TYPE-1B	
12+720	12+760	40	14.83	10.000	TYPE-1A	
12+760	12+860	100	14.83	10.000	TYPE-1B	
12+860	13+430	570	15.00	10.000	TYPE-1A	
13+430	13+550	120	15.00	10.000	TYPE-1B	
13+550	13+960	410	15.00	10.000	TYPE-1A	
13+960	13+989	29	15.00	10.000	TYPE-1B	

2.3.2 Existing Road

61. **Carriageway:** The detailed inventory on existing carriageway reveals that the project road stretch comprises of mainlysingle lane carriageway with width of 5.0m to 5.5m configuration. The existing pavement is flexible throughout the road section.

62. **Pavement Conditions:** The existing pavement of project road is bituminous surface with earthen shoulders of width 1.0 m to 1.5 m exist predominantly on both sides throughout the project stretch. The pavement is flexible type having earthen/gravel shoulders. Pavement condition is fair except few locations where it has been badly damaged. The pavement is showing signs of distress at some locations. The defects noticed include Cracking (alligator, transverse, longitudinal, edge cracks), Rutting and edge breaking. The shoulders are earthen/gravel with fair to poor condition. The road surface is black topped with Bituminous Macadam (BM); Semi Dense Bituminous Concrete (SDBC); except few locations in habitation area. The pavement conditions are shown in figure-4.

Figure 4: Photo showing pavement conditions of the road

Photo: Road conditions at km 4+400

Photo: Road conditions at km 7+810

2.3.3 Existing Cross Drainage Structures

63. There is one minor bridge and 25 nos. of pipe culverts and 4 box culverts are proposed for reconstruction in the present alignment. However, there is1 no. pipe culvert and 13 nos. of slab culverts has been retained with widening proposal.

2.3.4 Junctions and Intersections

64. There are 11 nos. minor of junction in the project road section. All the junctions are with internal roads and village roads only.

2.3.5 Trees Cutting

65. The engineering surveys confirm that felling of 85 number of trees is required for the improvement of road section.

2.4 Improvement Proposals

66. As part of the road improvement for the road section the existing single-lane road would be converted into 2-lane corridor (7.000m carriageway) with 0.9 m wide paved shoulder on either side, V-type Drain / Crash Barrier Hill / Valley side with 0.6m on each side. The total width required will be 10.0m in rural areas and 11.2m in built-up areas, where both side drain is proposed.

67. In addition, provisions the following provision for improvement have been made:

- Geometric Improvements
- Pavement – strengthening and reconstruction
- Cross-Drainage Structures
- Safety and
- Road Appurtenances

68. The draft design standards proposed for this project road are based on IRC: SP:73 2007, Manual of Standards& Specifications for Two Laning. The design standards are presented below:

(i) Design Life

69. *Geometry:* The geometry of a highway is difficult to improve at frequent intervals because of inherent difficulties in availability of land and inconvenience and hazards to running traffic during improvement works. Thus, a design life of pavement has been taken for 15 years.

70. *Structures:* Structure, like bridges are costly. It is difficult and uneconomical to augment/ widen these structures later. These structures have therefore to be designed for longer life, that is, 75-100 years. Culverts are designed for a design life of 25 years.

(ii) Design Speed

71. It was proposed that the design speeds tabulated in Table be adopted, in general, for the Project Road as recommended by IRC. Wherever it becomes necessary to impose short sections of geometry over which operating speeds will have to be lower than 30 km/h, (R<35 m), these will be adequately marked with appropriate warning road signs.

Road Classification	Design Speed (km/h)			
	Mountainous Terrain		Steep Terrain	
	Ruling	Min.	Ruling	Min.
National/State Highway	50	40	40	30

Major District Roads	40	30	30	20

72. **Traffic Surveys & Projections:** The traffic survey has been conducted at selected location for the road section to calculate traffic load and type of vehicles on the project road. The summary of ADT by vehicles numbers and PCU's of classified traffic volume count is given below:

Average Daily Traffic

Fast Power-Driven Vehicles				
1	2	3	4	5
Car/Taxi/Van/ Three Wheeler/Auto Rickshaw	Two Wheeler/Motor Cycle/ Scooter	Light Commercial Vehicle/ Mini Bus	Two Axle Truck/Tanker	Multi Axle Truck/Tanker
8745	**3020**	**526**	**41**	**0**

PCU Calculations

	Factor	**PCUs**	**ADT**	**%**	**AADT**
Fast vehicles					
LMV	1.0	8744	8744	70.9	10494
TW	0.50	3020	3020	24.5	3624
Bus/Truck	3.00	526	526	4.3	632
Truck/Trailer	4.50	40	41	0.3	50
Total Vehicle		**12330**	**12330**	**100.0**	**14796**
Total PCUs		**12013**	**12013**	**100.0**	**14416**

73. The traffic projections are based on IRC guidelines and the assumed growth rate is 7.5%. From the traffic count it is seen that project road section is qualify for 2- lane as per MoRT&H specification.

74. **Terrainand Topography:**This is determined by the general ground slope, and categorised as below:

Ground Slopes for Different Terrain

Terrain	**Percent cross slope of the country**
Plain	0-10
Rolling	10-25
Hilly	25-60
Mountainous	Greater than 60

75. **Sight Distance:**As per IRC recommendations, the minimum sight distance (Stopping sight distance) is absolutely minimum from safety angle and must be ensured regardless of any other considerations. It would be good practice if this value can be exceeded and visibility corresponding to intermediate sight distance in as much length of road as possible.The following stopping and intermediate sight distance for various design speeds are adopted:

Design Speed (kmph)	**Sight Distance (m)**	
	Stopping	**Intermediate**
20	20	40

25	25	50
30	30	60
35	40	80
40	45	90
50	60	120
60	80	160
65	90	180
80	120	240
100	180	360

76. **Soil Characteristics:** The soil characteristics along the alignment are determined in terms of CBR, both under soaked and un-soaked conditions. The design of pavement is based on the traffic load and on the soil characteristics available.

77. **Earth Work Slopes:** The recommended earthwork side slopes are tabulated in Table as shown-

Material	Cut	Fill	Slope from shoulder break point to side ditch
Soil	0.5:1	2:1	2:1
Rock	0.25:1	Not Applicable	

78. For 'rock' cuttings of height > 6.0 m in occurrences of friable material the consultants have considered the practical issue of inserting horizontal benches into the side slopes to reduce the load on the lower section of the cutting and to intercept occasional falls of soil, rocks fragments, and other debris.

(iii) Design Elements

79. Various design elements, which govern functioning of the project road, are broadly grouped under the following-

- Ø Geometric Design
- Ø Pavement Design
- Ø Cross Drainage structure

80. Geometric Design: Geometric design features include individual components like Cross-sectional Elements, Sight Distances, Horizontal Alignment and Vertical Alignment. These elements are geometrically combined to generate an efficient road layout.

(iv) Cross Sectional Elements for Shillong - Diengpasoh Road

Existing single lane is proposed to be widened to double lane.

Road Structure	Width
Carriageway width	7.0m
Paved shoulder	0.9m (each side)
V-type Drain / Crash Barrier [Hill / Valley side]	0.6m (each side)
Total width	10.0m for rural areas 11.2m for built-up with drains

81. Super elevation has been retained to maximum of 7.0%. Curve widening has been done on inner side wherever applicable.The surface cross fall of 2.5% is provided on main carriageway.

82. Components *of Horizontal Alignment:* Horizontal alignment has several components, all inter-dependent on each other. They are super-elevation, side Friction, radius of curvature, length of spiral, and attainment of super elevation. All the above elements are functions of design speed.

83. *Horizontal Curves*: The tangent sections, circular curve and transition curve elements are the major component of Horizontal alignment. A balanced control on the above elements is required to provide safe and continuous flow of vehicles under the general traffic conditions.

84. *Transition* curves in the form of spiral between the tangent sections and circular curve element are designed to satisfy the requirements of allowable rate of change in experiencing centrifugal acceleration by the user and attaining super-elevation on carriageway for the circular curve. The minimum transition lengths suggested in the IRC guideline are indicated in the following sections. However, in unavoidable cases, where transition curves cannot be provided, super-elevation should be achieved by two-third being attained on the straight section before start of circular curve and one-third on the curve. The radii for horizontal curves corresponding to ruling minimum and absolute minimum design speed and the minimum transition lengths suggested in the IRC guideline are indicated in the below Tables.

Minimum Radii of Horizontal Curves for Various Classes of Hill Roads

S. No.	Road Classification	Mountainous Terrain	
		Ruling Min.	Absolute Min.
1	National and State Highways	80	50
2	Major District Roads	50	30
3	Other District Roads	30	20
4	Village Roads	20	14

Minimum Transition Length for Different Speeds & Curve Radii for Mountainous Terrain

Curve Radius (m)	Design Speed (kmph)				
	50	40	30	25	20
15				NA	30
20				35	20
25			NA	25	20
30			30	25	15
40		NA	25	20	15
50		40	20	15	15
55		40	20	15	15
70	NA	30	15	15	15
80	55	25	15	15	NR
90	45	25	15	15	
100	45	20	15	15	
125	35	15	15	NR	
150	30	15	15		
170	25	15	NR		
200	20	15			
300	15	NR			
400	15				
500	NR				

85. *Horizontal Transition Curves:* Transition curves have not been used due to geometry in this terrain generally does not find sufficient straight lengths in between curves to accommodate spiral lengths for transition.

86. *Broken Back Curves:* It is recommended to adopt a minimum 15-20 m minimum length of straight between curves of the same turning direction within the flat and rolling terrain sections; and in the hilly and mountainous terrain sections make every attempt to avoid the incorporation of short straight elements. In these latter sections each situation is considered individually and, if deemed appropriate, suitable warning signage will be installed.

87. *Curve Widening:* Recommended curve widening for single lane road as per IRC: SP: 48-1998 are indicated in Table below:

Radius (m)	Widening (m)
< 20	0.9
20-60	0.6
>60	No Widening Required

88. *Components of Vertical Profile:* Various components of vertical profile are longitudinal gradient and vertical curves. These elements are functions of design speed.

Longitudinal Gradient

Maximum Gradient:

The maximum grades allowed in steep terrain upto 3000 m above MSL are

- Ø Ruling gradient – 6.0% (1 in 16.7)
- Ø Limiting gradient – 7.0% (1 in 14.3)
- Ø Exceptional gradient – 8.0% (1 in 12.5)

89. However, in *view* of the existing steep hills and necessary economy in the project it has been proposed to limit the gradient to 7%.

90. *Vertical Curve:* The vertical curves are classified into two categories: Summit or Crest Curves and Valley or Sag Curves. Crest curves are designed to provide visibility corresponding to safe stopping sight distance (SSD). Length of sag curves is based on headlight sight distance and comfort criteria.

91. The "K" value, the ratio of length of curve and the algebraic difference between the intersection *tangent* grades, adopted for different speeds are given below.

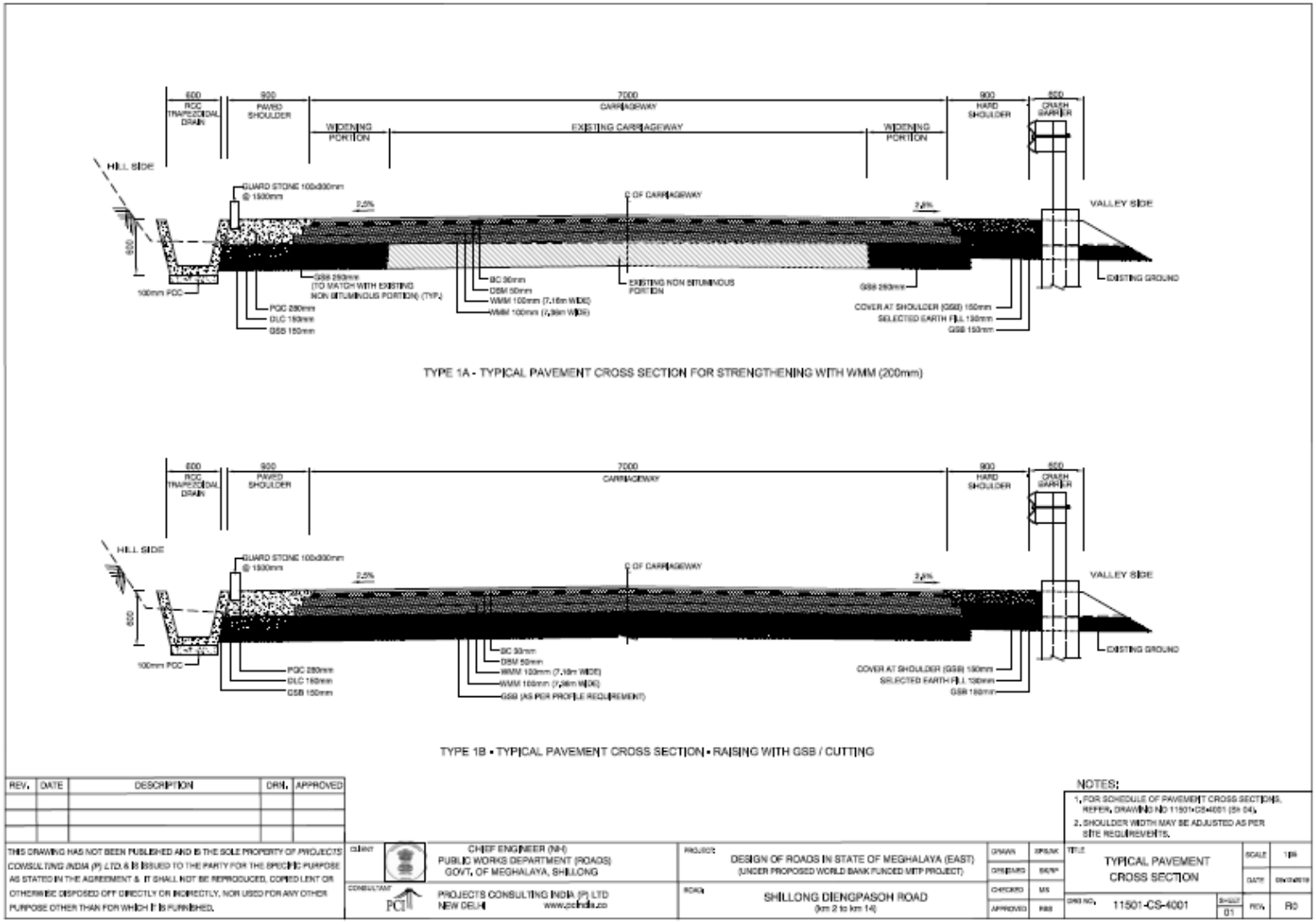
"K" Values for Vertical Curve

Design Speed (kmph) V	Rate of Vertical Curvature "K" (length (m) per % of grade difference)	
	Crest Curve	***Sag Curve***
30	2	3.5
50	9	8
65	19	16

92. Below mentioned Typical Pavement Cross sections are proposed for the road section, these are given in Figure-5:

- TCS-1A Typical Cross Section for Strengthening (with WMM 200mm)
- TCS-1B Typical Cross Section for Raising (with GSB)
- TCS-2A Typical Cross Section for Strengthening (with WMM) in built-up area, both side drains
- TCS-2B Typical Cross Section for Raising (with GSB) in built-up area, both side drain
- TCS 3A Typical Cross Section for Strengthening (with WMM) in built-up area, one side drain
- TCS 3B Typical Cross Section for Raising (with GSB) in built-up area, one side drain

Figure 5: Typical Road Cross-Section for Proposed Road section



TYPE 1A - TYPICAL PAVEMENT CROSS SECTION FOR STRENGTHENING WITH WMM (200mm)

TYPE 1B - TYPICAL PAVEMENT CROSS SECTION - RAISING WITH GSB / CUTTING

REV.	DATE	DESCRIPTION	DRN.	APPROVED

NOTES:
1. FOR SCHEDULE OF PAVEMENT CROSS SECTIONS, REFER, DRAWING NO 11501-CS-4001 (SH 04).
2. SHOULDER WIDTH MAY BE ADJUSTED AS PER SITE REQUIREMENTS.

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PUBLIC WORKS DEPARTMENT (ROADS)
GOVT. OF MEGHALAYA, SHILLONG

CONSULTANT: PROJECTS CONSULTING INDIA (P) LTD
NEW DELHI www.pcindia.co

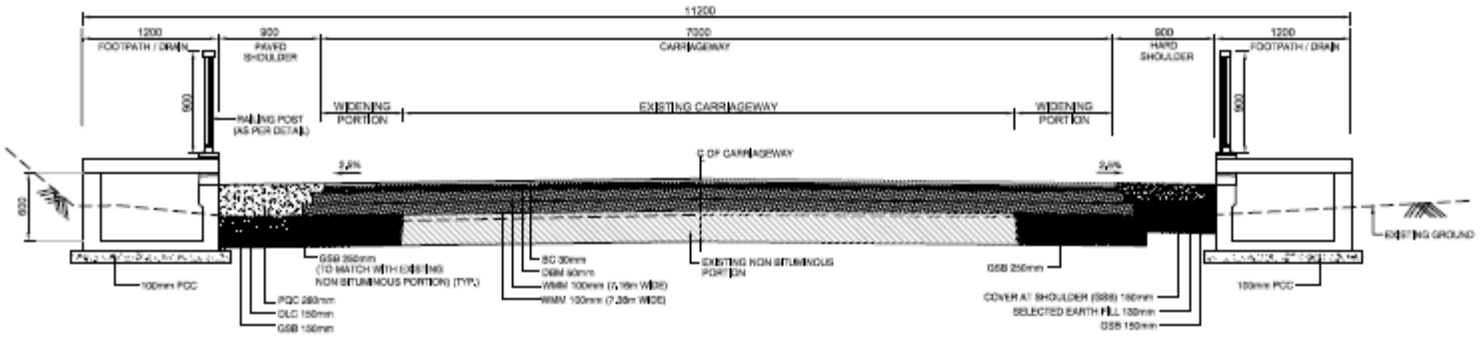
PROJECT: DESIGN OF ROADS IN STATE OF MEGHALAYA (EAST)
(UNDER PROPOSED WORLD BANK FUNDED MTP PROJECT)

ROAD: SHILLONG DIENGPASOH ROAD
(km 2 to km 14)

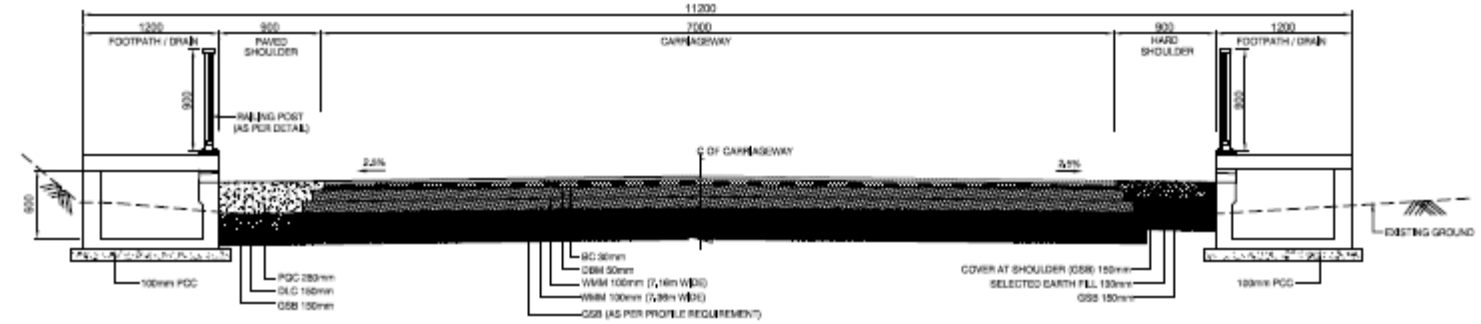
DRAWN	BRS/MK
CHECKED	BKR/MT
CHECKED	MS
APPROVED	HBS

TITLE: TYPICAL PAVEMENT CROSS SECTION

SCALE: 1:50
DATE: 09/04/2019
DRG NO.: 11501-CS-4001
SHEET: 01
REV.: R0



TYPE 2A - TYPICAL PAVEMENT CROSS SECTION FOR STRENGTHENING WITH WMM (200mm)
(DRAIN BOTH SIDES)



TYPE 2B - TYPICAL PAVEMENT CROSS SECTION - RAISING WITH GSB / CUTTING
(DRAIN BOTH SIDES)

REV.	DATE	DESCRIPTION	DRN.	APPROVED

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2. SHOULDER WIDTH MAY BE ADJUSTED AS PER SITE REQUIREMENTS.

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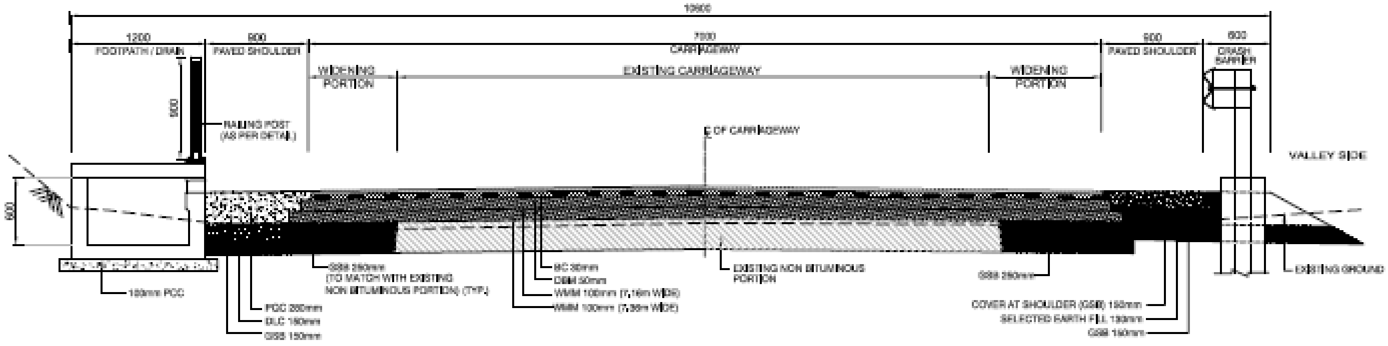
PROJECT: DESIGN OF ROADS IN STATE OF MEGHALAYA (EAST)
(UNDER PROPOSED WORLD BANK FUNDED MTP PROJECT)

ROAD: SHILLONG DIENGPASOH ROAD
(km 2 to km 14)

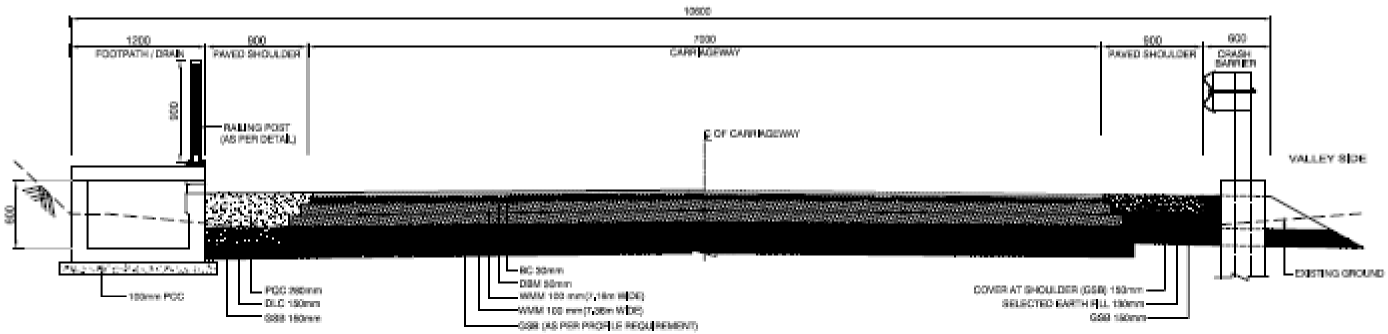
DRAWN	BRS/MK
DESIGNED	BKP
CHECKED	MS
APPROVED	RBS

TITLE: TYPICAL PAVEMENT CROSS SECTION

SCALE: 1:R
DATE: 09/04/2019
DRG NO.: 11501-CS-4001
SHEET: 02
REV.: R0



TYPE 3A - TYPICAL PAVEMENT CROSS SECTION FOR STRENGTHENING WITH WMM (200mm)
(DRAIN ONE SIDE)



TYPE 3B - TYPICAL PAVEMENT CROSS SECTION - RAISING WITH GSB / CUTTING
(DRAIN ONE SIDE)

REV.	DATE	DESCRIPTION	DRN.	APPROVED

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CONSULTANT: PROJECTS CONSULTING INDIA (P) LTD, NEW DELHI, www.pcindia.co

PROJECT: DESIGN OF ROADS IN STATE OF MEGHALAYA (EAST) (UNDER PROPOSED WORLD BANK FUNDED MITP PROJECT)

ROAD: SHILLONG DIENGPASOH ROAD (km 2 to km 14)

NOTES:
1. FOR SCHEDULE OF PAVEMENT CROSS SECTIONS, REFER, DRAWING NO 11501-CS-4001 (Sh 04).
2. SHOULDER WIDTH MAY BE ADJUSTED AS PER SITE REQUIREMENTS.

TITLE: TYPICAL PAVEMENT CROSS SECTION

DRG NO. 11501-CS-4001 | SHEET 03 | REV. R0

2.4.1 Bridge & Cross Drainage Structures

93. Of the 44 present CD structures on 1 minor bridge, 25 nos. of pipe culverts and 4 nos. of box culverts would be retained and of the remaining 1 pipe culvert and 13 nos. of slab culvert would be retained and widened. There is no proposal for new bridge or culvert.

2.5 Project Environmental Setting

94. The proposed Shillong - Diengpasoh Road starts near Shillong town and traverses in a North –eastern directions till Diengpasoh.

- The project road section is in East Khasi Hillsdistrict and traverses through Mylliem and MawryngKneng blocks.
- Near the start point of the road section Ishriyat reserve forest on right hand side upto a length of 3 km. Right of way is available in this section of the road, no additional land acquisition is proposed.
- The alignment passes through built up areas including Mawdiangdianag, Mawkasiang, Siejong, Tynring and Mawpdamg Nongthmmai.

2.6 Components & Activities of The Proposed Project

95. The development of the road would necessarily entail the following three stages. Each of the stages would have several activities and sub-activities. The three stages are

- Detailed design and Pre-Construction Stage
  - Carrying out EIA studies & preparation of EMP
  - Development of Forest Proposal, if forest land is involved
  - Finalization of alignment with incorporation of environmental and community concerns in addition to the design and safety aspects
  - Relocation of utilities and private & community structures
  - Community consultation for land identification for borrow areas, water availability, siting of camps, tree felling permission
  - Identification of sources of material
  - Contractor mobilization
- Construction Stage
  - Site clearing & construction camp sitting
  - Material procurement & transportation
  - Earthwork, hill side cutting, if required, embankment construction, GSB, WBM, operation of equipment, plant and machinery.
  - Structuredemolition& construction work
  - Surfacing and shoulder protection & road furniture
- Post-Construction, Operations & Maintenance Stage
  - Decommissioning of camp, removal of Construction &demolition waste
  - Operation of vehicles and safety of road users

2.7 Infrastructure Requirement for Road Development

96. During the construction and operations of the highway the following infrastructure would be developed and maintained by the Contractor

97. **Construction Camp:** Even though local labour would be employed to the extent possible number of activities would require specialised skilled labour e.g. operator of the vehicle and machinery, skilled crews for specialised operations e.g. bar-bending and casting. These labours in

most cases would be migrant from other parts of Meghalaya or other states. The Contractor would setup a construction camp for the accommodation of the workers.

98. **Hot Mix Plant:** For the manufacturing of the Bituminous material the Contractor would setup a Hot mix Plant. The plant would be setup considering the siting guidelines specified by regulatory authorities.

99. **Batching Plant:** The Concrete batching plant would also be installed for concrete casting of structures i.e. Minor bridges, box and Hume pipe culverts. The Batching plant in addition to cylos for cement,aggregates and sand would also have an area for storage of cement and additives.

100. **Laydown Areas:**The contractor would identify an area for storage of the raw-material required for construction including soil, sand GSB and aggregates. These would be stored as open heaps within the laydown area. The laydown area might also be sued as a maintenance yard for the vehicles and machinery.

101. The excavate material from the pavement and hill side cutting would have to be stored at some places before it can be utilised or disposed of at a permanent approved disposal site.

2.8 Resource Requirements for The Project

102. Soil for the embankment, sub grade and shoulders: The approx. 24430cum of earth would be required for the embankment. This would be sourced from borrow areas which would be identified by the Contractor at the time of construction. The locations of the borrow area would not only satisfy the requirements of MoRTH specifications but also meet the environmental health safety requirement.

103. Granular material for sub-base: The estimated 24553 cum of granular sub-base would be required. These would be sources from local sources in the proximity to the project location. The facilities which operate with valid environmental clearance would only be selected by the contractor during the Pre- Construction stage.

104. Stone aggregate for use in pavement course and cement concrete: The preliminary design estimates that 2655 cum of bituminous concrete and 4898 cum of Dense Bituminous Macadam would be used for the project. The aggregate required for these works would be sources from licensed quarriers. The Contractor shall identify these during the preconstruction stage.

105. Power: Power required at the construction camp would be drawn from the grid where it is available else DG sets would be used to supply the power to the Camp. 2 no. of 250 KVA DG set would be used for the supply of power. 1 DG would be in running condition and 1 on standby. In addition, one no. of 100 KVA DG set would be used for domestic purpose.

106. Manpower: The manpower requirement would vary over the construction period depending on the quantum and type of work involved. The peak manpower requirement would be approximately 150 which the average manpower requirement for the project road would be approximately 75. The skilled manpower, primarily the machine operators and concrete casting crew would be migrant labour and would be housed in the construction camp. On an average the crew in the construction camp is likely to be around 50 persons at any given point of time. The remaining 25 workmen would be local labour who would be working as day labours.

107. Time Frame: The construction period would be 36 months and the earth work and GSB would be completed within the 9-12 months.

108. Water: The project would require water for both construction activities and domestic purpose during the construction period. The operations period of the project would have no water requirement.

109. For up-gradation of the project road sections, approx.50-75 kl per day water is likely to be needed for construction purpose depending upon construction activities. Water for construction of the road will be extracted from river water /ground water sources after obtaining necessary permission. The break-up of water tentative requirement is given in Table 4.

Table 4:Break-up of water requirement for project road sections construction

S.No.	Purpose	Average Demand (KLD)	Peak Demand (KLD)	Source
1.	Road construction	50	75	Surface/Ground water
2.	Dust Suppression	25	25	
3.	Domestic (drinking & washing etc)	15	15	
Total		**90**	**115**	

2.9 Pollutant Sources & Characterisation

110. During construction phase environmental impacts are likely to result primarily from operation of heavy machinery and equipment, vehicular movement and from influx of workforce. The potential pollutant sources for construction phase and their characterisation has been discussed in the subsequent section.

111. Operations of Heavy Machineries & Vehicular Movement: The operations of construction vehicles, diesel generators and machineries would contribute to Suspended Particulate Matter (SPM), Sulphur and Nitrogen dioxides (SO2 and NOx), Carbon monoxide (CO) and other hydrocarbons (HC).

112. In addition, fugitive emissions are envisaged from plying of vehicles and also from storage, handling and transportation of materials during the construction phase. Mainly dust will be emitted during material transport and during loading-unloading activities which is planned to be controlled by periodic water sprinkling and by adopting adoption of good engineering practices.

113. Also, during construction phase, noise will be generated from operating heavy machineries to be used and from vehicular movement. All the generator sets will be equipped with exhaust mufflers and acoustic enclosures and subjected to periodic preventive maintenance.

114. Generation of Construction waste: It has been estimated in that approximately 61075 cum of earth would be excavated out this volume 24430 cum will be used in road construction. About 19136 cum of scarified bitumen would be generated from the existing carriageway. In addition, there would be waste from the batching plant, hot mix plant and from the demolition of existing cross drainage structures on the road. Some of the material would be recycled and used for back filling. Material which cannot be recycled would be considered as Construction and Demolition waste and has to be disposed of as per the existing rules.

115. Influx of Workforce: Sewage effluent will be to be generated during this phase from construction camps. Solid waste generated during the construction phase from the camps is expected to comprise of food waste and recyclables viz. packaging material, etc.

116. One construction camp will be set up by the contractor at a suitable location along the project road section in consultation with the Project Director and Meghalaya State Pollution Control Board.

2.10 Project Benefits

117. The proposed road sections under the project will have many positive impacts on the region and the people. The various direct impacts of the proposed project and their consequential impacts on the life and livelihood of people are discussed below.

- **ImprovedConnectivity in Area:** The projectroad sectionsare important district roads for Meghalaya state and connect major habitation areas with nationalhighway, thus improvement of these road sections will improvethe connectivity in the area, which will remove a critical bottleneck in the movement of freight and passengers within the State.
- **Carriageway and Road Quality** - The width of the carriageway for road sectionwill be increased with paved shoulders. The quality of road as well as riding quality will significantly improve. Also, the improvement in road infrastructure will lead to saving of precious fuel, as there will be fewer stoppages due to congestion.
- **Traffic Congestion** - Traffic movement will improve and congestion will be reduced once the road is widened to 2-lanes. Bottlenecks along the road will be removed. The traffic congestion will ease at all the major and minor junctions.
- **Road Safety** - There will be a decrease in the number of road accidents after widening of the highway, as there will be adequate space for plying vehicles to cross and overtake. Also, proper road signage will be provided for safety and convenience of people.
- **Environmental Quality** - The free flow of traffic on the improved road sections will improve the environmental quality as the emissions from the plying vehicles will reduce. The compensatory plantation done will further improve the air quality and aesthetics of the region.
- **Transportation Facilities** –Theproject road sections will add in transport convenience of people and to provide better transportation infrastructure to local communities. The travel time will be reduced due to widening and up-gradation of road.
- **Economic Development** - The project road sectionsare the lifeline between major habitation within district of the State. Economic activities will gradually improve once the road is widened. It will also benefit farmers, as they will be able to sell their agricultural produce in distant markets due to improved transportation. It will also bring other employment opportunities to the region.
- **Development Potential** - There will be higher potential for development in this area due to improvement in access and consequent growth in economic activities. Essential community infrastructures like drainage system, water supply, electricity, transportation etc will come as consequence of proposed development.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

3.1 Introduction

118. To address environmental risks of the project and its associated components and to protect and conserve the environment from any adverse impacts, the regulations, policy and guidelines enacted by the Government of India and Government of Meghalaya which must be followed are presented in the sections below. In addition, the World Bank have their own set of requirements i.e. the Operational Policy to which any project funded by them must also ensure compliance.

119. This Section focuses on the administrative framework under the purview of which the Project will fall and the EIA study will be governed, namely:

- The national and local, legal and institutional framework;
- World Bank Policies and framework; and
- International Safeguard Requirements.

3.2 Government (India) Environmental Legal Framework

120. The national legal framework of India consists of several acts, notifications, rules and regulations to protect environment and wildlife. In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment.

121. The environmental impact assessment requirement in India is based on the Environment (Protection) Act, 1986, the Environmental Impact Assessment Notification, 2006 (amended 2009), all its related circulars, MOEF&CC's Environmental Impact Assessment Guidance Manual for Highways 2010 and IRC Guidelines for Environmental Impacts Assessment (IRC:104-1988) of highway projects. In addition to road widening and rehabilitation including establishment of temporary workshops, construction camps, hotmix plants, and opening of quarries for road construction work require to comply with provisions of The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003): The Wildlife (Protection) Act, 1972 (Amended 1993); The Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Rules 1974; The Air (Prevention and Control of Pollution) Act, 1981 (Amended 1987) and Rules 1982; The Noise Pollution (Regulation and Control) Rules, 2000 (Amended 2002) and Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules 2008 (Amended 2009).

122. The Acts and Regulations require project to comply with the following:

a) As per provisions of Environmental Impact Assessment Notification 2006 (amended in 2009, 2011 and 2013), all major district road does not require environmental clearance from the Ministry of Environment and Forests & climate change. Since; all project road sections in the study are of category major district road, these do not fall under the purview of EIA notification. Therefore; Environmental Clearance from MoEF is not required for these project road sections.

b) Forest Clearance from Department of Forests is required for diversion of forest land to non-forest purpose. Prior permission is required from Forests Department to carry out any work

within the forest areas and felling of road side trees. Cutting of trees need to be compensated by compensatory afforestation as required by the Forest Department.[2]

c) As per Office Memorandum (OM) issued by MOEFCC on 19 March 2013 the grant of environmental clearance for linear projects including roads has been delinked from the forestry clearance procedure. Hence, after receipt of environmental clearance construction works may commence on sections/parts of a linear project that do not require forestry clearance. Construction works may commence on sections requiring forestry clearance only after receipt of the respective clearance.

d) Placement of hot-mix plants, quarrying and crushers, batch mixing plants, discharge of sewage from construction camps requires No Objection Certificate (Consent to Establish and Consent to Operate) from State Pollution Control Board prior to establishment.

e) Permission from Central Ground Water Authority is required for extracting ground water for construction purposes, from areas declared as critical or semi critical from ground water potential prospective by them.

123. Specifically, for the proposed Major District Road section Project in Meghalaya, the following (Table 4) environmental laws and regulations are applicable:

Table 5: Applicable Environmental National and State Requirements

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
1.	Environmental (Protection) Act, 1986 amended 1991 and associated rules / notifications	The Environment (Protection) Act is an umbrella legislation on control of pollution (the Water Actand the Air Act) by enacting a general legislation for environment Protection.	The Act and the Rulesframedunder the actdefines thestandards foremission anddischarges. All theequipmentmachinerywhich wouldbe usedin the project has to complywiththe emissionand ordischargestandards specified.	MoEFCC	Contractor
2.	Notification on Environment Impact Assessment of Development projects, 2006 as amended in 2009 and 2013,	Sand borrow soil and aggregate used for road construction has been classified as a minor mineral as per The Meghalaya	The quarry sites borrow areas and the sand mines would require a prior environmental clearance under the EIA	District Level Expert Appraisal Committee/ District Level Impact Assessment Authority	The Contractor has to obtainnecessary clearance before use ofany borrow area and quarry.

[2]For the proposed Road Project Sections, since no forest land is involved in these project road sections, permission would be required for cutting of road side trees from District authorities as project road sections do not pass through any forest area.

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
	2016	Minor Mineral Concession Rules, 2016.	Notification 2006.		
3	The Forest Conservation Act 1980 and The Forest Conservation Rules 1981	The central government enactedThe Forest (Conservation) Act in1980 to stop largescale diversion offorestland fornon-forest use.	The proposed alignment does not pass through any forest area hence no clearance is required.	The Forest Department, Government of Meghalaya and MoEF&CC	MPWD
4	Wildlife (Protection) Act, 1972 amended 1993 and Rules 1995; Wildlife (Protection) Amendment Act, 2002	The act was enacted to protect wild animals and birds through the creation of National Parks, Sanctuaries, Conservation Reserve, Tiger Reserve.	The present alignment does notpass through any wild lifesanctuary. Not Applicable	Wildlife Division, Government of Meghalaya/ MoEF&CC	MPWD
5.	Cutting of road side trees	The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003) and Environmental Protection Act of 1986 and as amended Meghalaya Forest Regulation (Application and Amendment) Act, 1973 The Meghalaya Tree (Preservation) Act, 1976	Permit from Autonomous District Councils Garo/Khasi/Jaintia Hills / Forest Department	Autonomous District Councils / State Department of Forests	MPWD
6.	Ancient Monuments & Archaeological Sites and Remains Act, 1958	The act has been enacted to prevent damage to archaeological sites identified by Archaeological Survey of India	The present alignment does not encroach within legally marked boundary of any national and state protected heritage sites. Not Applicable	Archaeological Dept. GOI and GoM	MPWD

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
7.	Construction and Demolition Waste Management Rules, 2016	Rules to manage construction waste resulting from construction, remodeling, repair and demolition of any civil structure.	Construction and demolition waste generated from the project construction shall be managed and disposed as per the rules.	State Pollution Control Board	The Contractor
8.	Municipal Solid Wastes Management Rules, 2016	Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing and disposal.	Solid waste generated during construction stage at construction camp shall be managed and disposed in accordance with the Rules.	State Pollution Control Board	The Contractor
9.	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets and construction vehicles	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended Central Motor Vehicle Act, 1988 and Central Motor Vehicle Rules,1989	Consent-for-establishment	State Pollution Control Board	The Contractor
10.	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended	Consent-for-operation	State Pollution Control Board	The Contractor
11.	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor
12.	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989 Hazardous and other Wastes (Management and Transboundary Movement) Rules,	Permission for storage of hazardous chemical	State Pollution Control Board or Local Authority (DM/DC)	The Contractor

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
		2015			
13.	Quarry operation	State Minor Mineral Concession Rules, The Mines and Minerals (Regulation and Development) Act (MMRD Act), 1957, The Meghalaya Minor Minerals Concession Rules 2016	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor
14.	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor
15.	Use of surface water for construction	-	Permission for use of water for construction purpose	Irrigation Department	The Contractor
16.	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor

3.3 Social Regulatory Requirements of India and State

124. 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 Contract Labour (Regulation and Abolition) Act, 1970;The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996, The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979, The Child Labour (Prohibition and Regulation) Act, 1986, Minimum Wages Act, 1948, Workmen Compensation Act, 1923 and Equal Remuneration Act, 1979; Payment of Gratuity Act, 1972; Employee State Insurance Act; Employees P.F. and Miscellaneous Provision Act, 1952; Maternity Benefit Act, 1951etc.

3.4 Operational Policies of World Bank

125. As part of the review of environmental and social risks and impacts of a proposed investment, World Bank as part of IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts. The resulting category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy.

126. The World Bank has 10 safeguard policies. The details and applicability of the safe guard policies to the project road are provided in the Table-6.

Table 6: Applicable World Bank Safeguards Policies for project

Safeguard Policy	Subject	Triggered or Not	Reason for its Applicability	Mitigation Measures	Documentation
OP 4.01	Environmental Assessment	Triggered	Umbrella Policy	All necessary mitigation measures to be incorporated.	EIA & EMP required
OP 4.04	Natural Habitats	Triggered	No project road section is passing through Reserved and Protected Forest.	Not Applicable	Not Applicable
OP 4.36	Forestry	Triggered	There is community forest along the road section. However there is no Reserved and Protected Forest.	Applicable	Applicable
OP 4.30	Involuntary Resettlement	Not Triggerred	Road sections widening Will not lead to loss of livelihoods and buildings etc	Not Applicable	Social Impact Assessment report is prepared
OP 4.20	Indigenous People	Not Triggered	No separate Indigenous people development Plan is required for the Project.	Not Applicable	Social Impact Assessment report with TPPF focusing on inclusion of tribal in the project benefits is prepared
OP4.11	Physical Cultural Resources (PCR)	Not Triggered	There is no archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance	Not Applicable	Social Impact Assessment report is prepared

Safeguard Policy	Subject	Triggered or Not	Reason for its Applicability	Mitigation Measures	Documentation
			within proposed RoW that require rehabilitation.		

3.5 Category of the Project

127. Environmental requirements of World Bank are specified in detail in its Operational Policy (OP) 4.01 and other related OPs. In instances in which the procedural and regulatory requirements differ, the more stringent applies. The World Bank environmental requirements are based on a three-part classification system.

- Category A: project requires a full Environmental Assessment (EA).
- Category B: project requires a lesser level of environmental investigation.
- Category C: project requires no environmental analysis.

128. Internally World Bank (WB) classified the project in to 'Category A' requiring Environmental Assessment. This classification is based on the type, location, sensitivity, and scale/magnitude of the project road. This could be largely due to anticipated impacts on socio-economic & physical and biological environmental attributes. In other words, the World Bank Classification is based on the anticipated cumulative environmental and social impacts due to the construction and operation of the project road sections.

129. The project road triggers three, out of ten safeguard policies. Therefore, implementation of the project in tune with these triggered safeguard policies is important.

130. The Banks Operational Policy 4.303 describes policy and procedures for project that involve involuntary resettlement. The policy requires that project minimize the need for involuntary resettlement. Banks policy aims to improve, or at a minimum, sustain the same standard of living of the people who will be displaced because of a development project. Where displacement is unavoidable, resettlement plans should pay particular attention to the vulnerable groups.

4. ENVIRONMENTAL BASELINE STATUS

4.1 Introduction

131. This section describes the existing environmental and social baseline of the study area around the Project Road. It includes relevant components of physical, biological and socio-economic environment.

132. The purposes of describing the environmental settings of the study area are:

- To understand the project needs and environmental characteristics of the area; and
- To assess the quality of the existing environment, as well as the environmental impacts of the future developments being studied.

133. The baseline environment for the EIA was studied through primary survey, information collected from secondary sources and discussion with local stakeholders.

4.2 Methodology

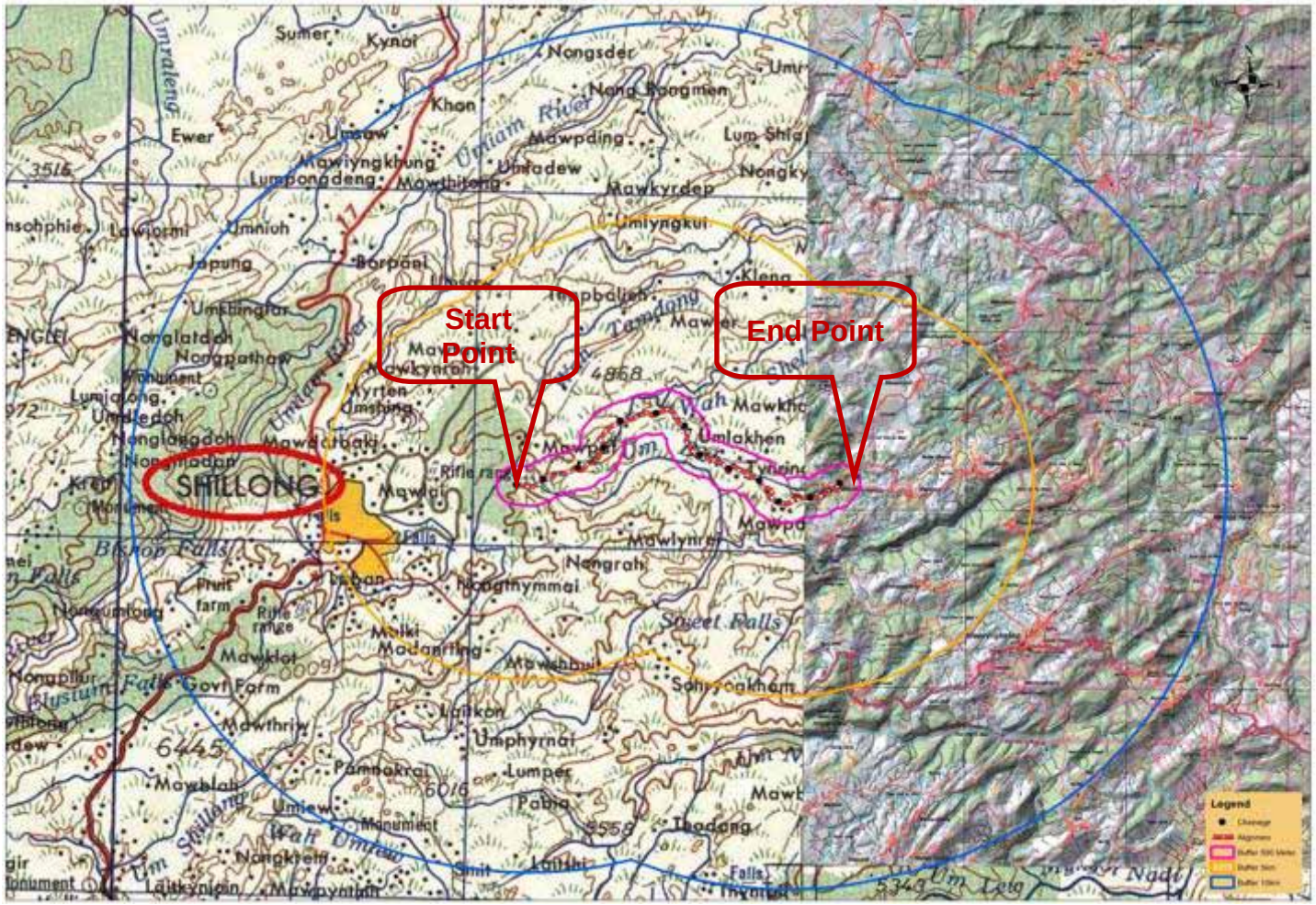
4.2.1 Study Area

134. As discussed in section -1. the study area has been defined as follows:

135. **Corridor of Impact (CoI):** The area of 500 m on either side of the proposed road centreline is considered as the corridor of impact. The proposed RoW i.e. 12 m is thus included within the CoI. This area is more vulnerable to the project's direct impacts.

136. **Project Influence Area (PIA):** In accordance with MoEF&CC's EIA Guideline Manual for Highways and as per guidelines of EIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arial distance) from boundary of road. Collection of secondary data, including likely impacts due to ancillary sites like borrow areas, quarry, material storage,disposal areas, etc. are done within this influence area. The project influence area is marked on toposheet is given in Figure-6.

Figure 6: Project alignment on toposheet showing study area and corridor of impact



4.2.2 Environmental Surveys and Studies

137. Collection of baseline information on bio-physical, socio-economic aspects of the project area is the most important reference for environmental assessment studies. The description of environmental settings includes the characteristic of area in which the activity of project road section would occur, and cover area affected by all environmental impacts. Thus, for conducting EIA, existing environmental conditions along the project road have been obtained by primary data collection, monitoring, sampling and secondary data collection from published source and various government agencies. The primary studies are focused on the Corridor of influence but the sensitivities in the project influence area have been collected through secondary literature review.

138. To assess the baseline environmental status of the Corridor of Impact, monitoring of various environmental attributes was conducted by the consultants during November-December 2019. Primary data for ambient air quality, ambient noise status, water quality (Ground and surface) and soil quality was collected and analysed through NABL accredited laboratory. The detailed results of baseline monitoring and photographs are given in Appendix-1.

139. Information of various physical parameters was collected from the Shillong Centre of Indian Meteorological Department, Statistical Department, Gazetteer of Meghalaya, Forest Department, Department of Environment and other concern Government Departments and discussions with the officials from these agencies.

4.3 Land Environment

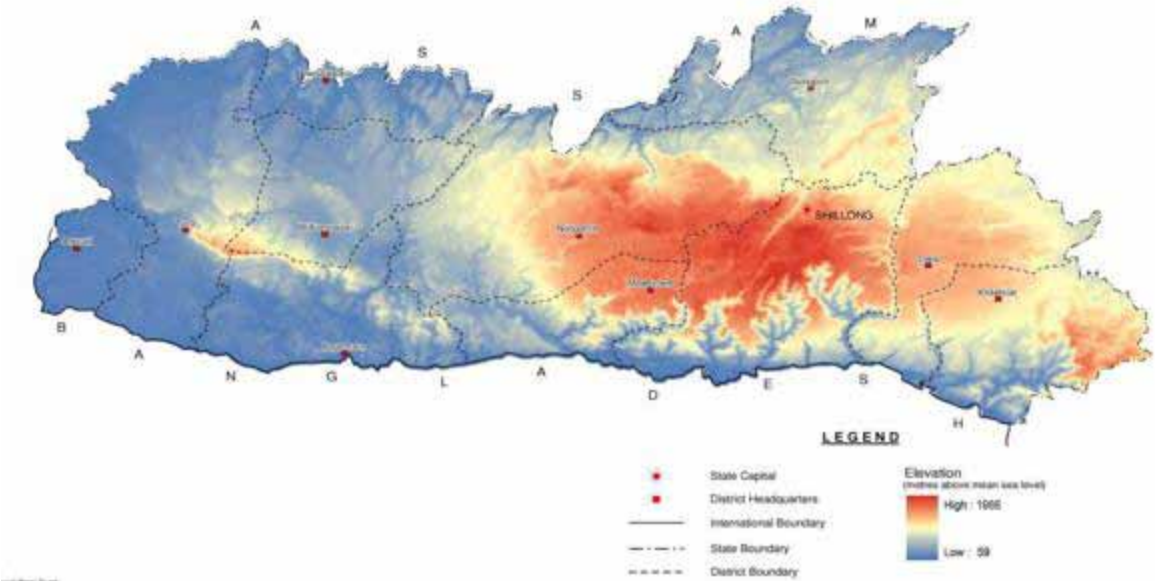
4.3.1 Topography

140. Meghalaya state is also known as Meghalaya plateau. The state can, broadly, be divided into three physiographic zones, namely:

- Central Plateau Region comprising the Khasi Hills and has the highest elevations between 900-2000m,
- Sub-montane region in continuation with the Central Plateau below 900m which gradually merges with the plains in the West and North, namely the Jaintia Hills, and
- Border region which stretches south-wards abruptly from the Central Plateau to the plains in Bangladesh, mainly the Garo Hills region, and is nearly plain.

141. The highest point in the state is the Shillong Peak with an altitude of 1961 meters. Figure 7 depicts the elevation across the state.

Figure 7: Topographical Map of the State



Source: Map of India

142. The project road is within the East Khasi Hills District of Meghalayastate. The general topography of East Khasi Hills district is hilly with deep gorges and ravines on the southern portion. The district is bounded by the Jaintia Hills District to the east and the West Khasi Hills District to the west. The district has an imposing plateau, rolling grassland, hills & river valleys. Deep gorges, abrupt slopes can be seen in the southern face of the plateau. Geographically, the district may be divided into two parts (i) War area in the southern part of the district comprising of hills & ranges abruptly falling into the plains of Bangladesh. (ii) Northern part where the ranges of the district run parallel from west to east. This area occupies the highest part of the state & Shillong peak with a height of 1963 m above sea level. Umkhen, Umlam, Umjam Umiam & Umsning are the important rivers of the district.

143. The proposed Shillong - Diengpasoh Road is located in north-eartren part of East Khasi Hills District, mostly elevation is in range of 1170-1462m.

4.3.2 Geology

144. Geologically the Meghalaya plateau comprises of rocks from the oldest Precambrian gneissic complex to the Recent alluvium formations. The stratigraphic sequence is as follows.

- Cretaceous –Tertiary sediments
- The Sylhet trap
- Lower Gondwana rocks
- Shillong Group of rocks
- Precambrian gneissic complex (Basement gneiss)

145. The Precambrian gneissic complex comprising para and orthogneisses, migmatites and the Shillong Group of rocks comprising mainly quartzytes are exposed in the central, eastern and northern parts of the Meghalaya plateau. They are intruded by basic and ultrabasic intrusives and late techtonic granite plutons.

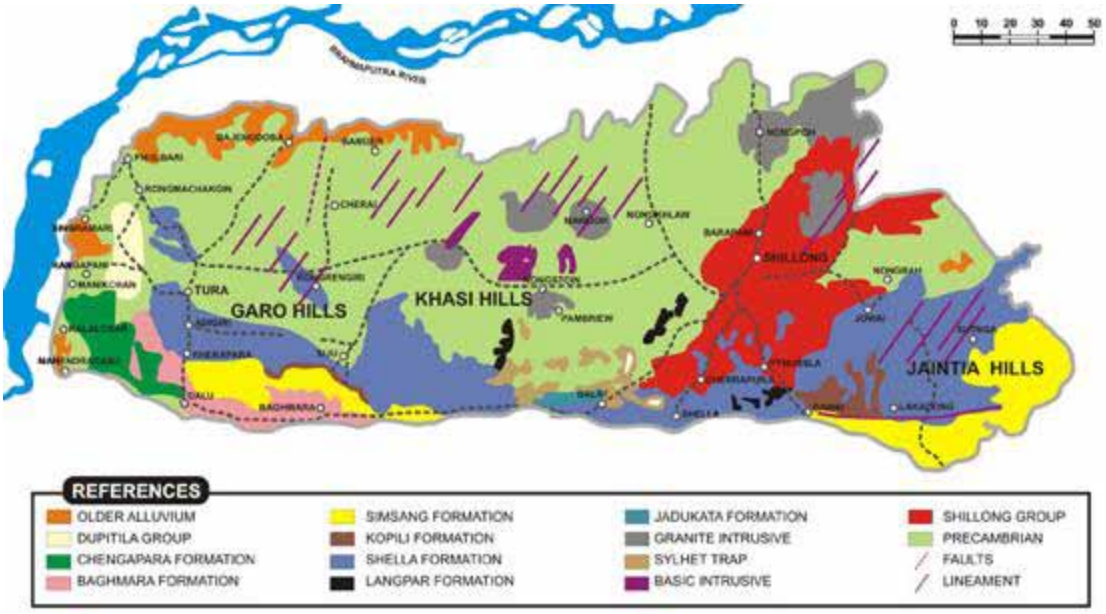
146. The lower Gondwana rocks of Permo-Carboniferous age are recognized at the western part of Garo Hills and consists of pebble bed, sandstone, and carbonaceous shale. The Sylhet trap of

middle Jurassic age comprising mainly of basalt, rhyolites, acid tuffs, is exposed in a narrow E-W strip along the southern border of Khasi Hills.

147. The Cretaceous – Tertiary sediments occupying southern part of the Meghalaya plateau comprises of the Khasi Group (arenaceous facies), the Jaintia Group (calcareous facies) and the youngest formation the Garo Group which is represented as Simsang, Bagmara and Chengapara formations.

148. Besides these the Dupi Tilla group of mid-Pliocene age occurs in the western part of Garo Hills and towards south of Khasi Hills. Isolated patches of older Alluvium overlie the Tertiary rocks along the southern and western borders of the State. The recent Alluvium formation is mostly found in the river valleys of Garo & Khasi Hills Districts.

Figure 8:Geological and Tectonic Map of Meghalaya



Source: GoM, Department of Mining and Geology

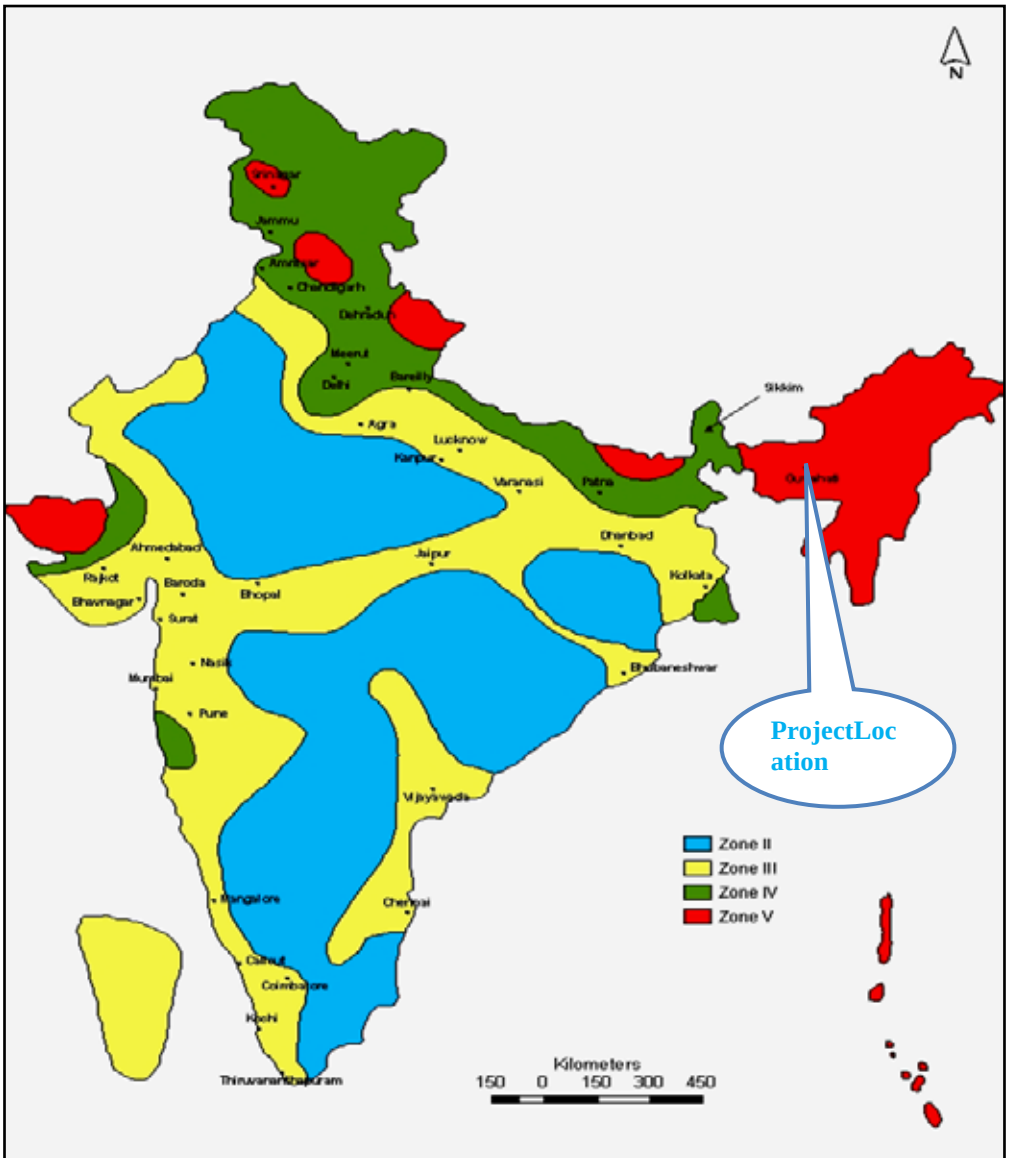
149. The project district area falls mainly within the Shillong or Meghalaya Plateau which is constituted mainly of arenaceous facies of composition in which granites, schists, amphibolits, calcsilicate rocks occur as inclusions of various dimensions.

4.3.3 Seismicity

150. The Bureau of Indian Standards[3] has categorized the entire country in various zones depending upon the degree of proneness to earthquakes. The Zone I signify lesser degree while Zone V signifies highest order. The proposed project road falls under the Seismic Zone V, which is susceptible to major earthquakes as per the seismic zone map of India (IS 1893 - Part I: 2002), shown below in Figure 9.

[3] Bureau of Indian Standards (BIS), a Government of India body has prepared the seismic zoning map for the entire India and established criteria for earth quake resistant design of structures. Zone I indicate the lesser proneness of the region to earthquakes and Zone V indicates higher degree of proneness of earthquakes.

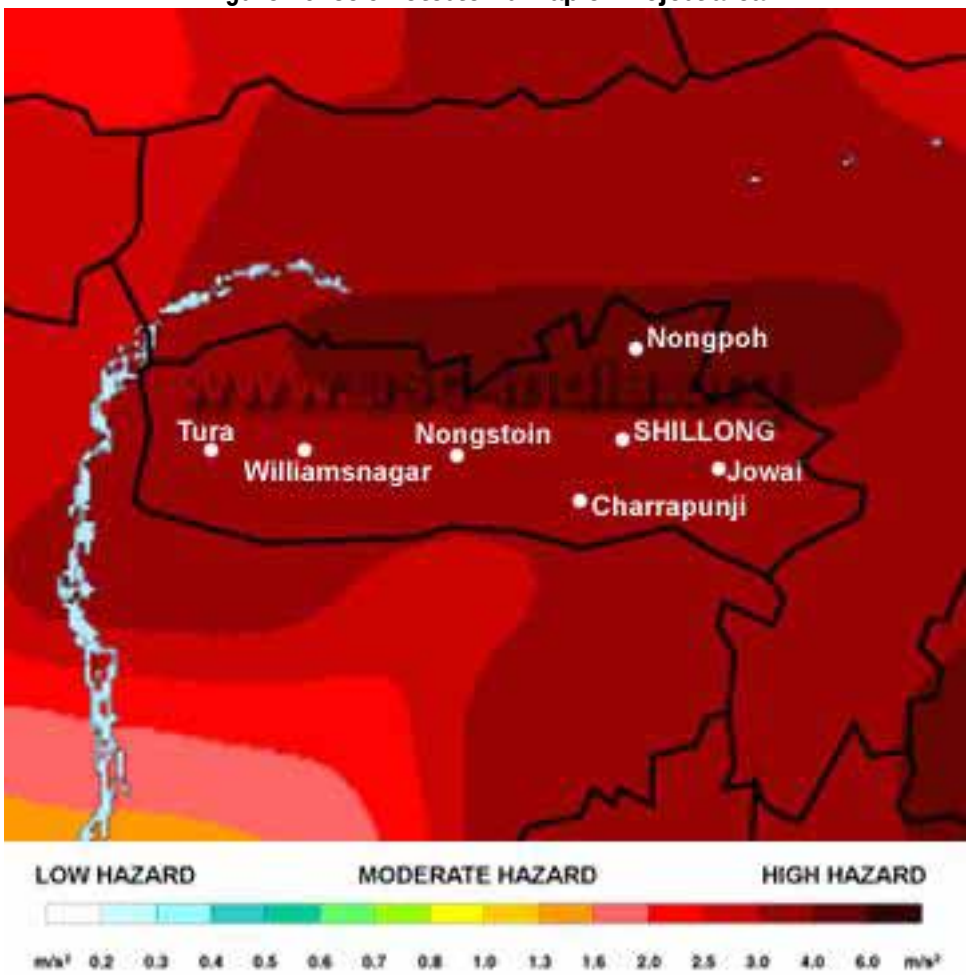
Figure 9: Seismic Zoning Map of India showing Project Location



(***Source:*** *Envis, Government of Meghalaya)*

151. According to GSHAP data, the state of Meghalaya falls in a region of high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state also falls in Zone V. Historically; parts of this state have experienced seismic activity greater than **M**6.0 including an **M**8.1 in 1897. Figure-10 shows the seismotectonic map of Project location.

Figure 10: Seismotectonic Map of Project area



(Source: ASC, Pune)

152. Considering high hazard seismic zone of the project road section area, design standards for structures stipulated in the clause under IRC: 6-2014 has been taken into account.

4.3.4 Soil Type and Quality

153. The soils of the hills are derived from gneissic complex parent materials; they are dark brown to dark reddish-brown in colour, varying in depth from 50-200 cm. The texture of soils varies from loamy to fine loamy.

154. Broadly, the central part of Garo hills and central upland of Khasi and Jaintia hills have read loamy soils formed as a result of weathering of granite, gneisses, diorites, etc. Red and yellow fine textured soils raining from loam to silty loam are found along the southern fringes of read loamy soils. Lateritic soils are present in the southern part of the State. Alluvial soils are found all along the southern, western and northern fringes of the State, with sandy to clay loam texture.

155. Soils are by and large highly leached, rich in organic carbon with high nitrogen supplying potential, but deficient in phosphorus and potassium. Soil reaction varies from acidic (pH 5.0 to 6.0) to strongly acidic (pH 4.5 to 5.0).

156. There is not much difference in fertility classes of soils across the State. Soils occurring on higher altitudes under high rainfall belt are strongly acidic due to intense leaching. These tend to be excessively drained and erosion-prone.

157. The soils of East Khasi Hills district are are thin, immature, light in colour, less clayey and less fertile on the hills slopes and are thick, mature, deep in colour, more clayey and more fertile in the

valleys and the lowlands. The major types of soil in the district are red loamy soils, laterite soils and alluvial soils.

158. This soil type is rich in organic matter, nitrogen and acidic in nature. They are found exposed in the central part of the district. Laterite soil is a weathering product of rocks like quartzite, schist, conglomerate etc., which are found exposed in the northern area of East Khasi Hills. The soils are rich in iron and aluminum. Alluvial soils are found exposed in the southern part of the district that are rich in potash but poor in phosphate content. They are acidic in nature.

159. Soil samples were collected from project influenced area and analysed to find physio-chemical properties. The soil sample locations are given in below Table-7.

Table 7: Soil sample collection location in the project area

S. No.	Location Code	Chainage	Location Name	Source
1	SS_1	7+160	Mawkasingh Village	From Agriculture field
2	SS_2	8+680	Mawpdang Village	From Agriculture field

160. The summary of soil quality results for the project stretch is presented in Table-8.

Table 8: Results of soil quality in the project area

S. No.	Parameter(S)	Unit	Test Result	
			SS_1	SS_2
1	Soil Texture	-	Silty Clay Soil	Silty Clay Soil
2	Soil Colour		Redish Brown	Reddish Brown
3	pH Value at 25°C	-	7.94	7.86
4	Conductivity at 25°C	µS/cm	694	542
5	Moisture	% by mass	8.4	6.4
6	Bulk Density	gm/cc	1.24	1.22
7	Water Holding Capacity	Inches/foot	1.18	1.12
8	Nitrogen as N	mg/Kg	22.4	24.6
9	Phosphorus	mg/Kg	3.65	3.12
10	Potassium (as K)	mg/Kg	70.2	68.4
11	Calcium as Ca	mg/Kg	58	62
12	Nitrate as NO_3	mg/Kg	104	98
13	Sulphate as SO_4	mg/Kg	15.2	14.2
14	Chloride	mg/Kg	6.2	5.2
15	Organic Carbon	% by mass	3.2	4.2
16	Organic Matter	% by mass	4.9	5.1
17	Total Soluble Solids	mg/Kg	12.6	13.5
18	Soil Texture			
a	Sand	% by mass	22.4	21.4
b	Silt	% by mass	36.2	32.8
c	Clay	% by mass	41.4	45.8

161. The results show soil texture of clay and silt in almost equal proportion in the project area. There is higher value of organic matter and nitrate can be observed from the chemical analysis of the soil samples. The soils from agriculture fields is not acidic in nature; may be due cropping pattern and proper drainage.

4.3.5 Land Use

162. Meghalaya lies between 24^0 58' North to 26^0 07' North latitudes and 89^0 48' East to 92^0 51' East longitudes. It covers an area of 22,429 sq. km. of which about 70% is endowed with dense forests and rivers cascading down undulating terrain. The State has most of its land covered by hills interspersed with gorges and small valleys.

163. Most of the land is under rural areas, with Shillong being predominately the main urban settlement. Only 12.74% is net sown area. The principal crop grown in the state is rice covering at least 80% of the cultivated land, followed by maize and wheat. About 17.4% of the land is under wasteland category, (comprising of scrubland, jhum, abandoned jhum lands and degraded scrub forest, with the highest proportion in the west Khasi hills and Jaintia hills.

164. The state of Meghalaya is a resource rich state. There are a variety of landholdings, water resources and forests under different classifications. The table-9 below provides district wise data on land use and forest cover:

Table 9: District-wise Land Use Classification, (2015 – 2016, Area in Ha)

District	Area under forest	Land not available for cultivation	Other un-cultivated land excluding Fallow land	Fallow Land	Net Sown Area	Total	Area Sown More than Once	Gross Cropped Area
East Khasi Hills	106964	53731	65508	10720	37866	**274789**	11127	48993
Ri - Bhoi	87141	33277	86290	15036	22751	**244495**	2983	25734
West Khasi Hills	156012	50284	110241	47802	20260	**384599**	4724	24984
South West Khasi Hills	50508	24818	34889	18865	11010	**140090**	2122	13132
East Jaintia Hills	84077	15565	78288	14642	25169	**203643**	48	11119
West Jaintia Hills	69886	17290	52797	12618	11071	**177760**	388	25557
North Garo Hills	55455	5063	35892	11445	17778	**115981**	2576	20354
East Garo Hills	69122	6364	26240	13596	19311	**144285**	2677	21988
West Garo Hills	126265	15809	29997	13596	73241	**281090**	18668	91909
South West Garo Hills	38526	6592	8900	10162	22406	**86586**	6699	29105
South Garo Hills	102292	11167	25382	24381	25462	**188684**	5264	30726
Total	**946248**	**239960**	**554424**	**215045**	**286325**	**2242902**	57276	343601

Source: Directorate of Economics & Statistics, Meghalaya (Statistical Abstract 2018)

165. The land utilization in the East Khasi Hills district varies in many respects. Forest cover which constitutes106964 ha.of the total geographical area of the district and is higher compared to other category of land use. Cultivable waste land and groves of about 65508 hindcasting there is high

degradation of land resulting from faulty agricultural practice and due to large-scale deforestation.The net sown area constitutes 48993 ha.of the total area, see Table-9.

166. Land use pattern abutting the project road section is mainly community forest (vegetation) and built up areas in between includingMawdiangdianag, Mawkasiang, Siejong, Tynring and Mawpdamg Nongthmmai habitation areas. The land use within the project influence area and the settlement along the project corridor is presented in Table-10.

Table 10: Landuse details along the project alignment

Chainage (Km)		Length (m)	Landuse	Remark
From	To			
2+200	3+000	0+800	BU	Built-up on LHS
3+000	3+600	0+600	OP/VG	Open &vegetation
3+600	5+400	1+800	BU	Built-up on Both side
5+400	6+600	1+200	OP/VG	Open & vegetation
6+600	9+000	2+400	BU	Built-up on Both side
9+000	10+000	1+000	OP/VG	Open & vegetation
10+000	10+400	0+400	BU	Built-up on LHS
10+400	11+600	1+200	OP/VG	Open & vegetation
11+600	13+000	1+400	BU	Built-up on Both side
13+000	13+983	0+983	OP/VG	Open & vegetation

Source: Environmental features survey along the project alignment October-December 2019

4.4 Air Environment

4.4.1 Climate & Meteorology

167. Climate of Meghalaya plateau is influenced by elevation and distribution of physical relief. On the basis of weather condition, the Meghalaya plateau has 4 distinct seasons. The seasons are:

(a) The rainy season from May to early October.
(b) The cool season from early October to November.
(c) The cold season from December to February.
(d) The warm season or hot season from March to April.

168. The salient climatic features of the state are as fallow:

- Average Annual Rainfall - 2000-4000 mm
- Concentration of precipitation - May to October
- Humidity - 67 to 94%
- Cloudiness - Heavily clouded
- Wind - Generally light except rainy season
- Temperature - Summer 23°C to 25°C
  Winter 7°C to 11°C

169. Garo hills experienced higher temperature conditions and humidity from February to October. April and May are the warmest months and January is the coldest month. The Khasi and Jaintia hills experience a moderate climate because of higher elevation. Warm and humid conditions are prevalent in the foothill region in the south and sub-montane region in the north and central uplands. The plateau experiences a temperature of 24^{o}C throughout the year. The southern parts of the plateau have the Cherrapunji -Mawsynram region which receives the heaviest rainfall, an annual

average of 12670mm which is the highest amount of rainfall in the world. The Khasi and Jaintia hills receive an average of 7700mm of rainfall and lies in the rain shadow area.

Table 11: District wise rainfall in the State (2004-2012)

District/Centres	2004	2005	2006	2007	2008	2009	2010	2011	2012
East Khasi Hills (a)Mawsynram	14026	10072	8082	13302	10722	8952	11069	8927	12327
(b)Sohra	NA	NA	NA	12647	11415	9000	13472	8732	13350
West Khasi Hills (a)Nongstoin	4036	3097	2366	4778	NA	*3507	3316	2982	NA
Jaintia Hills (a)Jowai	5374	3042	2898	5379	3094	3025	3404	2964	4254
East Garo Hills (a)Willliamnagar	3837	3612	2098	3899	3317	3252	3183	NA	3109
West Garo Hills (a)Tura	4107	4652	2528	4265	3632	3355	3278	4003	3580
Ribhoi (a)Nongpoh	1147	1792	1274	3086	3853	3354	1156	6278	NA
South Garo Hills (a)Baghmara	1811	2347	1405	2589	2392	1532	1161	2147	1841

*Source: District Agriculture office, Meghalaya, District and local Research Station and laboratories, West Garo Hills, Tura, S.D.O, PWD, Mawsynram, Sub-Divisional Agriculture Officer – Sohra (*February to December)*

170. Throughout the year, temperatures vary by 10.8 °C.

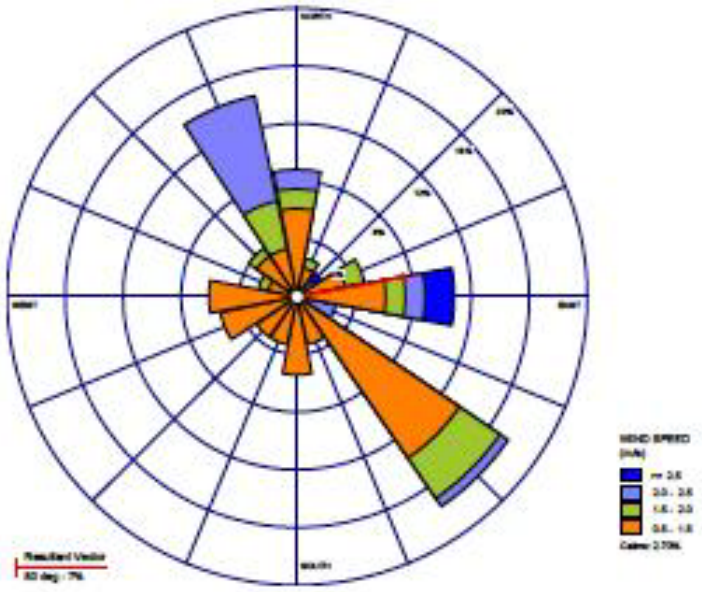
Table 12: Average Seasonal Temperature of the State

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temp. (°C)	10.4	12.3	16.4	18.9	19.6	20.8	21.2	21.1	20.5	18.1	14.4	11.4
Min Temp (°C)	4.9	7.3	11.2	14.4	15.9	17.9	18.5	18.2	17.3	14.1	9.3	5.9
Max Temp (°C)	15.9	17.4	21.6	23.5	23.4	23.7	23.9	24.1	23.7	22.2	19.5	16.9

Source: https://en.climate-data.org/asia/india/meghalaya/shillong-24618/

171. The below (Figure -11) wind-rose diagram indicates the distribution of wind direction and its speed over the monitoring period at Shillong. From the diagram it is shown that around 17% wind direction is from South-East with a wind speed of 0.1 to 1.5 m/s. Similarly, around 14% wind direction has been observed from North/North-West with 2-0-2.5 m/s wind speed. From the diagram the resultant vector has been obtained at 80 degree. The predominant wind direction was observed to be from East-North-East with an average wind speed value of 1.08 m/s. The highest wind speed frequency was generally observed in the range of 0.5-1.5 m/s with calm frequency being recorded at 2.70%.

Figure 11: Wind-rose diagram of the state capital (Shillong)



4.4.2 Ambient Air Quality

172. Two ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone, details are in Table -13. The selection of monitoring locations has been distributed throughout the study area so as to get representative baseline of any variation in land use as well as road geometrics and traffic conditions across the project road including the baseline at Sensitive Receptors along the project. The heights of the sampling locations were kept between 1.0 to 1.5 m in all the locations. The monitoring of the Ambient Air Quality (AAQ) for the various land uses along the project corridor was carried out at each selected location as per guidelines of Central Pollution Control Board (CPCB) and the requirements of MoEF&CC.

Table 13: Ambient air quality locations along the project road section

S.No.	Location Code	Chainage	Location Name	Category as per AAQ standards	Distance from project road	Environmental Setting
1	AAQM-I	5+800	Mawdiang Village, (Near Ru-An-Ba Enterprises)	Rural	10 m	Residential
2	AAQM-II	11+680	Mawpdang Village (On the roof of Minot Secondary School)	Rural	11 m	Residential

173. The summary of ambient air quality results for the project stretch is presented in Table-14.

Table 14: Results of ambient air quality monitoring

S.No.	Location	PM10 (µg/m3)	PM2.5 (µg/m3)	Sox (µg/m3)	NOx (µg/m3)	CO (µg/m3)
1	Mawdiang Village	51	22	3.6	8.4	BDL
2	Mawpdang Village	49	19	2.9	6.4	BDL
NAAQS Limits		**100**	**60**	**80**	**80**	**04**

174. All the pollutant levels along the project road are within the permissible limits. In case of gaseous pollutant, the however the measured levels are lower than standards. Overall the air quality of the project area is not a problem.

4.4.3 Ambient Noise Quality

175. Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. Three monitoring sites were identified for noise monitoring to characterise the baseline noise levels in the project area. Locations for noise monitoring along the corridor are identified based on the criteria same as those used for air monitoring. The description of environmental settings of noise given in Table -15.

Table 15: Noise level monitoring locations along the project road section

S.No.	Location Code	Chainage (km)	Location Name	Category as per AAQ standards	Distance from project road	Environmental Setting
1	NQ-I	5+800	MawdiangVillage, (Near Ru-An-Ba Enterprises)	Rural	10 m	Habitation (residential)
2	NQ-II	11+680	Mawpdang Village (On the roof of Minot Secondary School)	Rural	11 m	School is sensitive receptor

176. The main objective of noise monitoring in the study area is to establish the baseline noise levels, which was used to assess the impact of the total noise generated by the proposed project activities. Noise level monitoring was carried out continuously for 24 - hours with one-hour interval at each location using Sound level meter (HTC made in Taiwan Model No. SL-1350) capable of measuring the Sound Pressure Level (SPL) in dB (A). Hourly Leq values were computed by the noise integrating sound level meter and statistical analysis was done for measured noise levels at 2locations in the study area. The Leq day, and Leq night calculated for various locations in the area are presented below which are compared with the standards prescribed by CPCB for various zones. The Noise quality results presented in Table 16 show Leq Day time is in the range of 48.1 to 50.5 dB(A) and Leq Night time is in between 37.4 to 38.2 dB(A).

Table 16: Result of noise level monitoring

S.No.	Monitoring Location	Chainage (km)	Leq dB(A) day	Leq dB(A) night	Limits in Leq dB(A)	
					Day	Night
1	Mawdiang Village, (Near Ru-An-Ba Enterprises)	5+800	50.5	38.2	55	45
2	Mawpdang Village (On the roof of Minot Secondary School)	11+680	48.1	37.4	50	40

177. The noise levels are within the standards are almost comparable to the standards.

4.5 Water Environment

4.5.1 Hydrogeology

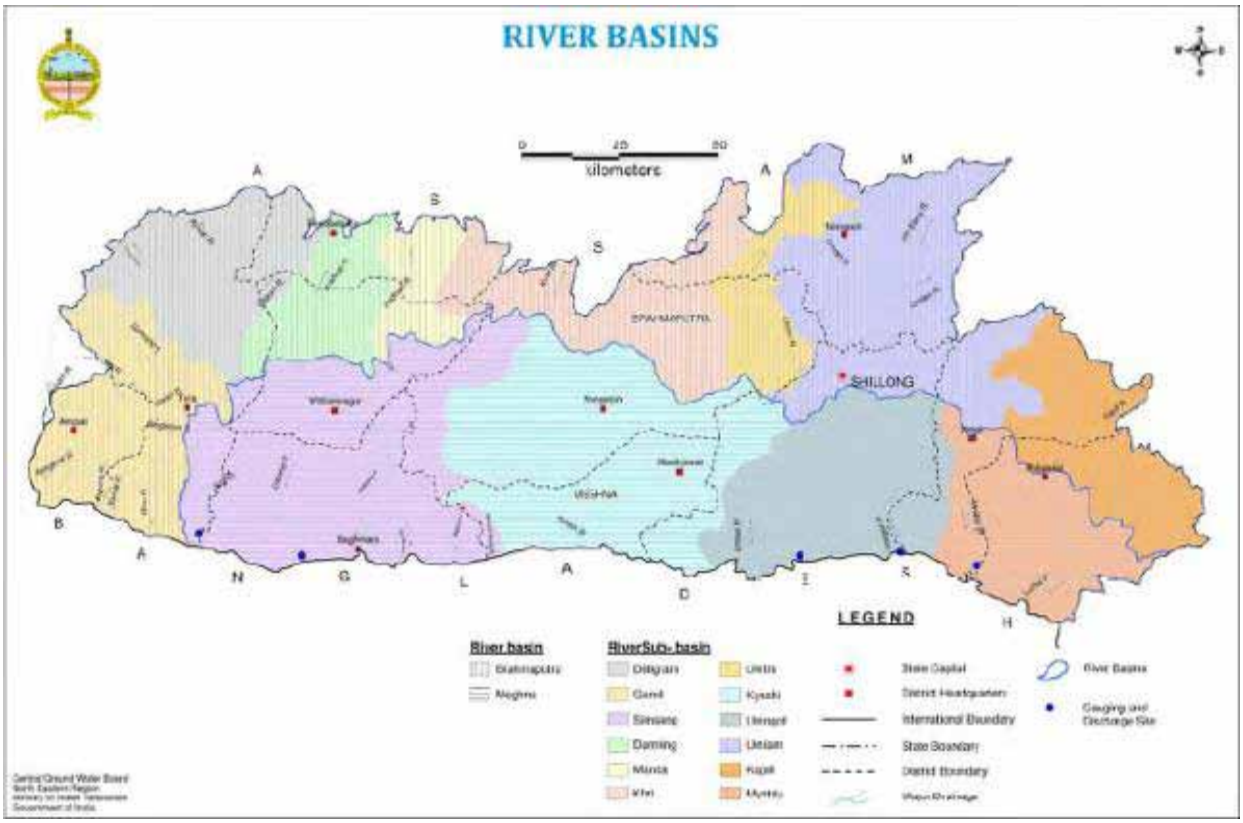
178. One of the world's wettest regions is found in Meghalaya. Mawsynram and Cherrapunji (Sohra) in the East Khasi Hills district are geographically considered as the rainiest places in the

World, with Cherrapunjee, receiving close to 12000 mm of annual rainfall and Mawsynram, a village directly west of Cherrapunji, where rainfall of around 17,800 mm (700 inches) per year. These areas receive rainfall on an average for 160 days in a year, spread over six to eight months between March to October. Paradoxically, even then the state of Meghalaya is water stressed in some regions during summer months. This is mainly due to topographical and geomorphological conditions apart from alterations of the natural land surface by way of development, mining and urbanization. Moreover, the characteristic hilly and steep sloping terrain condition in the area with localized small valleys results in very high surface run-off during the monsoon.

179. The rivers of the State are rainfed and therefore their discharge dwindles during summer. Important rivers in Garo Hills region are Daring, Sanda, Bugi, Dareng and Simsang. In the central and eastern part of the plateau are Umkhri, Digaru, Umngot and Myntdu rivers. The surface water resource is tapped in a number of places by constructing dams across the rivers. The reservoirs, like the Umiam and Kopili, so developed are not only used for irrigation and drinking water but also for generating electricity.

180. The surface water available in Meghalaya on annual basis is roughly estimated at 63.204 billion cubic metres (BCM) and the estimated replenishable ground water resources estimated as 1.15BCM. According to the Central Ground Water Board (CGWB) 1.04BCM of ground water is potentially available for utilization. Figure shows spread to two major river basins Brahmaputra and Meghna, and their sub-basins, refer Figure-12.

Figure 12: Brahmaputra and Meghna, and their sub-basins



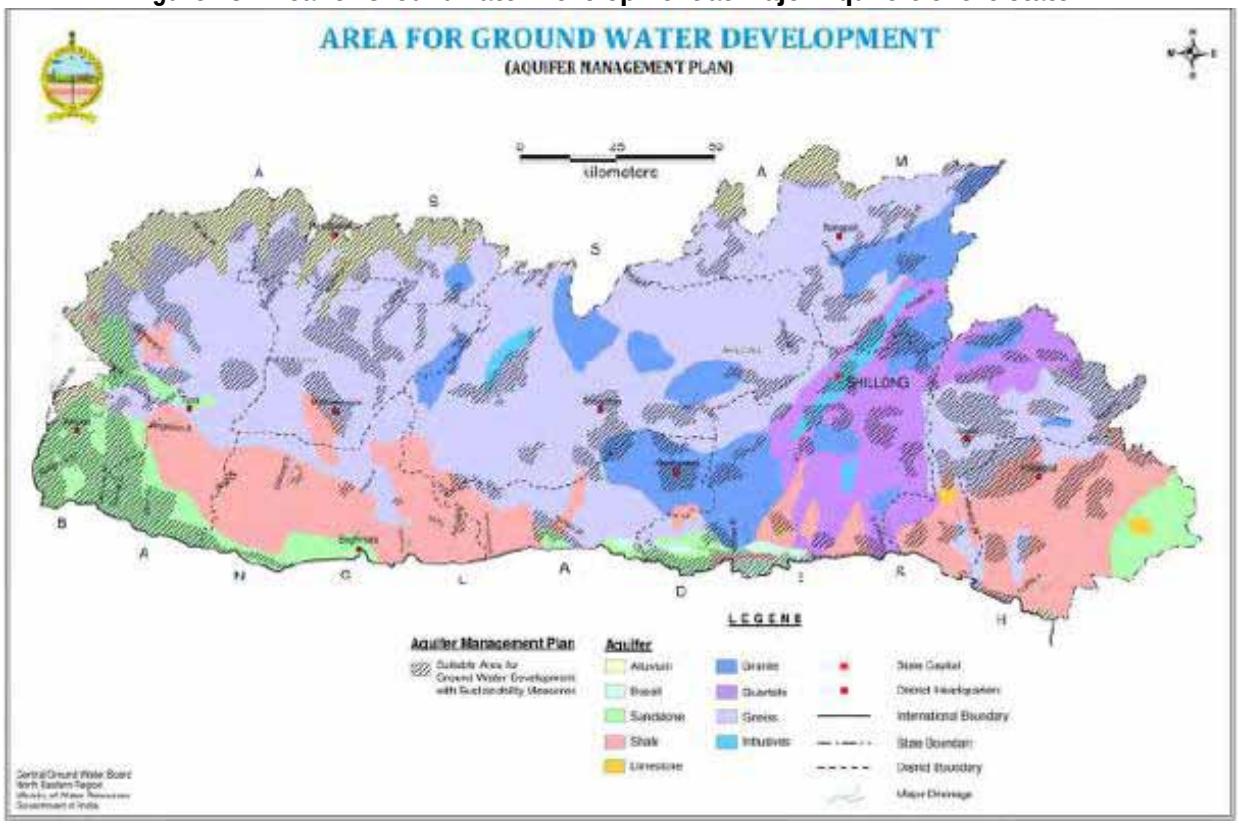
Source: Central Water Board

181. In Meghalaya, groundwater is generally extracted through dugwells and springs (or seepage wells in valley areas/topographic depressions) and bore wells. Apart from this, tubewells are in use in West Garo Hills district. Dugwells are generally shallow in depth. The level of ground water development in the state is 0.15%. The annual gross dynamic ground water recharge of Meghalaya has been estimated as 1.234BCM. Annual allocation for domestic & industrial water requirement

upto year 2025 is estimated as 0.096 BCM as per census 2001. 1.014 BCM of ground water potential may be utilized for irrigation. The importance and contribution of groundwater is felt in the recent years, particularly to meet the drinking water needs.

182. Meghalaya's economy is primarily agricultural engaging around 80 per cent of its total work force. Thus, major part of water consumption in the state is under irrigation followed by utilization of water in household and industrial needs. The State is mostly dependent on rain and surface water resources for irrigation purposes. Surface water is abundant but limited during non-rainy season. According to the CGWB, 18% of the available groundwater is currently utilized and there is ample potential for further increase in ground water exploitation.

Figure 13: Area for Groundwater Development at Major Aquifers of the State



Source: Central Water Board

183. The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl. Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks. At hydrogeologically feasible locations, well drilled down to the depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15 m3/hr in Archaean and Pre-Cambrian Group of rocks. Depth to water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas.

184. Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks. In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl.

185. Springs play a major role to cater water requirement of the people throughout the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period.

186. The water resource in the state are currently threatened with contamination, siltation and pollution primarily contributed from coal mining and domestic effluents. The water in coal mining areas is highly acidic with silt and suspended solids deposited at the bottom of these water bodies. The agricultural fields in the coal mining affected areas have turned into unusable infertile land from use and infiltration of the highly-polluted water. According to an estimate, the State has over 60,000 springs. A sample survey of 714 springs (MINR, 2015) has revealed that more than half of the total springs have either dried or water discharge from them has significantly reduced. Impaired springs have caused widespread water stress in the rural landscape, adversely affecting agriculture, livestock and other allied livelihood activities of the people and causing hardship and drudgery. Despite heavy rainfall, many areas are water-stressed due to increase in demand-supply gap leading to a surge in the use of ground water. Further, ground water data shows that the depletion rate between pre-and post-monsoon period is about 40 to 80% depending on the landscape. Changing land use, deforestation, quarrying, mining and climate change are perceived to be the main causes for deterioration of springs and ground water.

4.5.2 Groundwater Quality

187. The ground water quality analysis conducted by CGWB on sample collected fromvarious dug wells, springs, bore and tube wells in the East Khasi Hills district. The chemical constituents present in the ground water of the district (see Table -17) is within the desirable limit set for drinking and irrigation water standards except for Fe, for drinking purpose. Thus, the water of the district is generally good and fit for drinking as well as irrigation point of view.

Table 17:Chemical Analysis Results of Ground Water Samples

Constituents	Springs	Shallow aquifer	Deeper aquifer
pH	4.8-7.2	5.2-7.1	5.7-6.4
Specific conductance	20-170	51-260	51-214
Carbonate	Nil	Nil	Nil
Bi-carbonate	6.1-24	6.1-134	18-104
Chloride	3.5-35	7.1-35	7.1-11
Fluoride	*BDL-0.21	0.07-0.35	0.08-0.47
Calcium	2-30	4-40	2-22
Magnesium	1.2-4.9	2.4-4.7	1.2-8.5
Total Hardness	10-80	15-115	10-90
Iron	BDL-0.24	BDL-1.52	BDL-8.4

Source: CGWB East Khasi Hill district report

4.5.3 Hydrological Flow & Drainage

188. The drainage pattern of the State represents a most spectacular feature revealing extraordinary straight courses of the rivers and streams evidently along the joints and faults. The magnificent gorges scooped out by the rivers in the southern Khasi and Jaintia Hills are the result of massive headward erosion by antecedent streams along joints of the sedimentary rocks over the block, experiences relatively great uplift. Westward in the Garo Hills, the consequent streams are mostly controlled by the structures, faults and monoclines in the sedimentary rock. The northern part of the plateau devoid of any sedimentary cover is marked by long incisive valley formed due to head ward erosion along joints in the gneissic rocks and granites. The limestone-covered country over southern Garo, Khasi and Jaintia Hills represent typical karst topography. The present physiographic configuration of the plateau was attained through different geological events since Melozonic to present day as indicated by polycyclic surface at various levels.

189. Eight main rivers in the north and five main rivers in the south drain the State. Rivers of north and south are tributaries of Brahmaputra and Meghna; respectively.

190. The project road section does not cross any major river of the state. However; there are number of small streams and tributary rivers crossing the project road section. There is one seasonal stream crossing the alignment at km 13+500 and number of small seasonal streams are also located cross the road section. Some of them are used for drinking water and some used for domestic requirements.

4.5.4 Surface water quality

191. Total twowater samples were collected from the project road section influenced are to monitor the water quality, one each from ground water and surface source. The sample details are given in below table-18.

Table 18: Water quality sampling location along the project road section

S. No.	Location Code	Chainage	Location Name	Source
1	GW_1	7+160	Mawkasingh Village	Water Supply
2	SW_1	13+470	Umpyangkun Nallah	Surface Water

192. The water was analysed in a laboratory as per the methods prescribed in "Standard Methods for the Examination of Water and Wastewater (American Public Health Association)" and the result was compared against IS 10,500: 2012 for drinking water standards. The results are presented in Table-19.

Table 19: Ground (Drinking) & Surface water Characteristics in the project area

Sl. No.	Parameter	Prescribed Limit as per IS:10500 & IS:2296	Monitored Value	
			Water Sample	
			GW1	SW1
1	Colour, Hazen units	5 Max	<1	< 1
2	Odour		Agreeable	Agreeable
3	Turbidity, NTU	1 Max	<1	<1
4	Electrical Conductivity at 25°C	-	298	251
5	pH Value at 25°C	6.5 - 8.5	7.42	7.29
6	Total Dissolve Solids, mg/l	500 Max	192	163
7	Total Alkalinity (as $CaCO_3$) ,mg/l	200 Max	76	72
8	Total Hardness (as $HCaCO_3$) ,mg/l	200 Max	71	68
9	Calcium (as Ca),mg/l	75 Max	18.2	12.4
10	Magnesium (as Mg) , mg/l	30 Max	6.4	6.2
11	Chloride (as Cl),mg/l	250 Max	26	25
12	Sulphate (as SO_4) ,mg/l	200 Max	14	11
13	Nitrate (as NO_3) ,mg/l	45 Max	64	62
14	Sodium (as Na) ,mg/l	-	42	34
15	Potassium (as K) ,mg/l	-	28	24
16	Bicarbonate (as HCO_3),mg/l	200 Max	5.2	4.2
17	Fluoride (as F),mg/l	1 Max	0.04	0.05
18	Phenolic Compound (as C_6H_5OH) ,mg/l	0.001 Max	BDL	BDL
19	Cyanide, mg/l	0..05	BDL	BDL
20	Aluminum, mg/l	0.03	BDL	BDL
21	Arsenic, mg/l	0.05	BDL	BDL
22	Cadmium (as Cd) , mg/l	0.003 Max	BDL	BDL

23	Chromium as Cr,mg/l	0.05	BDL	BDL
24	Iron (as Fe),mg/l	0.3 Max	0.06	0.07
25	Copper (as Cu),mg/l	0.05 Max	BDL	BDL
26	Lead (as Pb) , mg/l	0.01 Max	BDL	BDL
27	Manganese (as Mn) , mg/l	0.1 Max	BDL	BDL
28	Zinc (as Zn) , mg/l	5 Max	BDL	BDL
29	Mercury as Hg,mg/l	0.001	BDL	BDL
30	Dissolve Oxygen, mg/l	-	-	6.8
31	Biochemical Oxygen Demand, mg/l	-	-	4
32	Chemical Oxygen Demand, mg/l	-	-	12
33	Oil &Grease, mg/l	-	-	BDL

193. Analysing the tests result of water samples analysis it was observed that the nitrates and iron are high in both ground water and surface water in the project area. The other parameters are all within the desired limits.

4.6 Biological Environment

4.6.1 Forest

194. As per the Forest Survey of India report, Meghalaya rank seventh amongst the Indian states in respect of percentage of geographical area uder forest cover. The forests of Meghalaya are rich in biodiversity and endowed with rare species of orchids and medicinal plants. The forest types in Meghalya are Subtropical Pine, Subtropical Broadleaf, Tropical Wet Evergreen, Tropical Semi-Evergreen, and Tropical Moist Deciduous Forests. Scared groves mostly located in the Khasi and the Jainita Hills represent the climax vegetation of the area. According to Haridasaan and Rao (1985), the forest vegetation of Meghalaya consisits of Tropical Evergreen Forest in the low-lying areas with high rainfall; Tropical Semi-Evergreen Forest up to the elevation of about 1,200 m with annual rainfall between 1,500 to 2,000 mm; Tropical Moist Deciduous Forest in the areas with less than 1,500 mm rainfall; Grassland on the tops of Khasi, the Jaintia and the Garo Hills; isolated patches of Temperate Forest along the sothern slopes of the Khasi and Jainita Hills; and Subtropical Pine Forest with pure stands of Pinus kesiya confined to the Higher reaches of the Shillong Plateau. Bamboo and canes are found in undisturbed forests. Meghalaya has many endemic plant species, the most famous being the carnivore pitcher plant Nepenthes khasiana.

195. The Forest and Tree cover in the State is 79.37 % covering 17,803 Sq.km. Out of total forest area of 17,146 sq km (76.44% of the state's geographical area) only 1145.19 sq km of Forest areas (5.10 % of geographical area) comes directly under the control of the State Forest Department in the form of reserved forest, protected forest, national parks, wildlife sanctuaries and parks & gardens. The rest of the forest areas belong to communities, clan and private people and District Councils. There are three Autonomous District Councils (ADCs) i.e., Khasi Hills Autonomous District Councils, Jaintia Hills Autonomous District Councils and Garo Hills Autonomous District Councils, which have been set up under the provisions of the Sixth Schedule to the Constitution of India. These ADCs have the power to make laws with respect to, among others, the management of any forest not being a reserved forest.

Table 20: Forest Cover of the State

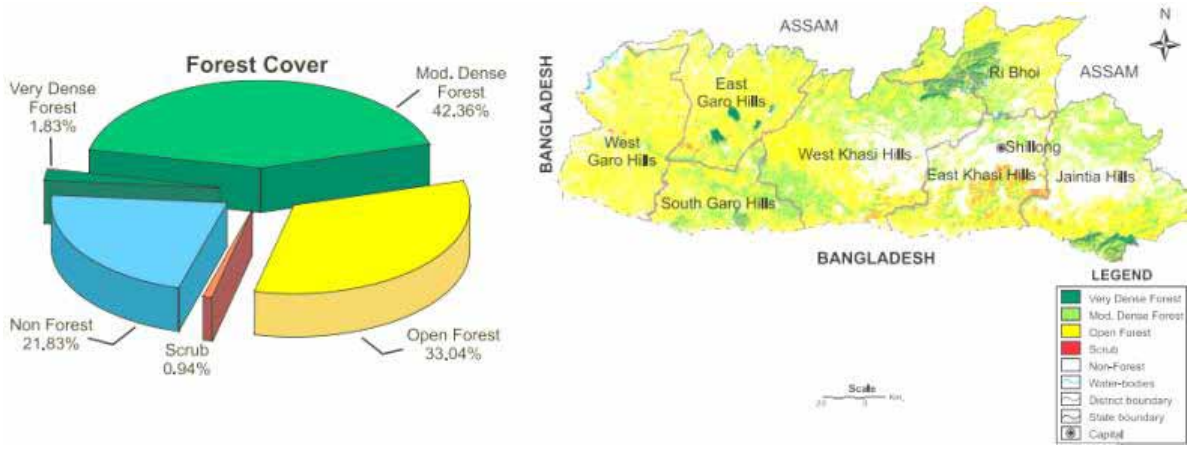
Class of Forests	Area (sq. km.)
Reserved Forests	626.55
Protected Forests	12.39
National Parks (including proposed)	399.48
Wildlife Sanctuary (including proposed)	100.74
Parks and Gardens	295.39

Non-Forest Land transferred to the Department and Exchanged lands	3.08
Sub-total	**1145.19**
Unclassified	1600.81
Total	**17146**

Source: Department of Forest, GoM

196. The Khasi Hills Autonomous District Council, Garo Hills Autonomous District Council and the Jaintia Hills Autonomous District Council. Under the Sixth Schedule of the Constitution, these District Councils have been vested with legislative, executive and judicial functions in many subjects. In terms of canopy density classes, the total forest area is classified under Very dense forests (VDF), moderately dense forests (MDF), open forests (OF) and scrub land.

Figure 14: Forest cover type in Meghalaya



Source: GoM, Department of Forest and Environment

197. In addition to providing an economic and cultural backdrop for the lives of people, forests in Meghalaya deliver an array of essential local and global environmental services, including water storage and filtration, soil stabilisation and carbon sequestration, prevention and reduction of floods, provide food, fodder, fuel, medicines, and materials for construction.

4.6.2 Forest type and density

198. The forests of Meghalaya can broadly be grouped under the tropical type and the temperate type, mainly based on the altitude, rainfall and dominant species composition.

- Tropical Forests: These forests are met within areas upto an elevation of 1200m and with an average rainfall of about 100-250cm. There are numerous subtypes within this category such as evergreen, semi-evergreen, moist and dry deciduous forest, etc.
- Tropical evergreen forests: These forests usually occur in high rainfall areas as well as near catchment areas. They seldom form continuous belts due to various exogenous factors. But still, they harbour very rich species diversity, where nature is at its extravaganza forming a closed evergreen canopy. The trees exhibit clear zonation with dense and impenetrable herbaceous undergrowth.
- Tropical semi-evergreen forests: This category of forests occupies the north-eastern and northern slopes of the State, typically upto elevations of 1200m, where annual rainfall is 150-200cm with a comparatively cooler winter. The numbers of species here are fewer than the evergreen zone. There are also a few species in these forests which are deciduous in nature, such as Careya arborea, Dillenia pentagyna and Callicarpa arborea. Again, there is a clear stratification of the trees in these forests.

- Tropical moist and dry deciduous forests: This type of forests occurs where annual rainfall is below 150cm and at comparatively low elevations. Typical natural deciduous forests do not occur anywhere in Meghalaya but are only subclimax or man-made forests. These forests are characterised by seasonal leaf shedding and profuse flowering of the trees. Recurrent forest fires are a common phenomenon here. Deciduous forests are much more extensive in their distribution in the State and include a host of economically important trees like Shorea robusta, Tectona grandis, Terminalia myriocarpa, Sterculia villosa, Logerstroemia flos-reginae, L. Porviflora, Morus laevigatus, Artocarpus chaplasha, and Gmelina arborea both as natural and as plantations. Schima wallichii, Artocarpus gameziana, Tetrameles mudiflora, Lannea coromandelica, Salmalia malabarica Erythrina stricta, Premnamilliflora, Vitex peduncularis, Albizialebbeck. Lucida, Terminalia bellirica etc is also in abundance. These trees of the deciduous canopy are always lofty and straight bole and with spreading crown.
- Grass and Savannas: Grasslands of Meghalaya are also not a climax type but are only as a result of removal of original forest cover. The rolling grasslands covering large areas can be seen throughout the Shillong plateau, around Riangdo, Ranikor, Weiloi, Mawphlang, Mawsynram, Cherrapunji, Shillong, Jowai, Jarain, and Sutnga in Khasi and Jaintia Hills and major parts of west Garo Hills.
- Temperate Forests: The temperate forests occupy the higher elevations about 1000m, mostly along the southern slope of Khasi and Jaintia Hills. The rainfall here is very high 200-500cm with a severe winter during November to March. Ground frost is also common during December to January.
- Sacred Groves: The scared groves of Meghalaya largely fall under the temperate type and are the relic type evolved through millions of years. These are rich storehouse of vegetation wealth incomparable to any other type of forests in the State. These isolated pockets are untouched due to the religious beliefs and myths attributed to them. Many of the endangered species of the State are presently confined to these pockets only. Fagacaea members dominate over others in these sacred forests. Epiphytic flora is quite abundant and again dominated over by ferns and orchids.

Table 21: Details of district wise forest cover in Meghalaya State

District	Geo graphical area (In Sq.Km)	Area InSq.Km				Percent of GA
		Very dense forest	Mod, Dense forest	Open forest	Total	
East Garo Hills	2603	68	1104	1045	2117	85.17
East Khasi Hills	2820	0	1084	716	1800	63.83
Jaintia Hills	3819	99	1578	839	2516	65.88
Ri Bhoi	2376	131	1092	898	2121	89.27
South Garo Hills	1849	44	1005	590	1639	88.64
West Garo Hills	3715	0	1361	1613	2974	80.05
West Khasi Hills	5247	91	2551	1366	4008	76.39
Total	**22429**	**433**	**9775**	**7067**	**17275**	**77.02**

Source:*FSI,State Forest Report, Meghalaya, 2011-12*

199. Theproject road sectionis passing through hill/rolling terrain with land use being agriculture and builtup area. The road section of Shillong–Diengpasoh is running along the boundary of Itshriyat reserve forest on RHS, approx. 3km length. Right of way is available for widening on LHS. There is no community forest along the road section proposed for improvement works.

4.6.3 Flora

200. The prevailing and pre-dominant floral species observed in the direct area of influence and in the study areas of the project road are Pinus kesiya (pine),schimawallichii (Diengshyrngan), Myrica esculenta (Diengsohphie), Quercus spp. (DiengShahdngiem) Shorea robusta (Sal, DiengBlei), Tectona grandis (Teak)Albizzia lebbeck, Dillenia indica (Diengsohkyrbam). Shrubs include Rubus, Osbeckia, Spirea and Artemesia.

201. Field survey has been carried out to identify the number and type of trees to be affected by the proposed improvement work of road alignment. It is envisaged that about 85number of trees are likely to be cut for the implementation of the improvements proposed under the project, list of trees in COI of the project road is given in Appendix-7.

4.6.4 Fauna

202. Meghalaya is a part of Indo-Burma biodiversity hot spot and identified as key area for biodiversity conservation due to high species diversity and high level of endemism. It has attracted the attention of wildlife enthusiasts and research scholars from all over the country.

The Clouded leopard *(Neofelis nebulosi)* is a Schedule – I animal, according to wildlife (Protection) act, 1972 and classified as Vulnerable (VU) by the IUCN which is found within Meghalaya. The globally endangered Indian Wild Water Buffalo (*Bubalusarnee*) is still found in small groups of 10 to 20 in the Balpakram-Siju-Baghmara belt and adjacent areas including parts of the West Khasi Hills. Shalyni barb (*Pethiashalynius*), is a species of cyprinid fish found in hill streams of Meghalaya, and spawns in rice paddies is currently on IUCN list of vulnerable species as with the increase in coal mining there are reports of heavy metals affecting to this species affecting the quality of habitat, which is declining. The Khasi Hill Rock Toad, Mawblang Toad *Bufoidesmeghalayanus* (IUCN Engaged species) is found in Cherrapunjee area, East Khasi Hills, usually occurs in forest areas dominated by screw pine trees, however the habitat has been affected due to extensive rock-blasting and stone quarrying near Cherrapunjee and the Mawblang plateau area. Other schedule -1 species found in Meghalaya include Black Spotted Turtle, Assam Roofed Turtle, Bengal Slow Loris, Guar, four horned Antelope, Capped Langur, Western Hoolock Gibbon, Chinese Pangolin, Sun Bear, Sloth Bear, Red Panda, Hedged badger, Oriental Small-clawed Otter, Large Indian Civet, Marbled Cat, Asiatic Golden Cat Leopard, Tiger and Asiatic Elephant.

203. No wild life movement or road kills have been reported from the alignment.

4.6.5 Protected Area Network

204. The protected area network in Meghalaya occupies 512.61 Sq.km area The Protected Area Network includes two National Parks, four Wildlife Sanctuaries and one Biosphere Reserve playing an important role in in-situ conservation of biodiversity. The Protected Area Network still support viable population of one of the two closely related Apes found in India, the endangered Western Hoolock Gibbon (*Hoolock hoolock*), and the Bengal Slow Loris (*Nycticebusbengalensis*). Other primates including Stumped-tailed Macaque (*Macacaarctoides*), Assamese Macaque (*Macacaassamensis*), Northern Pig-tailed Macaque (*Macacaleonina*), Rhesus Macaque (*Macaca mulatta*), Capped Langur (*Trachypithecuspileatus*) are also found in these areas. Among the carnivores, the Bengal Tiger (*Panthera tigris*) and the Clouded Leopard (*Neofelisnebulosa*) have become extremely rare while the adaptable Common Leopard (*Panthera pardus*) is still widely distributed. Bears including Sun Bear (*Helarctosmalayanus*), Asiatic Black Bear (*Ursusthibetanus*) and the Sloth Bear (*Melursus ursinus*) are found as well. Smaller cats like the Jungle Cat (*Felischaus*), Marbled Cat (*Pardofelis marmorata*) and Leopard Cat (*Prionailurusbengalensis*) are still found in these protected areas. Smaller carnivores are also abounding, among them mongoose, badger, binturong, dhole, jackal, weasel, otter, fox and marten.

205. The details of sites are given in Table 20. Figure 15 shows the protected area map of Meghalaya. The total area under the protected area network is 5.06 percent of total geographical area of state.

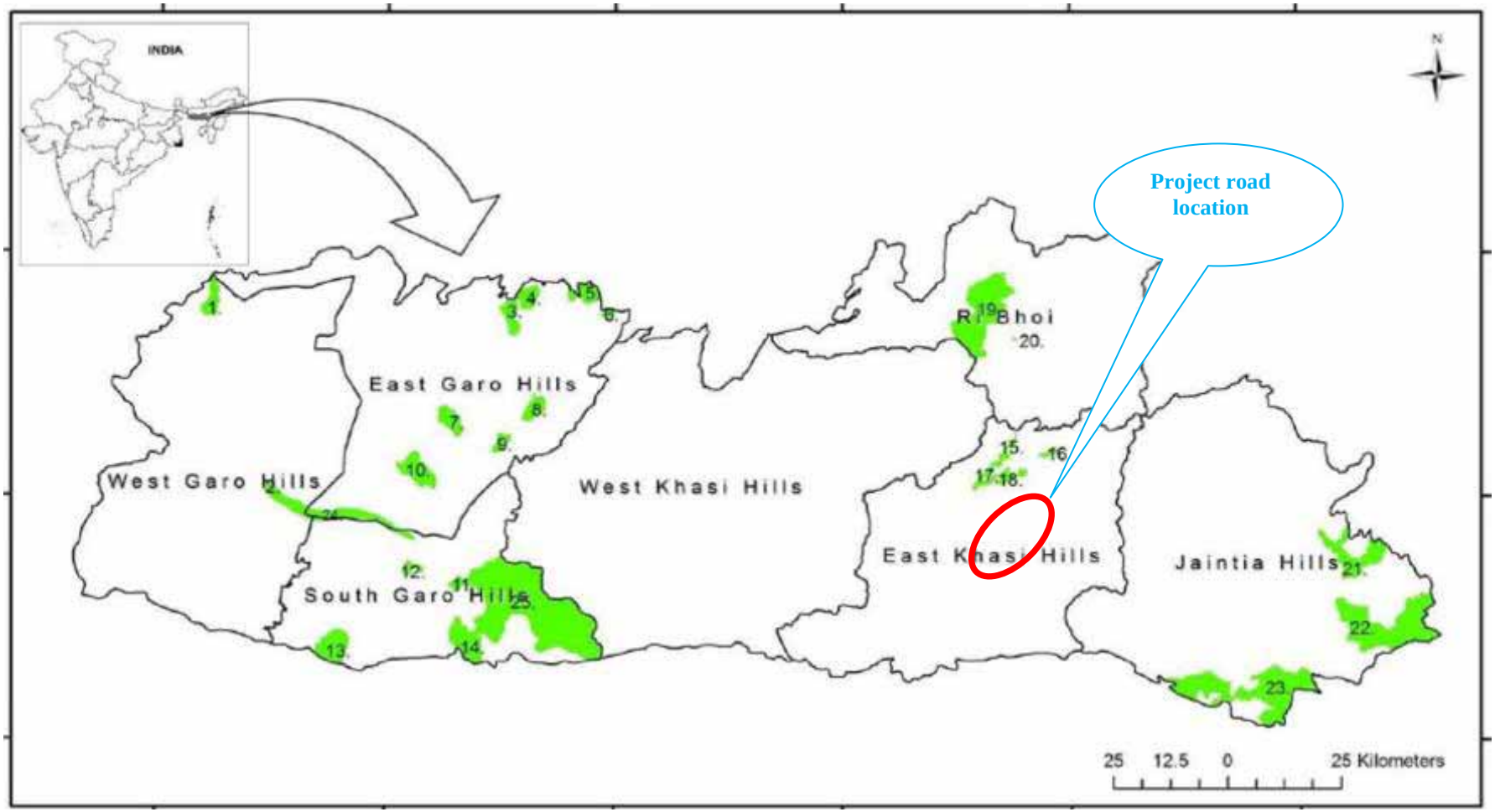
Table 22: Protected Area Network in the State of Meghalaya

Sl.	Protected Area	Location (District)	Area in sq.km
1	Siju Wildlife Sanctuary	South Garo Hills	5.81
2	Nongkhyllem Wildlife Sanctuary	Ri-Bhoi District	29
3	Baghmara Pitcher Plant Sancturay	South Garo Hills	0.02
4	Balpakram National Park	South Garo Hills	220
5	Nokrek Ridge National Park	East Garo Hills	47.78
6.	Nokrek Biosphere Reserve	East, West and South Garo Hills	820
7.	Narpuh Wildlife Sanctuary	East Jaintia Hills	59.90

Source: *Meghalaya Biodiversity Board*

206. Informal interviews were held with the local villagers, livestock herders to gather information on the presence of wildlife and their habitats along the project road. Officials from local forest department were also consulted. Local communities and local forest officials informed thatthere is no No National Parks or Wildlife Sanctuary within 10 km of theproposed alignment. It can be seen from the map (Figure 15) of the protected (notified) areas in State of Meghalaya.

Figure 15: Protected Area Map of Meghalaya State showing project area location



1. Dribruhills RF, 2. Tura peak RF, 3. ChimaBangshi RF, 4. Dhima RF, 5. Rajasimla RF, 6. Iidek RF, 7. Songsak RF, 8. Darugiri RF, 9. DambuRF, 10. Rongrengiri RF, 11. Siju WLS/RF, 12. Emanggiri RF, 13. Angratoli RF, 14. Baghmara WLS/RF, 15. RaitKhawn 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.

Source: GoM, Department of Forest &Envirnment

207. Meghalaya is part of Indo-Myanmar biogeographic region one of the mega bio-diversity regions of the world (Rodgers & Panwar, 1988). Bio-diversity rich areas of Meghalaya are:

- Balphakram National Park 2200 ha. (South Garo Hills)
- Nokrek Biosphere Reserve 82000 ha. (Garo Hills)
- Nongkhyllem Wildlife Sanctuary 2900 ha. (Ribhoi)
- Siju Wild Life Sanctuary 518 ha. (South Garo Hills)

208. There are 3,128 species of flowering plants including 1,237 endemic species and several valuable medicinal plant species. Some highly exploited and endangered species include *Panax pseudoginseng* and *RouvIfiaserpetania*.

209. According to 'Right of Passage: Elephant Corridors of India (2017)', five active elephant corridors have been identified in the State of Meghalaya. The details of five elephant corridors are given in Table -23:

Table 23: Elephant Corridor in the State

Corridor Name	Forest type	Habitation	Corridor Usage
Ranggira – Nokrek	Tropical evergreen and moist deciduous with *jhum* patches	Chasingre, Phagugre, Chibragre, GanolSangma, 2nd Police Battalion campus and Boldorenggre	Rare
Nokrek – Imangre	Tropical evergreen and moist deciduous patches	RongmaRekmangre, Dobagre, Gopgre, EnanRompagre and Papa Asakgre	Regular
Rewak – Imangre	Tropical evergreen forest	Jadegindam	Throughout the year
Siju – Rewak	Tropical evergreen forest with plantation	SijuAretika	Throughout the year
Baghmara – Balpakram	Forest, plantation and agriculture (*jhum*)	Settlements	Regular

210. There is no identified elephant corridor within the project influence area of this road section.

4.6.6 Sacred Groves

211. Sacred groves are forest patches, which are protected by communities based on religious beliefs, and have a significant religious connotation for the protecting community. These groves are considered as one of the most species-rich areas for plants, birds and mammals. Most of the groves are in the catchment areas of major rivers. The information on floristic richness of the sacred groves of Meghalaya revealed that at least 514 species representing 340 genera and 131 families are present in these sacred forests. Many endemic, rare, endangered and threatened species of the state are found in the sacred groves. The sacred grove biodiversity compares favourably with that of the core area of some of the biosphere reserves in this region, which are being managed by the state forest department[4].

[4] http://dspace.nehu.ac.in/bitstream/1/6287/1/Sacred%20groves%20of%20Meghalaya%20(BK%20Tiwari).pdf

212. Ryngkew, Basa, Labasa are some of the deities to whom these groves are dedicated. Bamboo, Needle wood, Indian birch, White Pear, Royal Robe, Balsum of Peru, Phurse Champ, Lac tree and Plot's Elm are among the most commonly found plant species in the sacred groves[5].

213. Tiwari et at (1998) reports 79 Sacred Groves from the State. Rodgers (1994) mentions categorization of protected groves in Meghalaya, which was formulated by Darbar of Khasis in 1925 as follows:

- Ki Law Lyngdoh: forests under the control of the traditional religious leader (or now
- village councils); no public use permitted.
- Ki Law Kyntang: forests of great sacred value for sacrificial and religious ceremonies.
- Ki Law Niam: religious forest (may not be distinct from above).
- Ki Law Adong: forest protected for non-commercial use, e.g. water.
- Ki Law Shnong: forest resources for village use.

214. Sacred Groves of Meghalaya are falling under severe anthropogenic pressure causing fragmentation, area shrinkage and degradation, alien species invasion, grazing, resource extraction. Changing social structure plays an important role in gradual declination of sacred grove system. These nature centric worship places in many areas have already been replaced by temples/solid structures in the name of modernization. Once the god/goddess has been shifted to the temple, the surrounding places become irrelevant to the people, thus immediately converted for other usage.

215. Comparatively rich vegetation cover and thick litter cover help to regulate the runoff water thus reducing the chances of flash floods (downstream) and release it slowly during lean season. Studies in Meghalaya indicate that well preserved groves efficiently reduce the erosive power of runoff water thus preventing soil erosion and nutrient wash out (Khiewtam and Ramakrishnan 1993).

216. No Sacred Groves of Meghalaya are located within the project influenced area of the project road section.

4.7 Socioeconomic Environment

4.7.1 Demographic Profile

217. The demographic feature of north-eastern states is unique in that there are more than 29 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The major minority groups in the state namely Khasi, Jaintia, Bhoi, War collectively known as the Hynniewtrep people predominantly inhabit the districts of East Meghalaya. The Garo Hills is predominantly inhabited by the Garos, belonging to the Bodo family of the Tibeto-Burman race, said to have migrated from Tibet. The Khasis inhabit the eastern part of Meghalaya, in the Khasi and Jaintia Hills. Khasis residing in Jaintia hills are now better known as Jaintias. Table 24 presents the demographic features of the state and the North eastern region.

[5]Tiwari B.K., S.K. Barik and R.S. Tripathi, 1999, "Sacred Forests of Meghalaya- Biological and Cultural Diversity", and Barik, S.K., H.N.Pandey, B.K. Tiwari and B. Singh, 2006, " Sacred Groves of Meghalaya: A sceintific and conservation perspective", Regional Centre, National Afforestation and Eco- Development Board, North- Eastern Hill University, Shillong.

Table 24: Demographic Features of project districtas per 2011 census

State/District	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
East Khasi Hills	2748	459441	366481	825922	301	1011
Ri-Bhoi	2448	233587	25253	258840	106	953
Jaintia Hills	3819	366694	28430	395124	103	1013
Meghalaya	22429	2371439	595450	2966889	132	989
NE Region	262179	45533982	5809395	39041167	173	936
All India	3287263	833087662	377105760	1210193422	382	933

Source: 1) Census of India, 2011, 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, Meghalaya 2017

4.7.2 Economy

(i) Agriculture and Forestry

218. The main occupation in the state is agriculture and allied activities as the industrial sector in Meghalaya is still under-developed. It employs 70% of the population in Meghalaya and contributes 22% to the State GDP. Agriculture is heavily dependent on monsoon with irrigation potential being under-utilised. Primitive agricultural practices like shifting cultivation (*Jhum*) are indigenous to the region especially in the Garo Hills.

(ii) Livestock*, Fisheries and other related activities*

219. The other economic sectors that add to the livelihood source of the people are livestock and poultry, pesciculture, apiculture, forestry, sericulture and weaving. There has been a steady increase in the production of milk and egg in the state, with a growth rate of 1.16 % on milk production and 0.63 % on egg. While, the production of meat has decreased by 0.44% over 2014-2015. Fisheries and aquaculture isan important source of revenue, food, employment and social security for the rural poor.

220. Data on *Fish Seed Distribution* clearly indicates that engagement of population in fisheries and aquaculture in East Khasi Hills, West Khasi Hills and South Garo Hills districts is higher in comparison to other districts. Climatic conditions are a big obstacle in the development of fisheries in the State with heavy rains and resulting flash floods and run-away water which causes siltation of fish ponds and washes away the fish feed.

(iii) Sericulture and *weaving*

221. Sericulture and weaving sector in Meghalaya are the two most important cottage based, eco-friendly industries in the rural areas. These twin industries portray the cultural ethos and rich heritage of the people of the State. There are 1812 sericulture villages as per 2011-2012 statistics and involve 28923 families engaged in sericulture.

222. With limited infrastructure and fragile environment not suitable for setting up of heavy industries in Meghalaya, it is the small-scale industries sector that contributes to the state's economy. From the table below it can be seen that there are 641 small scale industries at present in the state which employ 3057 people. Industries like tailoring and embroidery, betelnut preservation, cane and bamboo works, weaving and handloom, bee keeping, and honey processing have shown great potential in this sector.

223. Apart from this, educated individuals have taken up teaching, government jobs and private services as their profession. It is only in the recent times that individuals have been seen to take up various other entrepreneurial steps and come out of the so called conservative occupations and hence depend on business of varying natures and sizes.

(iv) Transportation

224. Transportation system is a key factor in the socio-economic development of any state/area. Meghalaya had a total road length of 9666.84 km as on March 2015. There is no railhead – Guwahati (103 km from Shillong) is thenearest railway station serves in the project area. Meghalaya has two airports located in Shillong and Baljek. The Shillong Airport (Umroi Airport) is fully operational, while the Baljek Airport is under construction/up-gradation.

(v) Mineral Resources

225. Meghalaya is endowed with large deposits of valuable minerals such as coal, limestone, kaolin, clay and iron. Mining and quarrying has been an integral part of the economic activity of the state for a long time. This, however, was brought to a close by the interim ban on mining activities in the state in 2014 by the National Green Tribunal6. Due to intensive unscientific rat hole mining in major coal reserve areas, vast lands have been degraded, with forest and water bodies equally affected by the mining activity. The project interventions should focus on rehabilitating some of these critical landscapes to increase land fertility, forest cover and protection of water bodies from further degradation. From the baseline survey it was found that coal mining has given way to sand mining in Nongtalang, further degrading its community forests and threatening the surrounding water sources.

Table 25: Estimated Reserves of Minerals in Meghalaya

Minerals	Reserves
Coal	563.5
Limestone	4147.0
Kaolin	4.5
Clay	81.0
Sillimanite	0.05
Glass sand	2.54
Quartz	0.08
Feldspar	0.06
Iron	4.0
Fire clay	12.0

Source: State Development Report, Chapter X, 2008-2009; Planning Department, Govt. of Meghalaya

(vi) Aesthetic and Tourism

226. The entire northeast region States has immense scope for promotion of tourism. It has a salubrious climate, exotic greenery and rich flora and fauna besides the rich culture. Various wildlife protected areas and natural.

227. There are about 101 tourist destinations in Meghalaya with majority of them existing in East Khasi Hills followed by West Garo Hills. This may be concentrated in the East Khasi Hills

[6]All Dimasa Students Union Dima Hasao Dist. Committee Vs. State of Meghalaya &Ors., Original Application No. 73/2014, National Green Tribunal, New Delhi, April 17, 2014.

District due to the accessibility and promotion of these sites. The number of tourists visiting Meghalaya has also considerably increased from 271720 in 2002 to 685567 in 2012.

Table 26: Tourists Visiting Meghalaya

Year	Indian	Foreign	Total
2002	268529	3191	271720
2003	371953	6304	378257
2004	433495	12407	445902
2005	375911	5099	381010
2006	400287	4259	404546
2007	457685	5267	462592
2008	549954	4919	554873
2009	591398	4522	595920
2010	NA	NA	NA
2011	667504	4803	672307
2012	680254	5313	685567

Source: Directorate of Tourism, Government of Meghalaya

(vii) Cultural Resources

228. Meghalaya states have great cultural value. Festivals and cultural activities are being celebrated throughout the year in the area. The department of arts and cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The region has great cultural value Christian. To promote and preserve the rich cultural heritage of the state, the department has been organising a number of programmes annually.

229. During the environmental and social screening survey, number of sensitive receptors such as school, temple etc. are located within next to existing RoW. However, no structure is going to be affected by the proposed road improvement works. The list of these structure is presented in Table 27.

Table 27: Physical /Sensitive Features along the project road section

Sl No	Chainage (at Km)	Side and Distance from road (m)	Receptor
1	5+860	LHS-30	Sharon Memorial Public School
2	7+800	RHS-25	Church
3	8+680	RHS-8	St.Francis Holistic Healing centre school
4	8+700	RHS-15	Church
5	11+600	LHS-6	Minot Secondary School
6	11+950	RHS-20	Medical Health Centre

(i) Archaeological and Historical Monuments

230. This is a list of Monuments of National Importance as officially recognized by Archaeological Survey of India is listed below, there are also state protected monuments, archaeological sites that have been recognized by the ASI in Meghalaya, in the West Garo Hills, these include excavated temples, Buddhist Stupa and a Fortress.

Table 28: Protected Archaeological and Historic Sites

Sl. No	Name of monuments/ sites	Location	District
1.	Megalithic Bridge between Jaraem and Syndai	Um-Nyakaneth	Jaintia Hills
2.	Megalithic Bridge known as Thulum-wi between Jowai and Jarain	Maput	Jaintia Hills
3.	Megalithic Bridge on the Um-Kumbeh	Um-Kumbeh	Jaintia Hills
4.	Stone memorial of U.Mawthaw - dur-briew	Nartiang	Jaintia Hills
5.	Tank, Syndai	Syndai	Jaintia Hills
6.	Stone memorial of U-Mawthoh-dur, Bhoi	Bhoi	East Khasi Hills
7.	Scott's Memorials	Cherrapunji	East Khasi Hills
8.	Manipur Memorial	Shillong	East Khasi Hills
9.	Monolithic Garden	Jowai	Jaintia Hills

231. There is no archaeological and historical monument is located along any of the project road section.

5. ANALYSIS OF ALTERNATIVES

232. This chapter presents a comparative analysis of various alternatives considered to avoid or minimize impacts that would be inevitable if technically (based on design speed and geometrics) best-fit alignment is followed. Cross-sections adopted for the up-gradation component as presented in Chapter -2 (project description) are flexible in design to avoid most of the impacts within RoW. Along the project road section there are number of habitation/settlements. Of them, mostly villages appear not so congested as mostly temporary roadside establishment spilling along the project road section. An analysis of various alternatives is attempted to arrive at the technically and environmentally & socially best-fit alternative.

233. Based on the secondary traffic data and traffic during site visit, upgradation of existing road section as two lanes may be adequate and that can be accommodated within existing right of way the road or with no additional land acquisition along the existing road section alignment. Under the present circumstance, No Bypass option is therefore proposed for the project road section. The requirement of bypass proposal is not anticipated on project road section and widening & improvement work will follow existing alignment only.

234. The project road section has number of geometric deficient locations and efforts has been made to improve these locations by providing alignment improvement where it is feasible and workable within available RoW.

5.1 Design Considerations

235. The proposed formation width and requirement of right of way various options were reviewed to minimize the land acquisition and R&R impacts. The final alternate design option selected for the road section with no additional land acquisition and nil R&R impacts.

236. Similarly; there is reserve forest on RHS along the road section upto a length of 3 km, to minimize adverse impacts on forest, improvement proposal in this section has been kept on LHS within available RoW.

5.2 With or Without Project Scenario

5.2.1 With Project' Scenario

237. The 'with project' scenario includes the widening of single lane road section to two lane carriageway configurations of the existing major district road section in Meghalaya. The 'with project' scenario has been assessed to be economically viable and will alleviate the existing conditions. It would thereby, contribute to the development goals envisaged by the Government of Meghalaya, and enhance the growth potential of the regional and the state.

238. To avoid the large-scale acquisition of land and properties, the project envisages the widening of single lane road to two lanes along the existing alignment to minimize the loss of properties and livelihood of the PAPs.

5.2.2 Without Project' Scenario

239. In the case of 'without project' scenario the existing road section with narrow carriageway width will be considered as it is. Considering the present traffic volume and potential for growth in near future, the capacity of the present road sections is insufficient for handling expected traffic volume and calls in for immediate improvements.

240. The existing road section has poor riding condition with landslide zones, poor drainage conditions and poor geometry. Poor drainage is seriously impacting and deteriorating the road surface. This is further compounded by the landslides and disrupting the traffic for long hours particularly in monsoon season. 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 already critical situation. The existing unsafe conditions and the adverse environmental consequences, in terms of the environmental quality along the roads, would continue to worsen in the absence of the proposed improvements.

241. 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. Keeping in view the site conditions and the scope of development of the area, the 'With' and 'Without' project scenarios have been compared as shown in Table 29.

242. By looking at the table it can be concluded that "With" project scenario with positive/beneficial impacts will vastly improve the environment and enhance social and economic development of the region compared to the "Without" project scenario, which will further deteriorate the present environmental setup and quality of life. Hence the "With" project scenario with minor reversible impacts is an acceptable option than the "Without" project scenario. The implementation of the project therefore will be definitely advantageous to achieve the all – round development of the economy and progress of the State.

Table 29:Comparision of 'With' and 'Without' project scenarios as alternative analysis

With Project		Without Project	
Impacts		Impacts	
+ve	-ve	+ve	-ve
· With the improvement of road surface and slope protection measures, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced. · Tourism will flourish. · Better access to other part of the region as the project road sections are as a lifeline of interior region. · Providing better level of service in terms of improved riding quality and smooth traffic flow. · Will reduce accident rate.	· Minor change in topography is expected due to construction of embankments. · Minor changes in land use pattern. · Loss to properties and livelihood.	Nil	· Increase in travel time. · Increase case of landslide and soil erosion. · Increase in fuel consumptions. · Increase in dust pollution and vehicular emission. · Increase in accident rate. · Overall economy of the State will be affected.
· All weather access reliability.	· Removal of vegetative cover along the road sections at selected locations and loss of trees. · Impacts of flora and fauna. · Removal of trees along the road sections.	Nil	· Increase in accidents.
· Reduced transportation costs.	· Increase in air pollution due to vehicular traffic. · Short term increase in dust due to earth work during construction at micro-level.	Nil	· Project road will further deteriorate.

With Project		Without Project	
Impacts		Impacts	
+ve	-ve	+ve	-ve
· Increased access to markets.	· Increase in noise pollution due to vehicular traffic during construction work.	Nil	· Increased vehicle operation cost.
· Access to new employment centers.	Nil	Nil	· Reduced employment/ economic opportunities.
· Employment to local workers during the execution of the project.	Nil	Nil	· Arrest of possible significant enhancement and economic development of the region.
· Better access to health care centres and other social services. · Improved quality of life.	Nil	Nil	· Land degradation, dust pollution and damage to pastureland, contamination in water bodies due to vehicles travelling along multiple tracks on the open ground. · Deep impact to human health in case of emergency.
· Strengthening of local economies.	Nil	Nil	· In absence of the project, it is extremely difficult to generate funds for such a massive improvement of the road infrastructure from its own resources.
· Reduction in travel time and development of the important places of in the district of Jaintia Hills, Ri-Bhoi and East Khasi Hill of Meghalaya State.	Increase in speed may lead to accidents in congested areas.	Nil	· Affect the development of the area.
· Reduction in erosion and landslides from multi tracking and stone pitching of elevated embankments.	Nil	Nil	· Increase in dust pollution and creation of sedimentation problems in water bodies.
· The widened and paved road will reduce impacts due to multiple tracking on soil and vegetation along the road.	Nil	Nil	· Increased adverse impacts on soil and vegetation.

5.3 Location and Alignment Alternatives

243. The proposed road section is major district road having strategic importance to connect important rural areas within district of East Khasi Hills. Government of Meghalaya has planned to implement the road section to connect with important rural economy and district centers for community development and market accessibility. Therefore; no alternate location were considered for the project road section.

244. The improvement of existing major district road section to be the best possible alignment. Ths alignments has following advantages over any other alternate alignment option:

- It follows existing alignment for project road section.
- Land take from forest and private parties is nil and improvement work within existing RoW can meet the traffic demand. No additional land will be required the project alignment.
- Existing road section alignment is geologically more stable and will require less or less volume of hill side cutting,
- The existing right of way is available to accommodate improvement proposal in the section road section passing along reserve forest, hence no forest Clarence is required in this section,
- Cost of construction is lower for improvement proposal on existing road alignment.

6. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Impact Assessment and Mitigation Measures

245. The impacts due to proposed project activities across different phases have been identified and predicted. The proposed project activities will impact the environment in two distinct phases:

(i) Construction phase
(ii) Operational phase

246. Impacts are identified and predicted based on the analysis of the information collected from the following:

- Project information (as outlined in Chapter 2);
- Baselineinformation (as outlined in Chapter 4).

247. The identification of likely impacts during construction and operational phases of the proposed project has been carried out based on likely activities having their impact on environmental parameters.

6.2 Potential Impact on Land Use

6.2.1 Impact Assessment

248. Since the road strengthening would follow the existing alignment of the road the change in land use would be limited only to areas widening is proposed, or improvement of geometrics is required, or widening within the existing RoW is undertaken. In this project no realignment or Bypass is proposed. There is no additional land acquisition is involved for the improvement proposal for the road section. Impacts on the agriculture land or the structures would have nil impact. As per final design no structures are likely to be impacted in road section.

249. Construction work of the project road section will be virtually through hilly terrain with steep and unstable slopes at few locations. Much of areas in this section is geologically young, resulting in soft/fragile substrates. Another complicating factor is the high monsoon rainfall throughout most parts of the project road section.These factors mean that project area conditions are amongst the most difficult in the region for road construction. Landslides frequently caused by inappropriate construction techniques, slope instability, and inadequate drainage are major problems and are associated with all types of road construction. It should be noted that a significant number of landslides that occur in the vicinity of road are caused by factors/features only indirectly linked to the road itself – frequently, irrigation channels, logging, quarrying and cultivation practices. However, on this road section no landslide zone has been identified.

250. Some temporary changes in land use might occur due to setting up of construction camp, material storage yards and plant and machinery. These would be fallow land or waste land and would be for a period of 2-3 years and the impacts would be low. With the development of the road there is a likelihood of induced ribbon development along the project roadsection. The agricultural or other land use would change to commercial and or residential use over time.

6.2.2 Mitigation Measures

251. To prevent any adverse impacts on land-use the following measures need to be adopted:

- The measures to be adopted for the control of soil erosion at identified landslide locations along the project road section:

  - The existing vegetation on slopes outside the immediate area of construction must remain undisturbed during construction and/or upgrading.
  - Bioengineering techniques will be used to prevent barren slopes and to stop soil erosion and to protect the animals from grazing animals.
  - Support structures will be installed where slope failures are anticipated or may have occurred previously.
  - Slope failures should be monitored and remedial actions initiated at the earliest possible time.
  - logging immediately above road should be restricted to reduce erosion/landslide potential;
  - quarrying along road ROW should be restricted;
  - excavated material should be properly disposed of and not simply dumped downhill;
  - adequate reclamation (e.g. fertilisation and reseeding) along denuded ROW should be implemented;
  - particular care should be given to providing adequate drainage; and
  - to the largest extent possible, care should be taken to avoid sacred and religious sites.

- No agricultural land, fallow land (current or temporary), grazing land should be used for setting up of construction camps, material storage or staging of plant and machinery. The following parameters would be considered while selecting site for construction camp:

- Sites /land types to be avoided:

  - Lands close to habitations
  - Irrigated agricultural lands
  - Lands belonging to small farmers
  - Lands under village forests
  - Lands within 100m of community water bodies and water sources as rivers
  - Lands supporting dense vegetation and Forest with/without conservations status
  - Low lying lands within 100m of watercourses
  - Grazing lands and lands with or without tenure rights
  - Lands where there is no willingness of the landowner to permit its use
  - 2km from towns 500m from any villages
  - Community land (Church, community forest) which is traditionally used as conservation areas

- Land Types Preferred

  - Waste lands.
  - Waste Lands belonging to owners who look upon the temporary use as a source of income.
  - Community lands or government land not used for beneficial purposes.
  - Private non-irrigated lands where the owner is willing.
  - Lands with an existing access road.

6.3 Potential Impact on Soil

6.3.1 Impact Assessment

- The impacts on the soil are expected along the alignment especially in case of expansion of carriageway as well as in the borrow areas and construction camp. The impact on the soil is primarily due to the:

- Loss of topsoil: The topsoil on the land parcels which is ether used for short term (e.g. borrow areas, construction camps etc) or permanent use (expansion of the road alignment) would be lost unless the same has been preserved.
- Soil Erosion: The alignment passes through areas which have sandy loam or sandy clayey loam. These soils are light textured and are thus prone to erosion by winds.
- Compaction: The movement of vehicle over land next to existing road and to access the construction site would also cause compactions of soil and affect soil fertility.

- It is estimated that approximately 61075 cum of material would be excavated during construction and about 19136 cum of BT and Non-BT material will be scarified from existing carriageway. The material from existing carriageway will be reused after processing. Out of total excavated material 24430 cum will be used in road construction. This would be primarily from hill side cutting and the construction of minor bridge or culvert,demolition and waste generated during the dismantling of the existing cross drainage structure andbituminous wastegenerated during dismantling of pavement. In addition, waste from off-spec hot-mix as wells as from the regular operations of the machinery e.g. layers andbitumen sprayers during the surfacing of the roads. The concrete wastes from the batching plant and transit mixer wash water would also be generated.
- The labour camps would be setup for construction would generate municipal solid waste and hazardouswaste (waste oil from the maintenance and operationof machinery). These wastes have potential to contaminate the soil around the site if it is not properly stored, handles and disposed.If these excess excavated material, construction and demolition wastes are disposed on agricultural land it may result in loss of productivity of land.

6.3.2 Mitigation Measures

252. Mitigation measures which would be considered to reduce impacts on soil during road and bridge construction are given below:

- The borrow areas should be developed as per the guideline presented in **Appendix-2** to minimize impacts.
- Excess excavated material should not be dumped by the contractor on any adjoining property. The excess excavated material to be stored at a specified location so that it can be reused where ever possible or used for strengthening of shoulders of village roads;
- All demolition debris especially from cross drainage structures and pavement should be utilised in the backfilling where ever possible. No virgin material shall be utilised unless the demolition debris are certified by the Engineer as “not fit for use”. All construction debris which cannot be reusedshould be disposed at pre-designated sites. The Contractor should identify site for temporary storage of the construction debris during the preconstruction
- Vehicular movement should be restricted over the open fields or agricultural land.

253. The storage, handling and disposal of Municipal Solid Waste, Hazardous Waste and construction demolition waste, the Contractor should follow all the provision of the respective rules. The guidance for storage of these waste are presented in Appendix-3. The same guidance (storage of Hazardous Waste) may be used for storage of hazardous materials (oil, lubricants).

6.4 Potential Impact on Surface Water Resources

6.4.1 Impacts Due to Construction

- There is no major river crossing on the project road section. There are only a few small season streams crosses the road alignments. The surface water will be used for construction activity. The construction activities e.g. earthwork, concreting of structure and labour camps, would require 90 KLD of water and may result in conflicting situations with local communities. In addition, the construction activities would also witness influx of

skilled labour who would be housed in the construction camps. It is estimated that approximately an average of 50-75 KLD of water would be required during the peak construction period for construction purpose and 15 KLD for domestic purpose in the road section. Water would also be required for domestic requirement and the stream water in the state meet the required standards of IS 10500: 2012.

- Like surface water and ground water are scarce. In project construction area withdrawal of water for any purpose other than for drinking will be taken with permission from CGWB. Using groundwater especially freshwater for domestic and construction activities would have serious impacts on the availability of the resource for local population.

- Local community is using stream water as source of water by tapping water from hill on road side, due to road improvement the community water tapping point may be affected.

6.4.2 Mitigation Measures

- The drainage and the contour maps indicate that the alignment passes through hilly topography so the contractor can identifychannel along the corridor and create tank, if required to store water for construction purpose. The entire exercise would beconducted in consultation with the local community.These tanks would be handed over to the community for use and maintenance after thecompletion of construction.

- Dust suppressant /dust binders shall be used to reduce water consumptions. The acceptable dust suppressants include: Acrylic polymers, Solid recycled asphalt, Chloride compounds (calcium chloride and magnesium chloride), Lignin compounds (lignin sulphate and lignin sulfonate powders), Natural oil resins (soybean oil) and Organic resin emulsions.

- The Contractor should notify the executing agency for its source for procurement of water. It should provide monthly reports of water consumed and its source.The water consumption for concrete mixing can be reduced by use of plasticizers/ super plasticizers as mentioned in IRC 015:2011.

- The water tapping point should be protected by providing barricades, in case of community consent to develop the water tapping point with facility of storage tank and tap on it.

6.5 Potential Impact on Surface Water Quality

6.5.1 Impacts Due to Construction

254. In addition to competition over the scarce resource, the construction camp and the construction activities would generate waste water. These would include domestic wastewater from the construction camp and the wash water from the machinery e.g. batching plant concrete transit mixers would cause deterioration of the water quality These liquid wastes have potential to contaminate the water bodies around the site if it is not properly handled.

6.5.2 Mitigation Measures

- No wastewater should be discharged from construction camps. Runoff from the camp shall be passed through an oil-water separator.

- Construction water would not be procured from any unauthorised wells or existing wells. The permission of CGWB would be obtained in case new wells are sunk;

- The Contractor shall make arrangement for bottle drinking water which conforms to IS 14543 (2004). In case the contractor uses groundwater for drinking purpose he shall install adequate treatment technologies e.g. mini water treatmentplant.

- Water usage for construction work would be reduced by adopting following best practices:

  - Use buckets etc. to wash tools instead of using running water;
  - Use of auto shut off taps (without sensors) in labour accommodation;
  - Awarenesscamping on water conservation practices to workers;
  - Install water metres with main supply pipes/water tanks/bore well to assess quantity of consumed water and
  - Use of plasticizers/superplasticizers in the concrete production to reduce water consumption.

255. The construction camps facilities management measures are presented in Appendix-4.

6.6 Potential Impact on Ambient Air Quality

256. The impact on the air environment is likely both during the construction as well as the operations phases.

6.6.1 Impacts Due to Construction

257. In the construction phases the activities related to the earthwork is likely to generate large quantities of particulates. The possible sources of generation of such particulates are borrow area operations, transport of material, storage of construction material, carrying out of earthwork, movement of vehicles on unpaved road. Vehicular movement due to the project would also add to PM 2.5 and SOx and NOx emissions. In case of the project road both PM 10 and PM 2.5 are identified as a major source of pollutant.

258. The operations of the Hot-mix plant, handling of cement in batching plants is also likely to generate the air pollutant. The generation of PM 2.5 due to the construction activities would add on the already stressed air environment.

6.6.2 Mitigation Measures During Construction

259. To prevent the generation of dust during the construction activity the following measures may be considered:

- The speed limit of project vehicle movement over unpaved surface should be limited to 15 kmph;
- All vehicles carrying construction material should be covered;
- The construction material should be stored against wind breaks so that they are not carried away by wind. The length of the windbreak wall shall be twice the height for it to effectively work. The stockpiling of material should be carried out considering the prevailing wind direction;
- Water sprinkling should be restricted due to the scarcity of water. Dust suppressant14 should be applied on the surface of the unpaved earthwork to reduce the consumption of water;
- Vehicular movement on the unpaved pavement should be strictly restricted. The access roads within the construction camp should be paved using the waste concrete or batching plant and concrete mixer wash;
- All project related vehicles and equipment should have valid Pollution Control Certificates.
- The pollution control equipment in the Hot-mix plant shall be kept in working condition at all times. The plant shall not be operated if the pollution control equipment is not functional;
- Requisite permits shall be obtained from the MSPCB for operation of the Hot Mix Plant and Quarry (in case of new Quarry);
- The grievance redressal mechanism for the project would also be used for reporting any matter related to air pollution

6.6.3 Impacts during Operation

260. The strengthening of the carriageway would improve vehicular movement, congestion is likely to get reduced and speed to vehicles is likely to improve. Even though there would be a decrease in vehicular emission due to the reduction in congestion the increased vehicular traffic on the MDR would increase the pollution load.

6.6.4 Mitigation during the Operations

261. To mitigate the impacts of vehicular pollution during operation phase, green belt shall be developed along the corridor. Local species which can arrest both gaseous and particulates shall be planted.

6.7 Potential Impact on Noise Quality

6.7.1 Impact due to Construction

262. The principal source of noise during construction of highway would be from operation of equipment, machinery and vehicles. Earth moving machineries e.g. excavators, graders and vibratory rollers has potential to generate high noise levels. These machineries produce noise level of more than 70 dB (A). This can cause disturbance to the settlement, adjacent to the carriageway or at 500 m from the worksite. The vibration produced by rollers can be transmitted along the ground. This may cause damage to kutcha structure located along the alignment. The extent of damage would be dependent on the type of soil, the age and construction of the structure.

263. The noise generated during the construction would cause inconvenience to the population adjoining the road especially within 500 m of the alignment after which it would be attenuated to acceptable levels Since, the settlement along the road alignment is sparse the severity of the impact would below. The impact on the workers however would be dealt with in separate section.

6.7.2 Mitigation Measures

- The DG sets used in the projectroad sectionshould conform to the CPCB stimulated standards for installation and operation.
- Regular maintenance of the machinery, equipment and vehicle would be carried out to prevent excessive noise. A maintenance schedule would be prepared and maintained by the contractor.
- Night time construction activity would be prohibited in case settlement/habitation is located within 500 m of the construction site.
- Consider the use of traffic calming measures[7] in the final design to reduce the speed of the vehicle.

6.7.3 Impact during Operation

264. The development of the road is expected to increase the traffic volume but at the same time reduce the congestion in the settlements. The noise levels are still expected to increase with the increase in traffic. As pointed out in section 4.4.3 the noise measured in front of the sensitive receptors e.g. schools are within the standards prescribed for sensitive receptors.

265. The increase in traffic would further aggravate the problem and would cause inconvenience especially at educational institution. As pointed out earlier in some case due to the proximity of the

[7]The following traffic calming measures can be considered in settlements: i) circular humps : this is capable of reducing the speed of vehicle by 5kmph below the desired speed.; ii) trapezoidal humps raised flat areas with two ramps; iii) zebra crossing on top of a trapezoidal hump with two pair of jingle strip on both side. This can be used in settlement areas where there is pedestrian crossover points; v) rumble strips caused by asphalt and thermoplastic would increase noise and but reduce speed vi) jingle strips vi) traffic islands

classroom to the exiting highway student have complained about noise. The operations of the highways and the increased traffic would further aggravate the noise levels.

6.7.4 Mitigation Measures

266. In cases where land is available two-layer plantations would be carried out with local species to act as a vegetative barrier for noise.

6.8 Potential Impact on Physiography and Drainage

6.8.1 Impact Identification

267. The alignment follows the existing topography except for the location of the cross-drainage structure. At these locations the vertical profile has been changed and the height of the finished level has been increased by approximately 0.25 to 0.5m. There is no existing Major Bridge on the Project road section only one Minor Bridge exist,and No additional bridges are proposed to be constructed. There are existing26 pipeculverts and 17 slab culverts. Thus, any change in the drainage is also not envisaged.

6.8.2 Mitigation Measures

- At all locations where the preliminary design has indicated in raise in the level of the embankment the final design should review the feasibility ofthe same and if possible, reduce the embankment height.
- At all location where the vertical profile has increase by 0.25 To 0.5 m or more protections of embankment is required.

6.9 Potential Impact on Biological Environment

6.9.1 Impact on Flora

268. It is estimated that 85 trees would be felled for the proposed road improvement project. Even though no major change in habitat is envisaged being agriculture and built up area along the road section, the felling of trees would have an impact on the flora. The impact would also not be significant as the alignment would not affect any forest area.

6.9.2 Mitigation Measures

- Plantation would be taken along the corridor to compensate for the tree felled. At least 10 trees would be planted for every tree felled or as mentioned in the permission for tree felling provided by the Department of Forest, Government of Meghalaya
- Only local tree species which are less water consuming should be used for plantation after prior approval for species from state forest department.

6.9.3 Impact on Fauna during construction

269. The proposed road project section does not pass through any protected area of the State. The alignment would not encroach into the natural habitats so there would be no impact on ecological resources.

270. During the construction hunting of wild animals by workers and, excavation has to be carried out for developing the foundation culverts. There is a small population of wildlife e.g. snake, rabbitsetc. in the project area. The risk to wildlife is primarily due to falling of the animal into the excavation carried out for foundation.

6.9.4 Mitigation Measures during Construction

271. During the detailed design investigations has beenundertaken to identify the areas with known road kills and wildlife movement. There is no identified location of wildlife movement in this

road section. Since the alignment follows the exiting topography and thenumber of cross drainage structure are provided for small animal crossing. Thefollowing measures would be undertaken:

- Traffic calming measures would be undertaken
- During the construction areas which have proven wildlife movement or presence temporary woven wire mesh guards of about 2.4 m (8 ft.) high will be put around the excavated areas to prevent small wild animal from falling. No harm would be done to the animal if they are trapped in the excavated area. The contractor in association with Executing Agency and Forest Department would ensure safe release of the animal.

6.9.5 Impact on Fauna during Operation

272. There is no concentrated population of wild animal and also no reported location of road kills. However, during the operations if road kills are reportedspecific measures would need to be undertaken.

6.9.6 Mitigation Measures during Operation

- A survey of the vulnerable stretches of the road especially with respect to road kill would be carried out. The measures discussed above would be under taken.

6.10 Potential Impact on Socio-economic Environment

273. The socio-economic impacts have been detailed in the Social Impact Assessment and Resettlement and Rehabilitation study carried out under the project.

6.11 Community Health and Safety Issues

6.11.1 Impacts during Construction

274. The construction activities would be carried out without hampering the existing traffic since there is no alternate corridor for diversions of traffic. The construction activities would also remove the additional spaces i.e. shoulder to accommodate the construction of the additional carriageway or strengthening of the carriageway and shoulders. Since the local slow-moving traffic including pedestrians and the through highway traffic would be using a reduced road space the congestions on the road section would increase during construction. This situation would be further aggravated by the additional vehicle used in the construction activity using the road for haulage of construction material.

275. The local slow-moving traffic and pedestrians are thus prone to collision with the through road traffic and the construction vehicle. Also, at times the excavations are carried out close to a village access road or settlement. These work sites may also cause potential injuries to the public unless they areprotected.

6.11.2 Mitigation measures

- All worksites should be barricaded, and the integrity of the workspace segregation from the trafficmaintained at all times;
- In settlement area the workplace should be segregated by the erecting barriers. Separate walkway should be identified in the settlement areas foruse by pedestrians and slow-moving traffic Crossover points should be provided at the worksite locations in settlement areas so that people can easilycrossover without coming is in close proximity with the construction work or equipment.
- At the point of entry or exit from the work site flagman should be provided. The entry and exit vehicle shall be regulated by the flagman to prevent collision;
- All worksite shall be provided with reflective stickers so that it can be easily identified during night;

- Precautionary signages should be put-up well in advance to warn drivers of impending construction works;
- Flashers should be provided near excavation to warn the traffic of the excavations;
- The worksite within the settlement shall be properly illuminated as a safety precaution;
- The construction debris should not be placed on the road as it would further constrict the space available for the public.

6.11.3 Impacts during Operations

276. During the operations phase of the highway the traffic volumes and vehicular speeds are both likely to increase. This can potentially be risky both for pedestrian as well as slow -moving traffic. In case of sensitive receptors mentioned above in addition, as traffic speeds increase the chances of vehicularcollisions are also expected to increase.

6.11.4 Mitigation Measures

- During the design activity a traffic hotspot study carried out to identify the location of accident or areas of conflicting traffic. Design interventions given for these locations
- During the operations of the road traffic hotspot studies should be carried out every year as per the MoRTHs Circular. The traffic safety expenditure should be included in the annual budget.

6.12 Occupational Health and Safety Issues

6.12.1 Impact Identification

277. Road workers are at risk of injury from i.) passing traffic vehicles, ii) Construction equipment operating within the work zone and in ancillary areas which support the work zone e.g. batching plant, hot-mix plants iii) construction vehicles entering and leaving the work zone.

278. Similarly, there are occupational risks during operation of the road is from traffic. Accidents primarily occur due to collisions with passing vehicle. The project districts experience extreme weather conditions especially during winter and rainy season. This can cause accidents and cold climate.

6.12.2 Mitigation Measures

279. The following mitigation measures need to be adopted to protect the workers:

- Temporary traffic control devices such as signages, warning devices, concrete barriers can be used to segregate the highway traffic from the work zone. These control devices should be setup at a distance ahead of the work zone to control traffic. Cover or remove the precautionary signages when the workers are not present;
- Flaggers/Flagmen should be placed with high reflective jackets and other devices so that they can slow down the traffic;
- No equipment or vehicle should enter the work zone without the flagmen being present to guide the equipment/vehicle;
- All vehicle should be fitted with reverse siren. Rotating equipment should also be fitted with siren which should come on when the equipment rotates to the reverse;
- In case of extreme temperatures, the working hours may be regulated. Night time working can be considered especially in areas outside settlement with the permission of the Executing Agency.
- These measures as discussed above would also be made part of the Standard bidding document of Contractors involved in project road section.

6.13 Key Impacts in the Project

280. Considering the sensitivity of the receiving environment along the project road section and the project intervention the following key impacts havebeen identified:

- In absence of any approved water source and the also community arranged supply of water for domestic and agricultural purpose sourcing of water for construction would cause stress on the surface water resource. Hence, sourcing of water from stream is prohibited. Prior permission from local community and authority should be processed before start of work.

- Approximately 61075 cum of excavated soil from hill cutting and about 19136 cum of BT and Non-BT material will be scarified from existing carrriageare expected to be generated form scarified bitumen, dismantling and excavation of existing culvert. The debris especially from cross drainage structures and pavement should be utilised in the backfilling where ever possible. No virgin material shall be utilised unless the demolition debris are certified by the Engineer as "not fit for use". All construction debris which cannot be reused should be disposed at pre-designated sites. The Contractor should identify site for temporary storage of the construction debris during the pre-construction.

- All hill/soil cutting areas should be revegetated as soon as construction activities are completed. At more vulnerable landslide locations, selected bioengineering techniques should be adopted - a combination of bioengineering techniques and engineering solutions such as rock bolting and the provision of bank drains may be required. Solutions will, however, need to be individually tailored by the geo-technical/ environmental experts of contractor or authority engineer.

- There isIshriyat reserve forest running along the road section of Shillong–Diengpasoh on RHS, approx.3km length.Right of way is available for widening on left hand side and no forest clearance is required for improvement proposal of this road section. It is estimated that 53 trees would be felled for the proposed road improvement project.

6.14 Climate ResilientMeasures in DPR

281. There are design measures also considered in detailed project report to minimize impacts on environmental conditions and social setup along road section due to proposed improvement works. The followingclimate resilientmeasures have been taken:

- Recycle/reuse of excavated soil from road side cutting and BT &Non-BT material scarified from existing carriage.
- Design of cross-drainage structures (44 nos.)based on rainfall data of the project area.
- Accommodation of improvement proposal within existing right of way, to avoid impacts on trees, land and existing structures.
- Improvement work on Left hand side in 3 km length of road section running along Itshriyat reserve forest.
- Tree plantation on valley side and application of Bio-engineering and bio technology on hill side
- Dumping areas for muck disposal has been identified and consent processed at DPR stage
- Provision of protection (1256m)and breast walls (1040m) at required locations with steep hill
- Provision of side drains to minimize soil erosion and water pollution.
- Involvement of community in maintenance works and plantation schemes along project road

7. PUBLICCONSULTATIONS AND DISCLOSURE

282. Stakeholder consultation is one of the integral issues of the road project section. Stakeholder consultation is a two-way process which involves the interaction of various stakeholders and the project proponent. It is highly desirable for all key stakeholders to arrive at a consensus on sensitive features, issues, impacts and remedial actions. It is useful for gathering and making them understand the project alternatives and mitigation and enhancement measures and last but not the least the compensation packages arrived for the affected population. The preliminary consultations were held with the road users, population residing and shop owners along the project road sections. The consultations were to know the views of public on widening, to know the locations of landslide of the project road, and to identify environmental issues in the project road.

283. The stakeholders identified are potential affected community, Field offices of the project Road and Building Department of Government of Meghalaya State, Forest Department, State Pollution Control Board, People residing along the project road, State Irrigation Department, State Electricity Department, State Transport Department and the State Tourism Department.

284. The main objectives of the consultation program were to minimise the negative impact of the project corridors and to make people aware of the road rehabilitation work. During the process efforts were made to ascertain the views and preferences of the people. The aims of community consultation were:

- To understand views of the people affected w.r.t to the impacts of the road
- To identify and assess all major economic and sociological characteristics of the village to enable effective planning and implementation and;
- To resolve the issues relating to the impacts on community property.

7.1 Local Level Consultation

285. Local level consultations were carried out in affected villages and all the comments received have been incorporated in the document. Efforts were made to select both small and big habitations along the project road section in order to get representation of all the segments of affected population. Prior intimation about consultation meeting was given to Village office /Community Leader/Villagers, so that the villagers were aware of date and location of meeting before hand for active participation.

286. The objectives of local level consultations were to inform the population about the project, solicit their opinion on the proposed development and understand their requirement with respect to a transportation corridor. The apprehensions about the project both during the construction and operation phases were also considered and incorporated their views into the policy making and design. The attendance sheet of the public consultations is given as Appendix-5.

7.1.1 Key findings of the local level consultations

287. The key findings of the local level consultations are as follows:

- The size of participants in each consultation is mentioned in the Table-30.
- The participants were aware of the fact that road will be widened, but they didn't know the details of the project.
- The participants, in general, were in favour of road widening and improvement; however, they had apprehensions regarding safety.

Table 30: Summery of public consultation for project road sections in East Meghalaya

Venue / Place	Date	Participants	Issues/Suggestions
Village: Mawkasiang	21 October 2019	33 Participants from village community including village head, housewife, business owners, labours, farmers and students	· Proposed widening and strengthening of the project road section will provide better level of services in terms of improved riding quality and smooth traffic flow. · All the villagers were in favour of the widening of the road. · The villagers raised their concern about the increased risk of accidents specially of children during construction. It was thus suggested that proper safety measures will be taken. Like diversion of traffic during construction and safety designs should be incorporated in road design wherever it is necessary. · Community has also raised the importance of both-side footpath and adequate street lighting along the roads passing through residential and commercial areas. · Development assistance in public utilities along the road sections like public toilets, safe playground, parking areas and market sheds was also requested during consultation. · Noise disturbance at night time due to construction and air pollution in the form of dust are the health concerns raised by the community. Asthma patients would be seriously affected due to this. It was thus assured that construction work will be done only during daytime in the habitation areas. · To reduce pollution the consultant suggested the remedial measures like dust suppression and screens will be used to confine the pollution within the work zone. Water will be sprinkled twice a day for dust suppression. · Similar to there was a demand for drains along the roads to be constructed. The consultant shared that provision has been given for road side drains and these are integral part of Road design in habitation areas along the road section.
Village: Laitlyngkot	21 October 2019	24 Participants from village community including village head, housewife, business owners, labours, farmers and students	
Nartiang Presbyterian Higher Secondary School, Jaintia Hills	22 October 2019	28 Participants from village community including village head, housewife, business owners, labours, farmers and students	
PWD Inspection Bungalow, Shangpung, Jaintia Hills	22 October 2019	16 Participants from village community including village head, housewife, business owners, labours, farmers and students	

Photo-Public consultation

7.2 Conclusion of Stakeholder Consultations

288. All the stakeholder's suggestions and comments were conveyed to the design team for consideration and incorporation in the project design. It can be concluded that all the concerns of stakeholders have been taken into account in the project planning and design issues.

8. ENVIRONMENT MANAGEMENT PLAN

8.1 Introduction

289. This Environmental Management Plan has been drawn based on the understanding of the interactions between the environmental setting and the project components and the assessment of the likely impacts. Mitigation measures described earlier in the report has been further elaborated as specific actions which would have to be implemented during the project implementation. The EMP would help the MPWD implement the project in an environmentally sustainable manner and where all contractors, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage such risk.

8.2 Environment Management Plans

290. Considering the nature of the works and environmental setup along the project road section in the state of Meghalaya, anEMP (Appendix-6) have been developed. Prior to start of construction work Environmental Expert of PMC in coordination with Contractor will update the EMP to make it road specific construction EMP.

291. The Environment Management Plan would be included as part of the Bidding document and shall at a later date used by the Contractor for developing the Contractor's EMP. The contractor's environment management plan should be in accordance with the EIA presented in the Environment Assessment Report.

8.3 Environmental Monitoring Program

292. The Environmental Monitoring Program is aimed at essentially monitoring the day to day activitiesin order to ensure that the environmental quality is not adversely affected during theimplementation. The monitoring programme consists of Performance Indicators and ProcessIndicators.

8.3.1 Monitoring Indicators

293. Monitoring indicators have been identified to objectively identify and assess a particularenvironmental component which is expected to be affected due toparticular activities at a particular time of the project lifecycle. These indicators would be a mix of both objective as well as subjective. The performanceindicators shall be evaluated under three heads as;

- Environmental condition indicators to determine efficacy of environmental management with respect to air, noise, water and soil pollution.
- Environmental management indicators to determine compliance with the suggested environmental management measures
- Operational performance indicators have also been devised to determine efficacy and utility of the proposed mitigation measures

294. The performance indicators include the components which have to be identified and reportedduring the different stages of the implementation. These wouldhelp identify the level ofenvironmental performance of the project. In addition, there would be Process Indicators whichwould help in assessing theeffectiveness of the system which has been instituted.

295. The process and performance indicators for different stages are presented in Table-31.

Table 31: Details of process and performance indicators

S.No.	Indicator	Description	Type of Indicator
Pre-construction			
1	Sourcing of Water	Has the Contractor applied for permit for groundwater abstraction or local community permission for use of stream water	Performance Indicator
2	Rainwater Harvesting	Has the Contractor initiated the process of rainwater harvesting in storm channels and at camp site	Performance Indicator
3	Siting of Contractors Camp	Have the EA/IA intimated the Contractor the guidelines for siting of the Camp	Process indicator
4	Facilities in Contractors Camp	Has the IA/EA verified the design /Plan of the Contractor's Camp for adequacy of the Facility	Process indicator
5	Adequacy of cross drainage structures	The adequacy of cross drainage structure should be checked not only from the hydraulic perspective but also whether the location and number of culverts for efficiency in removing waterfrom the different micro-catchment along the alignment so that the embankment does not impede on the movement of water or there is no back flow.	Performance Indicator
6	Impact Water HarvestingStructure	The alignment should not encroach upon any water harvesting structure or its catchment. The runofffrom the pavement should also not drain into the catchment of such areas	Performance Indicator
7	Number of Trees which could be saved	Possibility of preventing felling of trees especially mature trees by modification of design. TheFeasibility of transplantation of trees should also be worked out	Performance Indicator
8	Schools, Hospitals and community sensitive receptors	The design should include mitigation measures for noise and safety of children in front of the school. The design should traffic calming measures and also measure for ensuring noise attenuation	Performance Indicator
9	Review of Design for landslide locations	Has the design been reviewed and observations sent for improvement of works for such locations	Process indicator
Construction Phase			
10	Dust Suppression	Dust suppression activities carried out by the Contractor using the dust suppressant	Process indicator
		Air Quality Monitoring carried out by the Contractor	Process indicator
		Effectiveness of the dust suppression carried out by the Contractor	Performance Indicator
11	Nuisance due to Noise	Complaints received from local people	Performance Indicator
		Noise monitoring carried out by the Contractor	Process indicator
12	Usage of Water for Construction	Quantity and source of extraction of water	Performance Indicator
13	Safety of the workers	No. of cases where the non- conformance has been reported to the Health and Safety Plan	Process indicator
		No of cases of injuries or fatalities reported	Performance

S.No.	Indicator	Description	Type of Indicator
			Indicator
14	Community Health safety	Non-conformance on Community health safety pointes in the audit	Process indicator
15	Prevention of pollution	No of cases of non-conformance pointed out from discharges from labour camps and equipment(concrete wash water)and emission from machinery	Performance Indicator

9. IMPLEMENTATION ARRANGEMENT

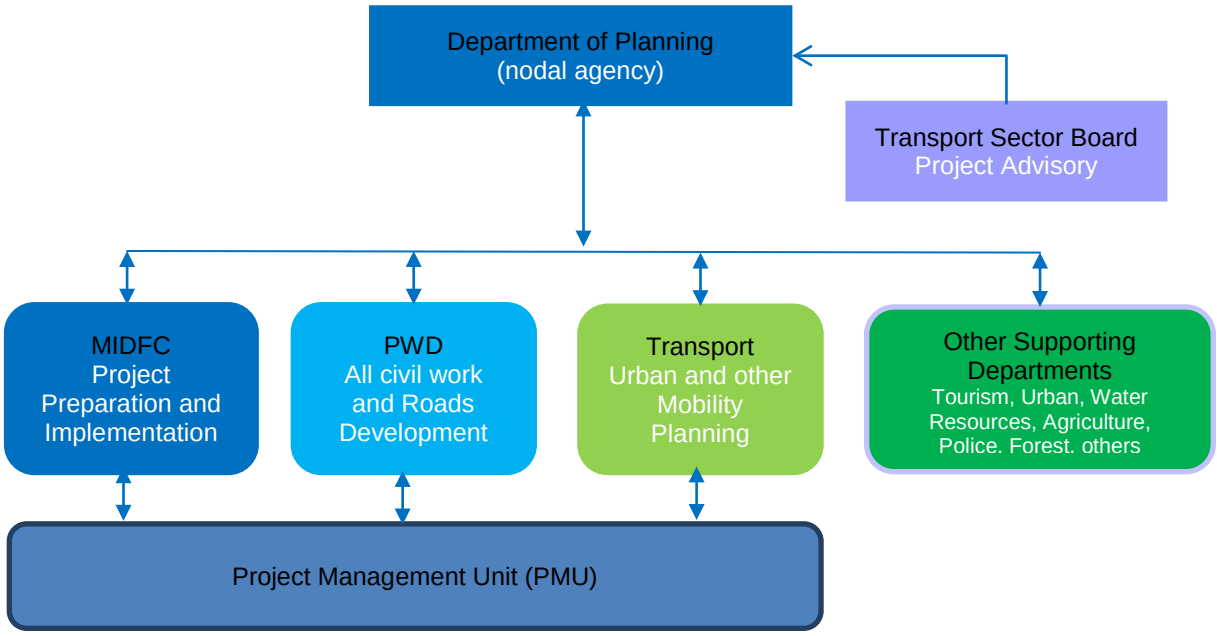
9.1 Project Implementation Arrangement

296. Theproject activities will be implemented by agencies: Public Works Department (PWD), Urban Affairs (UA) Department, Department of Tourism, Transport Department and Community and Rural Development Department. Each of the mentioned departments, will depute a Project Director (PD) preferably at the level of a Chief Engineer/Superintending Engineer along with the required supporting staff with the overall responsibility for project implementation with the involvement of the various field divisions and other units at the head-quarters (HQ – Shillong).

297. PDs will work under the overall guidance and oversight of a Project Advisory Committee headed by the Secretary of the respective departments. In addition, nodal officers will be deputed from the beneficiary departments like Tourism, Agriculture, Police, Health, Education and C&RD. All civil works component will be implemented mainly by PWD, and involvement UA and Transport departments will be mainly for the technical assistance and pilot projects on improving mobility. When functional, the Transport Sector Board will also be constituted to provide high level policy guidance and oversight for project implementation.

298. Meghalaya Infrastructure Finance Development Corporation (MIFDC) set up under the Planning Department will be responsible for overall planning, coordination, implementation and monitoring of the project along with various departments. It will also be responsible for mobilizing private sector finance for the development works. The State Planning Department will be the nodal department for the Project. MIDFC will be responsible for overall planning and implementation of the entire project. It will ensure that ESIA is conducted and ESMPs are prepared and that the ESMF is followed during project implementation. Additionally, a project management unit (PMU) will be mobilized under MIDFC to support the implementing agencies during project preparation and subsequent implementation. The overall institutional arrangement for the implementation of the project is outlined in the following Figure-16.

Figure 16: Institutional Set-up for project implementation



9.2 Project Management Unit (PMU)

299. The Project Management Unit (PMU) will engage a consulting firm, as Project Management Consultant (PMC) for providing technical support to the project and facilitate implementation of project framed activities. The experts of the PMC will assist MIDFC in preparing and updating ESIA (including E&SMPs). The PMC will also assist MIDFC in preparing semi-annual safeguards monitoring reports. Specific roles of the PMC with regard to ESMF implementation would include the followings.

Ø **Preparatory Stage:**

(i) Initial field visit to project sites and assessment of environmental and social aspects of project activities;
(ii) Discussion with different stakeholders, including implementing agencies on safeguard measures and their expected role;
(iii) Preparing / finalizing assessment framework in line with the Environment and Social indicators;
(iv) Finalizing TOR of the contractors incorporating safeguard measures to be taken;
(v) Facilitate / organize training / workshops on safeguard measures for the stakeholders;
(vi) Designing study / assessment tools for periodic assessment, its piloting and finalization.

Ø **Implementation Stage:**

(i) Conducting periodic site visits and observe the measures taken as per the safeguard norms;
(ii) On the spot guidance to contractor/s / implementing agencies on safeguards;
(iii) Preparation of site-specific reports and sharing with MIDFC;
(iv) Documentation of learning cases for sharing and dissemination;
(v) Visual documentation of site-specific safeguard measures;
(vi) Tracking activity specific environmental and social monitoring indicators;
(vii) Organizing / facilitating refresher training courses for stakeholders;
(viii) Monthly and quarterly progress report preparation and submission to MIDFC.

Ø **Post-Implementation Stage:**

(i) Consolidation of periodic monitoring reports;
(ii) Support in conducting environment and social audit;
(iii) Consolidation of good practice documents and its submission to MIDFC;
(iv) Final sharing workshop on environment and social safeguard practices and its outcome.

300. The PMU shall have one environmental expert and one social and gender expert for implementation of ESMF and E&SMPs.

301. **Environmental Expert:**The environment expert will look after environmental aspects. She / he will guide the project team on environmental aspects and support in building environmental parameters to be built in the bids. She / he will also guide the contracts and monitor their works from time to time. In case of requirement, she/he will prepare a detail environment management plan for different activities to be executed by the project. The expert will be guided by the MIDFC Project Director and reporting to the Project Director directly.

302. The project is headed by the Chief Engineer of the PMU who will be responsible for the successful implementation of the Project. The Chief Engineer is also responsible for the Environment Health Safety performance of the project. The Chief Engineer would be assisted by an Environmental Expert form the Project management Unit. The team at the PMU would be assisted by the Project Management Consultant (PMC). The PMC also would have an Environmental Engineer who would assist the Environmental Officer at the PMU in ensuring environmental safeguards are implemented.

303. The actual responsibility of implementation of the EMP would be with the Contractor. An Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards.

9.2.1 Roles and Responsibilities

304. The roles and responsibilities of the different officers and professionals involved in the implementation of the environmental safeguards are presented in Table-32.

Table 32: Roles and Responsibilities for implementation of Environmental Safeguards

S.No.	Position	Responsibilities
1	Chief Engineer (PMU)	• Overview of the project's compliance to Bank's and national laws and regulations • Oversight of the EHS requirements to be integrated in the Project formulation, implementation and formulation e.g. design, bid documents and contract • Ensure that sufficient funds are available for implementation of all agreed Environmental safeguards measures. • Review of environment monitoring and audit findings, grievance associated with environment during each of the project review • Submit annual safeguards monitoring reports to the Bank and closure of the observations made by the Bank. • Review of the annual environmental audit and approve of the mitigation of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • In case of significant new or unforeseen impacts, immediately inform Bank to make a decision on the same besides updating relevant project reports.
2	Environmental Officer (PMU)	• Ensure that project meets the statutory requirement and Bank's requirement; • Recommend for approval to PMU all document and ensure that design and documents includeall relevant EHS Safeguards • Recommend for approval to PMU theContractor's Environmental Management Planafter approval of the Environmental Engineer ofthe PMC; • Review the environmental performance of theproject through Monthly Reports and Monthly • Environmental Audits reports submitted by theProject Management Consultants and report tothe Management; • Carry out quarterly environmental audits andreport back to the management • Review Corrective Action Plan for closure of theEnvironmental Audit Findings • Overall coordination and management throughPIU supported by PMC and Authority Engineerfor implementation of Environment Safeguards. • Review and action on all grievance related toenvironment through the Grievance RedressMechanism. • Prepare the Annual Safeguards Monitoring &closure Reports to the Management for reviewand onwards submission to the Bank and itsclosure; • Review of all the finding in the monitoring andauditing report and ensuring corrective actionare implemented so that it does not

S.No.	Position	Responsibilities
		reoccur; • Updating of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • Organise training for Capacity building of thePMU and the PIU for effective implementation ofsafeguard requirements
3	Environmental Engineer (PMC)	• Ensure that Contractor is in compliance with allthe statutory requirement and the Safeguardrequirement mentioned in the EMP. • Review and approve the Contractor's EMPImplementation Plan; • Ensure that the weekly environmental reportsare compiled by Contractor, reviewed andsubmitted to PMC; • Carry out any specialized designs which would berequired for the environmental safeguards; • Facilitating the Contractor to obtain necessary permissions/ approvals and its submission toPMC • Directly interact with aggrieved persons andrecord their views and grievances in theGrievance Management System. • Work with the contractor to ensure grievances ifany at field level is resolved • Review and approve the package specific EMP'sand make necessary modifications if required. • Ensure that all mitigation measures as given inthe EMP are implemented properly by theContractor during the study. • Conduct weekly environmental monitoring of allproject during pre-construction, constructionand operation phases. • Ensure monthly, quarterly and annualenvironmental monitoring reports are preparedand submitted to PMC. • Work with the Contractor and PMC forpreparation of the environmental correctiveactions on audit observations
4	Environmental Engineer (Contractor)	• Responsible for integration of the mitigationmeasures proposed in the EnvironmentalManagement Plans (EMP) associated with theconstruction activities into the constructionprocesses. • Responsible for daily monitoring of theenvironmental compliance and submission of theinformation to the Authority Engineer. • Preparation of Contract Specific managementand submission of the same to the AuthorityEngineer for approval. • Ensure that adequate budget provisions aremade for implementing all mitigation measuresspecified in the Contract specific EMP. • Participate in induction training on EMPprovisions and requirements delivered by thePMU and carry out the same for all contractstaff. • Carry out liasoning with the regulatory agenciesfor necessary environmental license(s), permitsetc. • Assist the PIU with support required forobtaining necessary environmental permits • Participate in resolving issues as a member of theGrievance Redressal Cell. • Respond promptly to grievances raised by thelocal community or and implement correctiveactions.
5	Health and Safety Office (Contractor)	• Responsible for ensuring integration of thehealth and safety aspects in the work processesassociated with the construction activities.

S.No.	Position	Responsibilities
		• Responsible for day -to day monitoring of theoccupational health and safety performance and submission of the information to the AuthorityEngineer. • Preparation of a Safety Plan and submission ofthe same to the Authority Engineer for approval. • Participate in induction training on EMPprovisions and requirements delivered by thePMU and carry out the same for all contractstaff. • Carry out Construction safety Audits and reportit to the Team Leader of the Contractor. • Assist the PMC with the health safety performanceof the project • Respond promptly to grievances raised by thelocal community for the safety and implementcorrective actions.

9.2.2 Training and Capacity Building

305. Training and capacity building would be required especially for the PMU staff associated with the project as the Environmental Safeguards would bea relatively new area which the staff are required to handle. The training and capacity building would not only be project specific but would also target and develop long term capacities in the PWD Division. The training program would include:

- Sensitisation Training: primarily aimed at introducing the EHS safeguards to the officers and also make them aware of the responsibilities.
- Orientation Training: Introducing the Environmental safeguards to the PMU staff and making them aware of the key principles of environmental safeguards
- Detailed Training: aimed at the PMU staff to make them aware of the detailed activities which needs to be implemented and enforced during the EMP Implementations
- Refresher Training: this would be a need-based training organized to rectify the shortcomings identified during the Monitoring.

9.3 Monitoring Plan

306. Reporting system for the suggested monitoring plan, operating at two levels are as follows:

- Reporting for environmental management (EM) indicators to assess the progress of the EMP Implementations
- Review of the Environmental management implementation to assess the effectiveness of the implementation

307. The monitoring responsibilities and their reporting authority over the period of one year is presented in Table-33. This cycle would be replicated over the tenure of the project.

Table 33: Reporting requirement details of the project

Reports	Responsibility	Reporting authority
Daily	Contractor-Summery of all environmental issues and activities	Authority Engineer-review of reports and corrective action
Monthly	PMC- Monitoring of all projects and compilation and review of all corrective actions	PMU- review the action taken repeat and develop new strategies
Quarterly	PMU- review of project progress and auditing of the process of implementation	Management- review of progress and process of implementation, Approve of the Corrective ActionPlan

Annual External Audit	External Agency- review of progress EMP of implementation	Management/World Bank- Review of findings and approve of the corrective Action Plan; Report to the World Bank

9.3.1 Monitoring

308. Periodic Monitoring of the EMP is required for assessing the progress of the implementation of the EMP. The monitoring would include regular activities related to the activities proposed in the EMP.The following Monitoring reports would be submitted as per the protocol described earlier:

- Daily Monitoring Report: by the Contractor to the PMC on the environmental actions which has been implemented on site on a daily basis. The complains received from the community, observations at site for EHS issues, daily site audit, unsafe acts etc. would alsorecord;
- Monthly Monitoring: by the PMC for reporting to the PMU, would include a monitoring of all the packages and report the observations. The Completed Action would also be assessed for its effectiveness and sustainability.
- QuarterlyMonitoring: by the PMU for reporting to the World Bank, would include a monitoring of all observations and Completed Action would also be assessed for its effectiveness and sustainability.

9.3.2 Periodic Evaluation

309. An external evaluation of the safeguard implementation prepared for sub projects will also be undertaken twice during the implementation of the project – midterm and at the end of the implementation. During implementation, meetings will be organized by PMU inviting all PIUs for providing information on the progress of the project work.

- **Mid-term Assessment Study** – this would be undertaken mid-way through the project to ascertain the progress achieved and any mid-course corrections which need to be introduced. It would include indicators to measure progress towards log frame goals and objectives.
- **End-Term Assessment Study** – this will be undertaken at the end of the project period (around the time of project completion) and will assess the achievement of the project during the tenure.

310. All monitoring and evaluation records would be transmitted and maintained electronically. No hardcopies of the documents would be used for circulation. Each of the documents would be uniquelynumbered by the Package, Project Corridor Nomenclature of the Report and Date. The records ofthe project would be stored in a Central repository at the PMU.

9.3.3 Review and Corrective Action

311. An annual review shall be conducted by Project Advisory Committee at the time of the ProjectReviewmeeting and after the completion of the Quarterly and Annual audit. The Project Directors and theAssistant Engineer of the respective projects shall deliberate on the findings andrecommendationof Environment Audit and agree on a Corrective Action Plan including budgetary support ifrequired. The Corrective Action Plan shall be implemented in a time bound manner and reportedback to the PMU. The PMU would prepare a closure report which would form a part of the AnnualReport submitted to the Bank.

9.4 Environment Management Budget

312. The budget for implementing the Environmental management Plan for the road section is presented in Table-34. Thisbudget would not be part of the Contract and would be used by the

PMU to implement theEnvironmental Safeguards. The budget should not form a part of the Bid Document.

Table 34: EMP budget estimation for the project road section

S.No.	Measure	Description	Unit	Quantity	Rate	Amount (Rs.)
1	Dust Suppression	Water Sprinkling a day in all construction sites and dust suppressant in Habitation area	Month	36	100000	3600000
2	Development of water source structures	Concrete drain	Lumpsum	3	300000	900000
		Water Tank	Lumpsum	4	90000	360000
3	Flora	Compensatory plantation against tree cut	nos.	850	1250	2037500
		Additional tree plantation	Nos.	1000	1250	1250000
4	Soil Erosion protection	Vegetated bamboo crib wall during construction	rm	2000	1000	2000000
		Turfing with sods on slope protection	sq.m.	23505	119	2797095
		Bio-engineering measures	sq.m.	15000	150	2250000
5	Training and capacity building		Lumpsum		450000	450000
6	Protectionarea/cutting area management measures	Disposal of material from location upto 1000m distance	cum	12432	118	1466976
		Disposal of material from location more than 1km to 6km distance	cum	12432	158	1964256
		Cement Treated Crushed Rock	cum	1000	4021	4021000
7	Monitoring Expenses	Monitoring expenditure for PMU Monitoring Expenses for PMU (travel Expenses +Incidental Expenses)	36	Months for the pkg	100000	3600000
		Digital camera and potable sound meter	set	1	75000	75000
8	Ambient environment parameter monitoring	Air, Water and Noise Quality Monitoring (once every quarter depending on need)	3	Lumpsum	698000	2094000
9	Road Safety Measures	Covered under Civil Works BOQ				
10	External Auditing	Annual External Auditing (involving auditing both at the PMU and the site)	3	Lumpsum	250000	750000
					Total (Rs.)	**29615827**

10. SUMMARY AND CONCLUSION

313. The project road section would be developed with financial assistance of The World Bank. Total length of the road section11.763km is presently intermediate lane road and would be upgraded to two laning with granular shoulders.

314. The major district road section alignment pass through East Khasi Hills district of Meghalaya State. Development of this connectivity would not only provide connection between important habitation of the district but also help economic development of the rural economic and market accessibility to the farmers. It would also provide connectivity to several settlements along the road sections taken for improvement. Commuting to either State Capital and district headquarters for work or other purposes would be easier and faster.

315. The EIA was focused on interactions between the Project activities and various resources/receptors that could result in significant impacts. To understand the baseline environmental condition of thesources and receptors along the project corridor primary baselines environmental monitoring and studies were carried out. In addition, desktop studies were carried out for the project influenceareas of 10 km on either side of the corridor through review of secondary literature. The paragraphbelow gives a description of the significant impact which were identified during the EIA studies andthe mitigations which have been adopted in the project.

316. The area East Khasi Hills district, experience high rainfall in monsoon season asthe characteristic of the Sate. Along the road section in the region there are many steep hillsides locations. People along the alignment may face road blockages due to landslide in rainy season due to narrow carriageway width. Steep hillside locations along the road section identified and engineering measures provided to provide all season connectivity to the areas in the project road section. Longitudinal drains have been provided along the carriageway in thedesign in selected habitation locations.

317. It is estimated for the road section that approximately an average of 90-110 KLD of water would be required during thepeak construction period for construction purposeand 15KLD for domestic purpose. Due to non-availability of ground water source in the hilly terrain, the people are dependent on surface for drinking and domestic purpose.The sourcing ofwater for construction from surface ground water would also put stress on the water resource.Thus, for sourcing construction water, the Contractor has to either undertake permission from local community or construct concrete drain and tanks with community consent for use of water for construction and drinking purpose.

318. The drainage and the contour maps indicate that the alignment passes through the hillythe topography so the contractor can identify channel along the corridor and create Tanks atappropriate location would to store water for construction purpose. During the detailed designthe Contractor shall identify these locations. The entire exercise would be conducted in consultation with the local community. The PMU can enter into an agreement with the panchayat for development of Tank and using the water stored in it for construction purpose. These Tanks would be handed over to the community for use and maintenance after the completionof construction.

319. it is estimated 85 number trees need to be felled for these project road sections. All cut trees will be compensated at the rate of 1:10 with preference to fast growing local species that are more efficient in absorbing emissions.

320. The road section of Shillong – Diengpasoh is running along the boundary of Itshriyat reserve forest on RHS, approx. 3km length. Right of way is available for improvement on LHS.

321. In addition to the above specific measures to mitigate construction related impact theEnvironmental Management Plan has suggested measures and also developed a managementsystem to ensure that they are effectively implemented.However, in spite of MPWD division to implement the EMP in the road alignment and develop the project in a sustainable manner some issues would remain especially during theconstruction period. However, these environmental issues would be short term i.e. during theconstruction period and would not cause any permanent change in the receiving environment. Thebenefits accruing to the local people would far outweigh the inconvenience faced during theconstruction.

APPENDICES

Appendix-1: Baseline parameter monitoring results

ISO 9001 : 2015

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

Analysis Report

AMBIENT AIR QUALITY ANALYSIS REPORT

Test Report No. : ITL/ED/01
Dispatch Date : 09.12.2019

1.	Laboratory Sample No.	ITL/12-19/PR/01/01
2.	Issued to	**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**
3.	Contact person from Industry	**Mr. R.B. Singh**
4.	Name of the Sample Collecting Officer	By Lab. Representative
5.	Type of Sample	Ambient Air Quality Monitoring
6.	Location of Sample Collection	**Mawdiang Village, (Near Ru-An-Ba Enterprises)**
7.	Sampling Method	IS 5182 (Part -14)
8.	Date of Sample Collection	02/12/2019 to 03/12/2019
9.	Duration of Sample Collection	24 hrs. Except CO (8 hr)
10	Date of Sample Receipt	05/12/2019
11.	Sampling Site	**Shillong –Diengpasoh Road**
Date of analysis Commencement	04/12/2019	Date of analysis completion	09/12/2019

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I
1	Particulate Matter, $PM_{2.5}$	* CPCB method	µg/m³	22	60
2	Particulate Matter, PM_{10}	IS 5182 Part 23:2006	µg/m³	51	100
3	Sulphur dioxide (SO2)	IS 5182 Part 2:2001	µg/m³	3.6	80
4	Nitrogen dioxide (NO2)	IS 5182 Part 6:2006	µg/m³	8.4	80
5	Carbon monoxide (CO)	* CPCB method	mg /m³	BDL	4

* NAAQS Monitoring & Analysis Guidelines Volume-1, 2011 CPCB

----------End of the report---------

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

ISO 9001 : 2015

Analysis Report

AMBIENT AIR QUALITY ANALYSIS REPORT
Test Report No. : ITL/ED/02
Dispatch Date : 09.12.2019

1.	Laboratory Sample No.	ITL/12-19/PR/01/02	
2.	Issued to	**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**	
3.	Contact person from Industry	**Mr. R.B. Singh**	
4.	Name of the Sample Collecting Officer	By Lab. Representative	
5.	Type of Sample	Ambient Air Quality Monitoring	
6.	Location of Sample Collection	**Mawpdang Village, On the roof of Minot Secondary School**	
7.	Sampling Method	IS 5182 (Part -14)	
8.	Date of Sample Collection	02/12/2019 to 03/12/2019	
9.	Duration of Sample Collection	24 hrs. Except CO (8 hr)	
10.	Date of Sample Receipt	05/12/2019	
11.	Sampling Site	**Shillong –Diengpasoh Road**	
Date of analysis Commencement	04/12/2019	Date of analysis completion	09/12/2019

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I
1	Particulate Matter, $PM_{2.5}$	* CPCB method	$\mu g/m^3$	19	60
2	Particulate Matter, PM_{10}	IS 5182 Part 23:2006	$\mu g/m^3$	49	100
3	Sulphur dioxide (SO2)	IS 5182 Part 2:2001	$\mu g/m^3$	2.9	80
4	Nitrogen dioxide (NO2)	IS 5182 Part 6:2006	$\mu g/m^3$	6.4	80
5	Carbon monoxide (CO)	* CPCB method	mg/m^3	BDL	4

* NAAQS Monitoring & Analysis Guidelines Volume-1, 2011 CPCB

----------End of the report---------

ANALYST

AUTHORIZED SIGNATORY
Head-ITL Laboratory

NOTE: 1. The results are related to the tested items only 2. Total liability of our laboratory is limited to the invoiced amount. 3. Sample will be destroyed after one month from the date of issue of test certificate unless otherwise specified. 4. Report is not to be produced wholly or in part as an evidence in the court of law and should not be used in any advertising media without the permission in writing from laboratory. 5. In case of any reconfirmation of the contents of the test report is required, please contact the authorized signatory of the test report within 15 days of the issue of the test report. 7. Report is valid for **self –monitoring purposes and not for consent** of the industry

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(A Govt. Approved Laboratory)

ISO 9001 : 2015

Analysis Report

NOISE QUALITY ANALYSIS REPORT
Test Report No. : ITL/ED/03
Dispatch Date : 09.12.2019

1.	Laboratory Sample No.	ITL/12-19/PR/01/03
2.	Issued to	**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**
3.	Contact person from company	**Mr. R.B. Singh**
4.	Name of the Sample Collecting Officer	By Lab. Representative
5.	Type of Sample	Noise Quality Monitoring
6.	Location of Sample Collection	**Mawdiang Village, (Near Ru-An-Ba Enterprises)**
7.	Sampling Method	ITL/SOP/NQ/01
8.	Date of Sample Collection	02/12/2019 to 03/12/2019
9.	Duration of Sample Collection	24 hrs
10.	Date of Sample Receipt	-
11.	Sampling Site	**Shillong –Diengpasoh Road**
Date of analysis Commencement	-	Date of analysis completion -

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Regulatory Standards (EPA, 1986)
1	Leq dB(A) day (6AM to 10PM)	IS 9989 -1981 RA- 2001	dBA	50.5	55
2	Leq dB(A) night (10PM to 6AM)	IS 9989 -1981 RA- 2001	dBA	38.2	45

End of the report

ANALYST

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Head - ITL C H Laboratory

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Analysis Report

NOISE QUALITY ANALYSIS REPORT

Test Report No. : ITL/ED/04
Dispatch Date : 09.12.2019

1.	Laboratory Sample No.	ITL/12-19/PR/01/04
2.	Issued to	**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**
3.	Contact person from Industry	**Mr. R.B. Singh**
4.	Name of the Sample Collecting Officer	By Lab. Representative
5.	Type of Sample	Noise Quality Monitoring
6.	Location of Sample Collection	**Mawpdang Village,On the roof of Minot Secondary School**
7.	Sampling Method	ITL/SOP/NQ/01
8.	Date of Sample Collection	02/12/2019 to 03/12/2019
9.	Duration of Sample Collection	24 hrs
10.	Date of Sample Receipt	-
11.	Sampling Site	**Shillong –Diengpasoh Road**
Date of analysis Commencement	-	Date of analysis completion -

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Regulatory Standards (EPA, 1986)
1	Leq dB(A) day (6AM to 10PM)	IS 9989 -1981 RA- 2001	dBA	48.1	50
2	Leq dB(A) night (10PM to 6AM)	IS 9989 -1981 RA- 2001	dBA	37.4	40

----------End of the report----------

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Head- ITL/CH Laboratory

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ISO 9001 : 2015

Analysis Report

WATER QUALITY ANALYSIS REPORT
Test Report No : ITL/ED/05 Dispatch Date : 09.12.2019

1.	Laboratory Sample No.	ITL/12-19/PR/01/05-06	
2	Issued to	M/S PROJECTS CONSULTING INDIA (P) LTD 611012, SECTOR-6, VASANTKUNJ, NEW DELHI 110070	
3	Contact person from Industry	Mr. R.B. Singh	
4	Name of the Sample Collecting Officer	By Lab. Representative	
5	Type of Sample	Water Sample	
6	Description of Sample	GW-1, Ground Water Sample SW1-1, Surface Water Sample	
7	Location of Sample Collection	GW-1 Water Supply, Mawkasingh Village SW-1 Umpyangkun Nallah	
8	Sampling Method	IS 3025 (Part -1)	
9	Date of Sample Collection	02/12/2019	
10.	Date of Sample Receipt	04/12/2019	
11	Sampling Site	Shillong –Dienggpasoh Road	
Date of analysis Commencement	04/12/2019	Date of analysis completion	09/12/2019

Test Results

Sl. No.	Parameter	Prescribed Limit as per IS:10500 & IS:2296	Result	
			Ground water	Surface water
			GW_1	SW_1
1	Colour, Hazen units	5 Max	<1	< 1
2	Odour		Agreeable	Agreeable
3	Turbidity, NTU	1 Max	<1	<1
4	Electrical Conductivity at 25°C	-	298	251
5	pH Value at 25°C	6.5 - 8.5	7.42	7.29
6	Total Dissolve Solids, mg/l	500 Max	192	163
7	Total Alkalinity (as $CaCO_3$) ,mg/l	200 Max	76	72
8	Total Hardness (as $HCaCO_3$) ,mg/l	200 Max	71	68
9	Calcium (as Ca),mg/l	75 Max	18.2	12.4
10	Magnesium (as Mg) , mg/l	30 Max	6.4	6.2
11	Sodium (as Na) ,mg/l	-	26	25
12	Potassium (as K) ,mg/l	-	14	11
13	Bicarbonate (as HCO_3),mg/l	200 Max	64	62
14	Sulphate (as SO_4) ,mg/l	200 Max	42	34
15	Chloride (as Cl),mg/l	250 Max	28	24
16	Nitrate (as NO_3) ,mg/l	45 Max	5.2	4.2
17	Fluoride (as F),mg/l	1 Max	0.04	0.05
18	Phenolic Compound (as C_6H_5OH) ,mg/l	0.001 Max	BDL	BDL
19	Cyanide, mg/l	0.05	BDL	BDL
20	Aluminum, mg/l	0.03	BDL	BDL
21	Arsenic, mg/l	0.05	BDL	BDL
22	Cadmium (as Cd) , mg/l	0.003 Max	BDL	BDL
23	Chromium as Cr,mg/l	0.05	BDL	BDL
24	Iron (as Fe),mg/l	0.3 Max	0.06	0.07
25	Copper (as Cu),mg/l	0.05 Max	BDL	BDL
26	Lead (as Pb) , mg/l	0.01 Max	BDL	BDL
27	Manganese (as Mn) , mg/l	0.1 Max	BDL	BDL
28	Zinc (as Zn) , mg/l	5 Max	BDL	BDL
29	Mercury as Hg,mg/l	0.001	BDL	BDL
30	Dissolve Oxygen, mg/l	-	-	6.8
31	Biochemical Oxygen Demand, mg/l	-	-	4
32	Chemical Oxygen Demand, mg/l	-	-	12
33	Oil &Grease, mg/l	-	-	BDL

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End of the report

AUTHORIZED SIGNATORY
Head- ITL/CH Laboratory

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ISO 9001 : 2015

Analysis Report

SOIL SAMPLE ANALYSIS REPORT
Test Report No. : ITL/EDI/06 Dispatch Date : 09.12.2019

1.	Laboratory Sample No.		ITL/12-19/PR/01/07-08		
2.	Issued to		M/S PROJECTS CONSULTING INDIA (P) LTD S110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070		
3.	Contact person from Industry		Mr. R.B. Singh		
4.	Name of the Sample Collecting Officer		By Lab. Representative		
5.	Type of Sample		Soil Sample		
6.	Description of Sample		SS-1, Soil Sample (ITL/12-19/PR/01/07) SS-2, Soil Sample (ITL/12-19/PR/01/08)		
7.	Location of Sample Collection		SS-1, Agriculture Field, Mawkasingh Village SS-2, Agriculture Field, Mawpdang Village		
8.	Sampling Method		ITL/SOP/ENV/SS/01		
9.	Date of Sample Collection		03/12/2019		
10.	Date of Sample Receipt		04/12/2019		
11.	Sampling Site		Shillong –Dienggpasoh Road		
Date of analysis Commencement		04/12/2019	Date of analysis completion		09/12/2019

Test Results

S. No.	Parameter(S)	Unit	Test Result	
			SS_1	SS_2
1	Soil Texture	-	Silty Clay Soil	Silty Clay Soil
2	Soil Colour	-	Reddish Brown	Reddish Brown
3	pH Value at 25°C	-	7.94	7.86
4	Conductivity at 25°C	µS/cm	694	542
5	Moisture	% by mass	6.4	6.4
6	Bulk Density	gm/cc	1.24	1.22
7	Water Holding Capacity	inches/foot	1.16	1.12
8	Nitrogen as N	mg/Kg	22.4	24.6
9	Phosphorus as PO_4	mg/Kg	3.05	3.12
10	Potassium (as K)	mg/Kg	70.2	68.4
11	Calcium as Ca	mg/Kg	58	62
12	Nitrate as NO_3	mg/Kg	104	98
13	Sulphate as SO_4	mg/Kg	15.2	14.2
14	Chloride	mg/Kg	6.2	5.2
15	Organic Carbon	% by mass	3.2	4.2
16	Organic Matter	% by mass	4.9	5.1
17	Total Soluble Solids	mg/Kg	12.6	13.5
18	Soil Texture			
a	Sand	% by mass	22.4	21.4
b	Silt	% by mass	36.2	32.8
c	Clay	% by mass	41.4	45.8

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AUTHORIZED SIGNATORY
Head- PCB Laboratory

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Ambient Air Quality Monitoring and Noise Quality Monitoring location

Mawdiang Village, [Ch; 5+800]
(Near Ru-An-Ba Enterprises)

Mawdiang Village, [Ch; 5+800]
(Near Ru-An-Ba Enterprises)

Mawpdang Village [Ch; 11+680]
(On the roof of Minot Secondary School)

Mawpdang Village [Ch; 11+680]
(On the roof of Minot Secondary School)

Shillong – Diengpasoh Road

Water and Soil Samples location

Mawkasingh Village [7+160]

Mawkasingh Village [7+160]

Mawpdang Village [8+680]

Mawpdang Village [8+680]

Appendix-2: Borrow area management guidelines

Borrow Area Management

Preconstruction Stage

The contractor shall identify the borrow area locations in consultation with the individual owners in case of private lands and the concerned department in case of government lands, after assessing suitability of material. The contractor shall submit an application to the District Level Environmental Assessment Committee for Environmental Clearance with the required details. The Environmental clearance shall be submitted to the Employer before the borrowing operations can begin.

Borrowing are to be avoided in the following areas:

- Lands close to toe line of the existing or proposed road.
- Irrigated agricultural lands shall be avoided. (In case of necessity for borrowing from agricultural land, the topsoil shall be preserved in stockpiles. The subsequent Guidelines detail the conservation of topsoil.
- Grazing land or any community property e.g. Orans, Gochars etc.
- Lands within 0.8km of settlements.
- Environmental sensitive areas such as Reserve Forests, Protected Forests, Sanctuary, wetlands. distance of 1000 m should be maintained from such areas.
- Eco-sensitive areas around Mount Abu and Eco-Sensitive Zones of the Wild Life Sanctuaries
- Unstable side-hills.
- Water-bodies.
- Streams and seepage areas.
- Areas supporting rare plant/ animal species;

The Employer/Authority Engineer will have the right to stop work at any borrow location even after the required environmental clearance is received if it violates any of the above.
The Contractor shall ensure soft rock is not prominent within the proposed depth of excavation as it will render rehabilitation difficult. The compliance to with MoRTH, clause 305.2.2.2 for redevelopment of Borrow area must be considered.

The rehabilitation measures for the borrow areas shall be dependent on the following factors:

- Land use objectives and agreed post-borrowing activities with the owner of the land as per the agreement;
  - Physical aspects (landform stability, erosion, re-establishment of drainage, geological profile);
  - Biological aspects (species richness, plant density,) for areas of native re vegetation;
  - Water quality and soil standards; and
  - Public safety issues.

The method statement which can be adopted for different options is presented below in as Options for Rehabilitation of Borrow areas to the Guidance Notes Operation of the Borrow Areas during the Construction Period.

The Contractor will work out statutory requirement for borrowing with the land from the Department of Mining and Geology, Govt. of Meghalaya. The Contractor must also obtain the necessary environmental clearance as per the EIA Notification 2006.

The Contractor shall also work out an agreement for the borrowing of soil with the concerned land owner. The arrangements will include:

- commitment not to use the topsoil;
- redevelopment after completion of borrowing;
- Commercial terms and conditions as may be agreed between the two parties;

The contractor shall submit to the Employer/Engineer the following before beginning work on the borrow areas.

- Environmental Clearance Certificate of the borrow area
- Written No-objection certificate of the owner;
- Estimate extent of earth requires;
- Extent of land required and duration of the agreement;
- Photograph of the site in original condition; and
- Site redevelopment plan after completion.

The arrangements (except for the commercial terms and conditions) will be verified by the Employer/Engineer to enable redressal of grievances at a later stage of the project. The Employer/Engineer shall approve the borrow area with or without inspection of the site to verify the reclamation plan and its suitability with the contractor and landowner. The contractor shall commence borrowing soil only after the approval by the Employer/Engineer.

The depth of excavation should be decided based on natural ground level of the land and its surroundings, as well as based on the rehabilitation plan. In case of highland larger depths may be allowed but the final level of the borrowed land shall in no case be lower than the adjoining plots so that it gets water logged. In case higher depth of excavation is agreed by backfilling using unsuitable excavated soil (from roadway), in those cases filling should be adequately compacted except for topsoil, which must be spread on the top most layer (for at least 20m thick).

In case the borrow pit is on agricultural land, the depth of borrow pits shall not exceed 45 cm and may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside. In case of stripping and stockpiling of topsoil, provisions of Topsoil Salvage, Storage and Replacement need to be followed.

The guidelines for location, depth, size and shape of the borrow areas are available in the following:

- Clause 305.2.2.2 of MoRTH specification for roads and bridge works of IRC;
- Guidelines for environmental impact assessment of highway projects, Indian Roads Congress, 1989: IRC: 104-1988);
- IRC: 10-1961-Recommended practice for borrow pits for road embankments constructed by manual operations, as revised in 1989;
- Highways Sector EIA manual of MoEFCC, 2010 (http://envfor.nic.in/sites/default/files/highways-10_may_0.pdf);

During the excavation the contractor must ensure that following database must be documented for each identified borrow areas that provide the basis of the redevelopment plan.

- Chainage along with offset distance;
- Area of the plot (Sq.);
- Geo-tagged Photograph of the borrow pit from all sides;
- Type of access/width/kutcha/pucca etc from the carriageway;
- Soil type;
- Slope/drainage characteristics;
- Water table of the area or identify from the nearest well, etc;
- Existing landuse, for example barren/agricultural/grazing land;
- Location/name/population of the nearest settlement from borrow area;
- Present usage of borrow area; and
- Community facility near borrow pit.

Appendix-3: GUIDELINES FOR STORAGE, HANDLING AND DISPOSAL OF HAZARDOUS WASTE, MUNICIPAL SOLID WASTE AND CONSTRUCTION AND DEMOLITION WASTE

Hazardous Waste

- For storing of hazardous waste (Used oil and waste oil, Empty barrels/containers of oil, lubricant and grease, Contaminated cotton rags or other cleaning materials), the Contractor shall follow the guidelines while planning and designing the hazardous waste storage areas:
  - The storage area should be provided with concrete floor;
  - The storage area floor should be provided with secondary containment;
  - Proper slopes as well as collection pit to be provided in the storage area to collect wash water and the leakages/spills etc.;
  - Storage area should be provided with the flameproof electrical fittings;
  - Automatic smoke, heat detection system should be provided in the sheds;
  - Adequate firefighting systems (ABC type fire extinguisher) should be provided for the storage area; and
  - The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

Municipal Solid Waste

- The Contractor shall segregate and store bio-degradable and non-biodegradable municipal solid waste in two separate bins (primary collection point). The storage area should be provided with concrete floor;
- The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.
- The storage area shall be enclosed, or the storage containers shall be covered to prevent vermis and scavengers from littering

Construction and Demolition Waste

- The Contractor shall keep the construction and demolition waste within the premise or at a designated place for the collection of the C&D waste. The designated place shall be decided in consultation with the local body. The agreement with the local body shall essentially mention the end-use of the designated location. The designated site shall be away from:
  - Located at least 1000 m away from sensitive locations;
  - do not contaminate any water sources, rivers etc; and
  - Lotal site has adequate capacity equal to the amount of debris generated;
  - Public perception about the location of debris disposal site has to be obtained before
  - finalizing the location;
  - Productive lands are avoided; and available waste lands shall be given preference;
  - Forest land shall be avoided.

- During the site clearance and disposal of debris, the contractor will take full care to ensure that the public or private properties are not damaged/affected and that the traffic is not interrupted.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Authority Engineer.
- The contractor will at all times ensure that the existing water bodies and drains within and adjacent to the site are kept safe and free from any debris.
- In case the dumping operations are carried out in dry and windy condition Contractor will regulate the dumping operations so that the dust generation is minimised, or preferably carry

out the operations in early morning when the environment is moist. The contractor may utilize effective water sprays during the delivery and handling of materials.

- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of Authority Engineer.
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the contractor will take into account the wind direction and location of settlements to ensure against any dust problems. The contractor can also consider the use of dust screens to prevent dust pollution.

EMERGENCY SPILL CONTROL PROCEDURE

Should a spill occur, either though spillage or equipment failure, the applicable emergency spill procedure outlined below must followed.

Spill Procedure: In the case of a spill, overflow or release fluid into the stream waterway (whether water is flowing during the spill or not), any actions that is practical and safely possible to control the situation, shall be implemented.

- Stop the flow
  - Stop the release into the stream waterway
  - Shutdown equipment
  - Close valves and pumps
  - Plug hoses
- Remove Ignition Sources
  - Shut off vehicles and other engines
- Do not allow torches, mobile phone, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible).
- Contact the environmental Officer and initiate Emergency Response
- Notify the site supervisor and the Contractor's Environmental Engineer and Health and Safety Officer as soon as possible
- The Environmental Engineer of the Contractor will review the situation and decide if Emergency Services like Fire Brigade are required
- Appropriate parties to be notified of the spill are The contractor's Project Manager, The
- Authority Engineer through his designated Environmental Officer, The PIU, Regulatory Agencies like Pollution Control Board, Municipal Authorities, as applicable,

Clean up and Disposal

- Identify nature and type of chemical/fuel spilled through information available onsite or from first responder.
- Refer to the MSDS for any special instruction
- Wear personal protective equipment (PPEs) viz. chemical resistant gloves, safety boots, safety glasses etc. Reach for the spill kit placed at the Contractor Camp.
- In case of spill on land create a dyke on the spill and use readily available sand, saw dust to contain the spill. Use absorbent pads, to clean up the spill. In case of spill in a water channel which is dry use the above method.

- In case the spill occurs within a waterbody stop any agitation to the waterbody and place absorbent material to remove the spill.
- Recover the spill contaminated absorbent materials and use pads and store the same in “Hazardous Waste” containers and store it in the waste storage area for disposal.
- For spill on unpaved areas such as soil, remove the upper layer of soil in the contaminated area with a shovel and transfer it to the hazardous waste containers using a bucket.
- If any of your PPEs have been exposed to spill material dispose it off safely in hazardous waste containers

Reporting

- The Contractor’s Environmental Officer will document the event and submit reports to the Authority Engineer. The Authority Engineer would send a report of the incident immediately with its observations to the PIU, PMC and Environmental Officer at the PMU.
- If required the Client would direct the Contractor to imitate the process of reporting to the regulatory agencies. like the Pollution Control Board.

Procedure Review

- The Environmental Office will review the report, determine if changes are required to procedures and recommend implementation of all required changes. He would also intimate the management of such incident.

GUIDANCE NOTE ON SITE CLEARANCE

Vegetation Clearance

- Vegetation clearance shall comprise uprooting of vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm. measured at a height of one meter above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately. The procedure/ steps involved for uprooting, skating and felling trees are described below.

Uprooting of Vegetation

- The roots of trees and saplings shall be removed to a depth of 60 cm. below ground level or 30 cm. below formation level or 15 cm below sub grade level, whichever is lower.
- All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled.
- Trees, shrubs, poles, fences, signs, monuments, pipe lines, cables etc. within or adjacent to the area, which are not required to be disturbed during vegetation clearance shall be properly protected by the contractor at his own cost.

Staking and Disposal

- All useful materials obtained from clearing and grubbing operation shall be staked in the manner as directed by the Consultant.
- Trunks and branches of trees shall be cleared of limbs and tops stacked properly at the places indicated by the Consultant. These materials shall be the property of the Government.
- All unserviceable materials are disposed off in such a manner that there is no livelihood of getting mixed up with the materials meant for construction.

Felling Trees

- Marking of tress: Trees, above 30 cm girth (measured at a height of one meter above ground level) to be cut, shall be approved by the Consultant and then marked at the site.
- Felling of trees: Felling of trees shall include taking out roots up to 60 cm. below ground level or 30 cm. below formation level or 15 cm. below sub-grade level, whichever is lower.
- Filling: All excavations below general ground level arising out of removal of trees, stumps etc. shall be filled with suitable material in 20 cm. layers and compacted thoroughly so that the surface at these points conform to the surrounding area.
- Sizing: The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Consultant.
- Staking: The serviceable materials shall be staked in the manner as directed by the Environmental specialist of Supervision Consultant.

Disposal: The material, which cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Consultant. Unsuitable waste materials should not get mixed with construction material during disposal

Appendix-4: Construction camp management

1. 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.

2. 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.

A. Scope

3. 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.

1. Siting, Establishing, Operation and Closure of Construction Camp

a. Potential Environmental Impacts

4. 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).

b. Mitigation Measures

2. Siting of Construction Camps

5. The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1 km from boundaries of designated Reserved Forests, Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain a distance of 500m from river, stream, lake and ponds
- Maintain a distance of 200 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 500 m 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.

3. 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 (specially 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 of Appendix 1 to Clause 501 of Specifications for Road and Bridge Works to cover the spillage of bitumen and/or chemicals like retarders, curing compounds, etc.
- 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 been made, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.
- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

4. Equipment and Vehicle-related issues

a. Potential Environmental Impacts

6. 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.

b. Mitigation Measures

i. 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.

ii. Workshop and Maintenance areas

- These areas must have impervious flooring to prevent seepage of any leaked oil & grease 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.

1.
2.
3.
4.

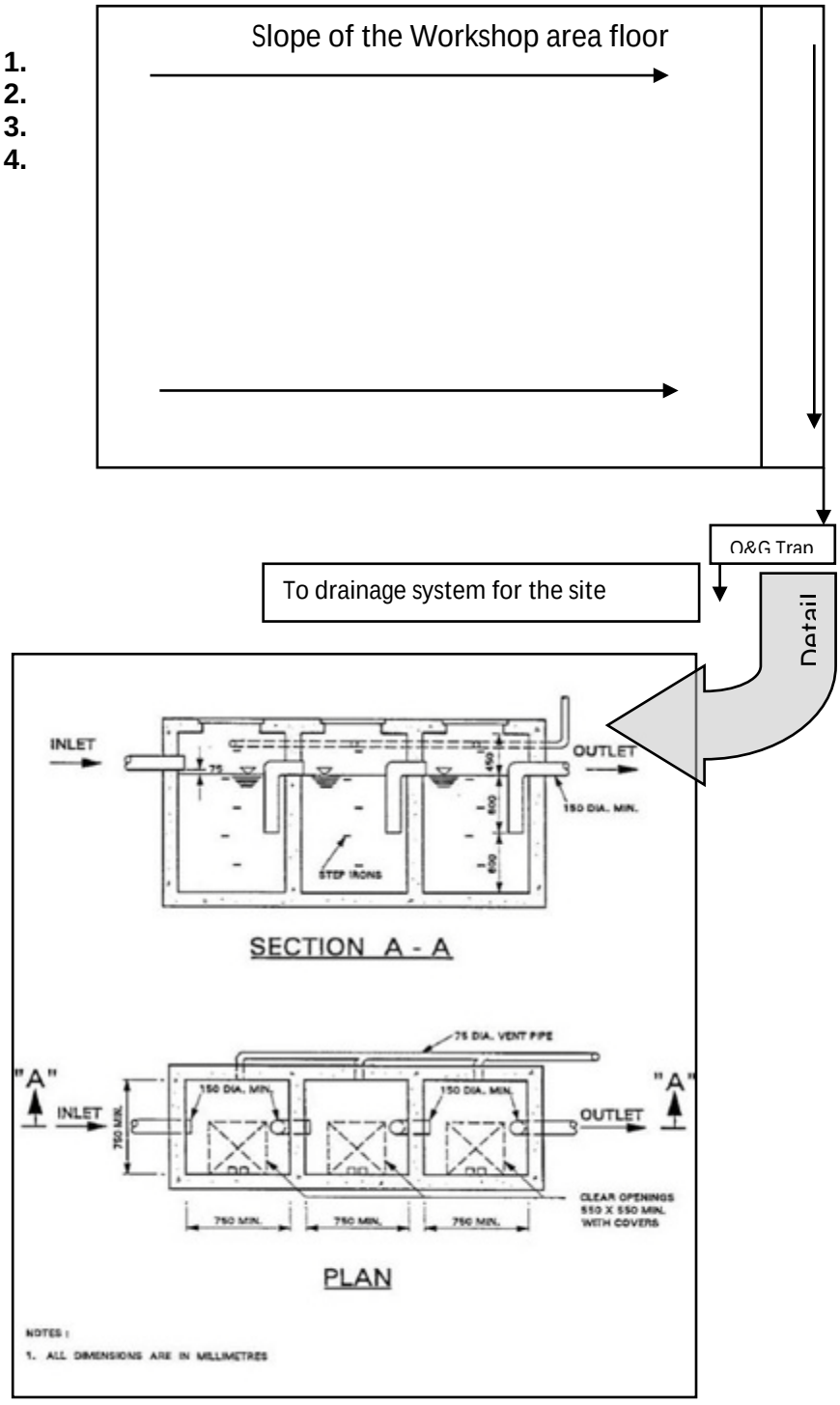


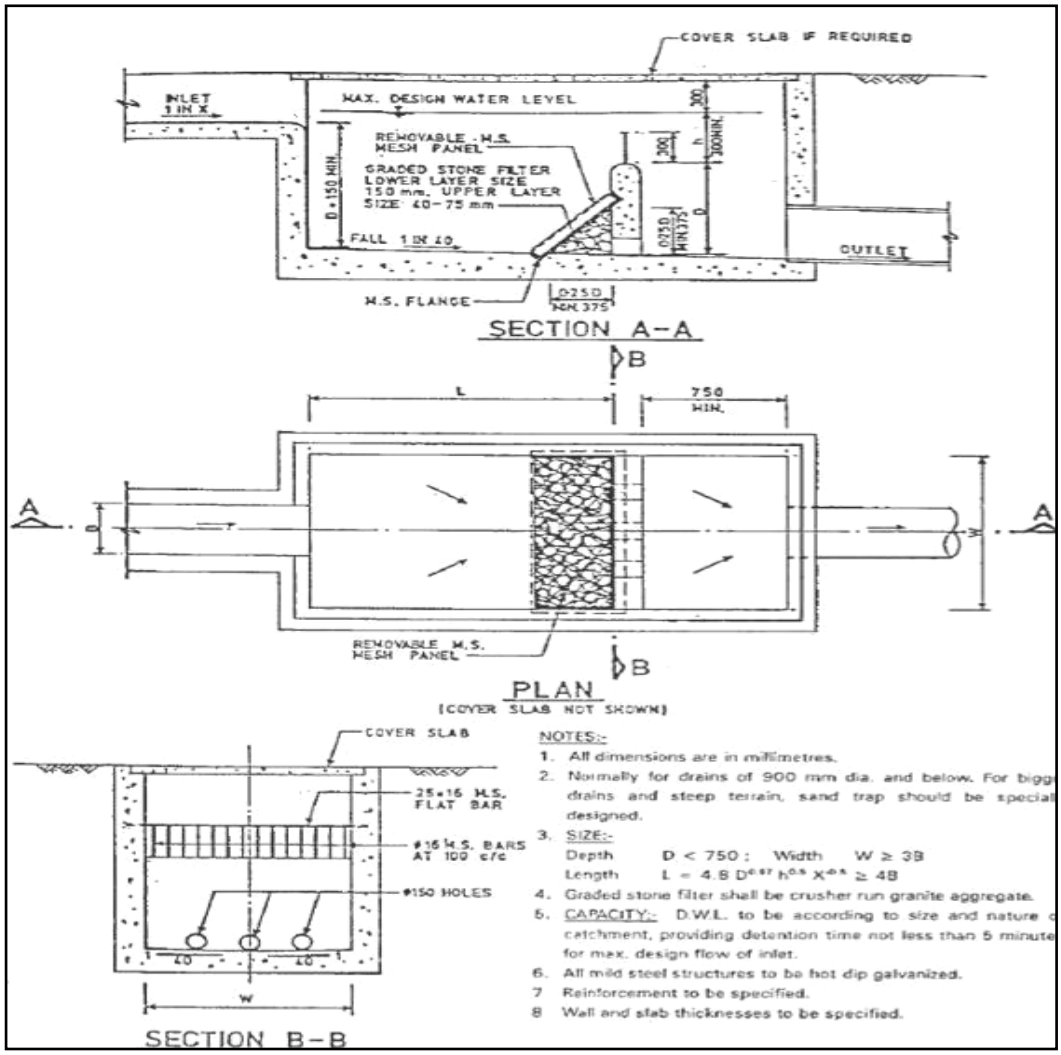
Figure 1: Workshop Area Pollution Control

- 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 oil waste 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.

Figure 2: Sedimentation Chamber for vehicle washing ramp discharge



5. Facilities for Labour

a. Potential Environmental Impacts

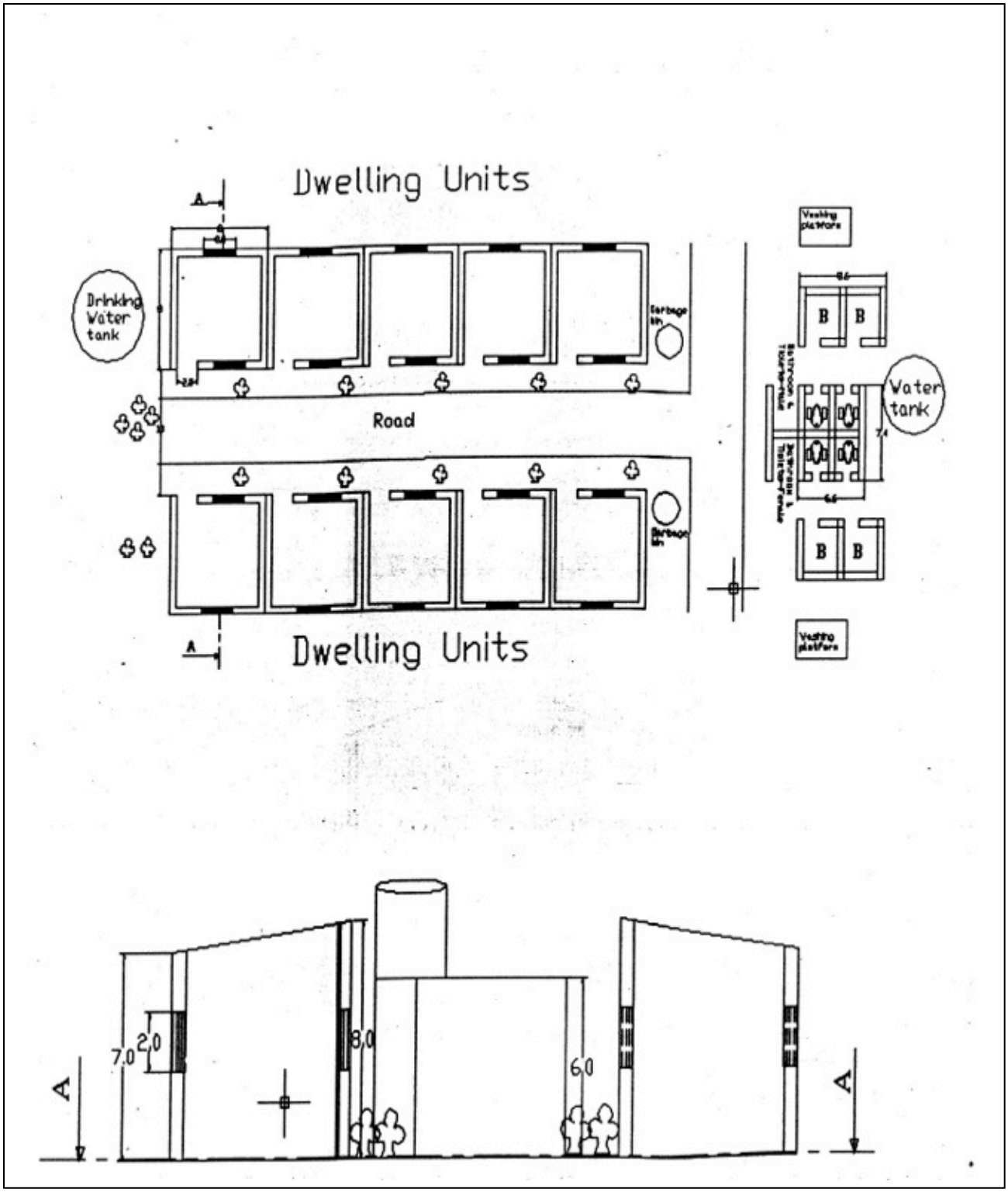
7. The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and 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.

b. Mitigation Measures

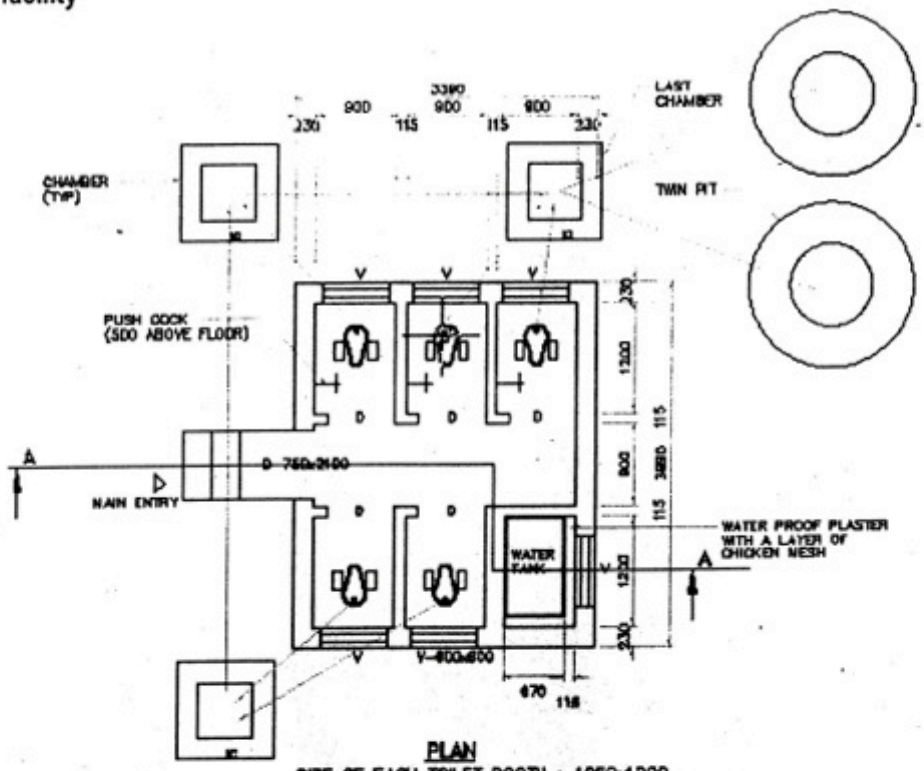
8. It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as 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.

TYPICAL DRAWING OF WORKERS' CAMP SANITARY FACILITY

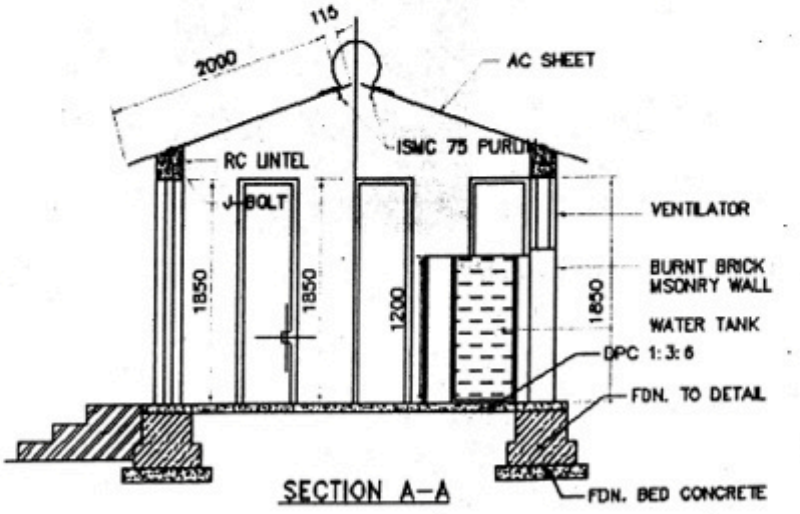


Sanitary facility



PLAN

SIZE OF EACH TOILET BOOTH : 1050x1200
(TYPICAL WITH 8 WC ENCLOSURE FOR SCHOOLS, SHOPPING AREAS)

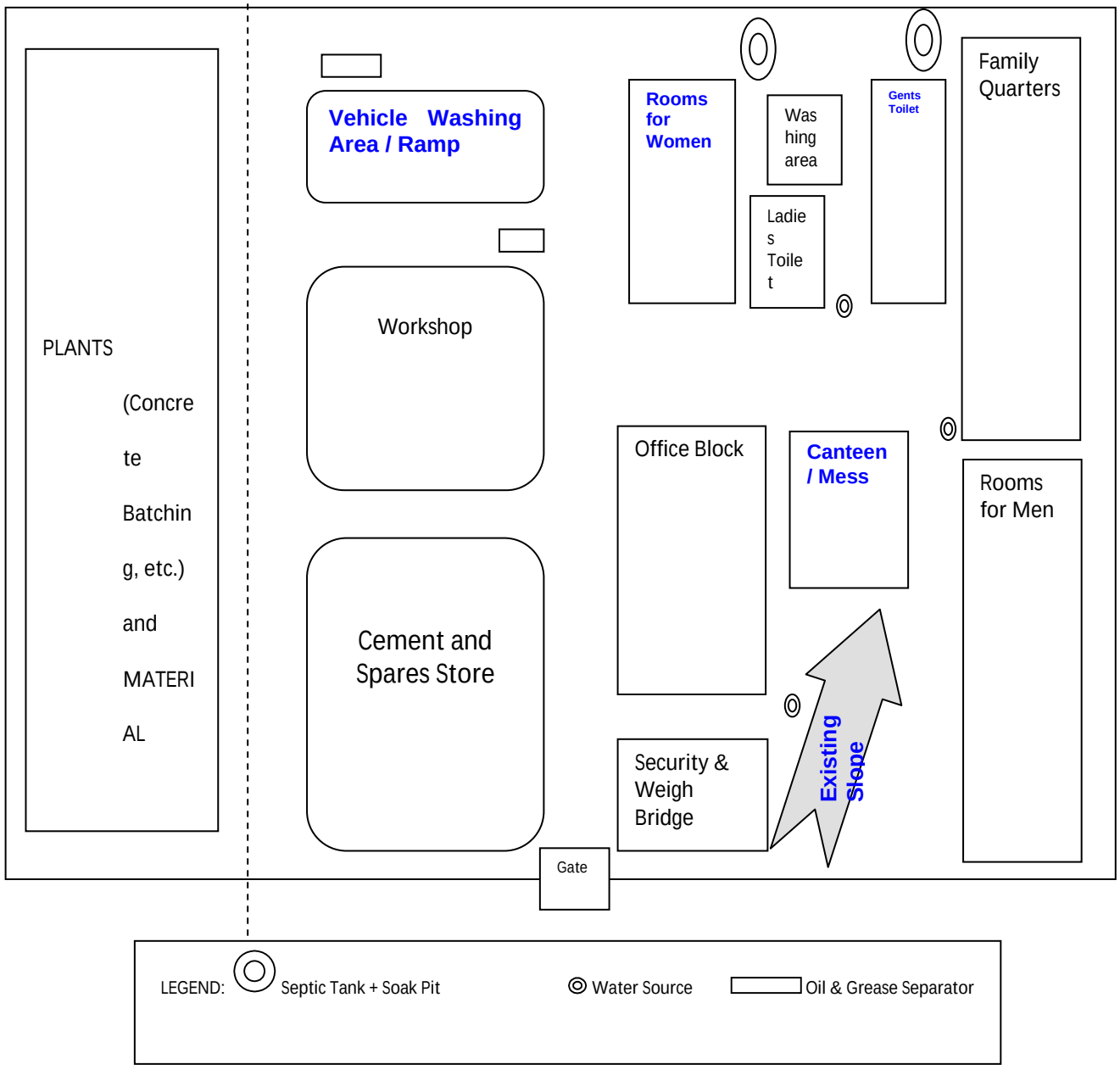


SECTION A–A

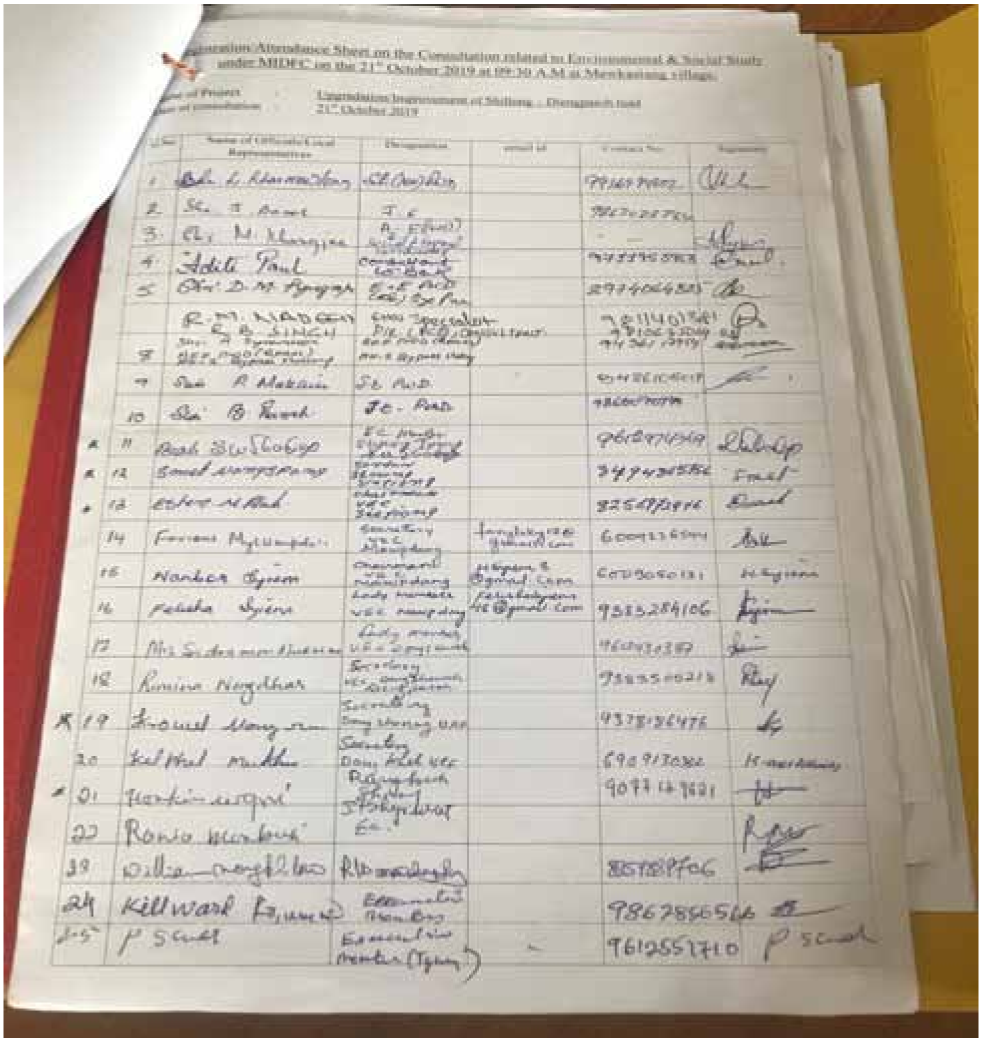
NOTES:

1. INSPECTION CHAMBER (IC) 600x600x600 DEEP WITH AIRTIGHT MH COVER
2. SEPTIC TANK & SOAK PIT AS PER SITE CONDITIONS

Layout of a Construction camp



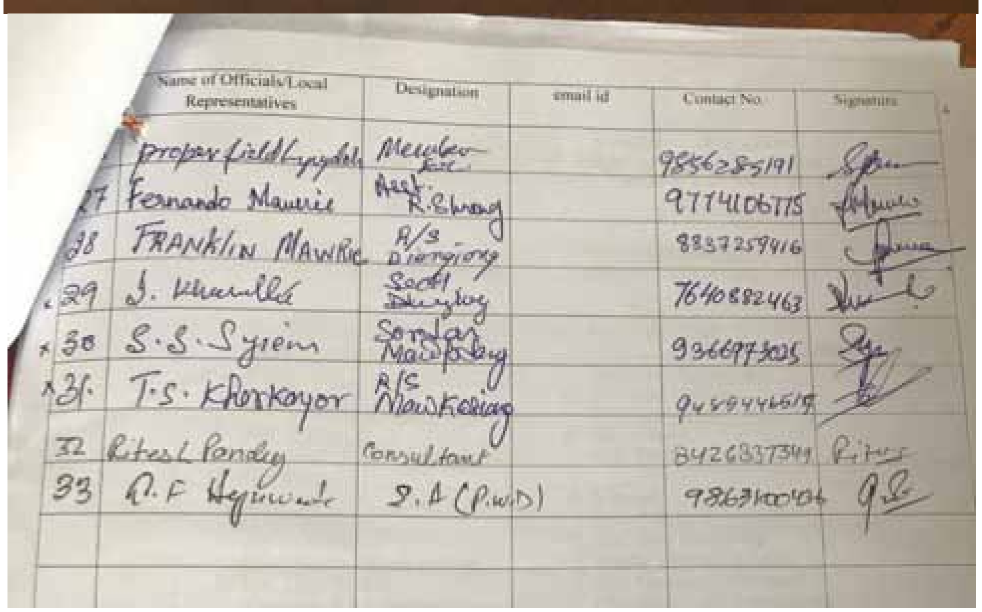
Appendix-5: Attendance Sheet of public consultations



[illegible]Attendance Sheet on the Consultation related to Environmental & Social Study under MIDFC on the 21st October 2019 at 09:30 A.M at [illegible] village.

Name of Project : Upgradation Improvement of Shillong – [illegible] road
Date of consultation : 21st October 2019

Sl. No.	Name of Officials/Local Representatives	Designation	email id	Contact No.	Signature
1	[illegible]	[illegible]		[illegible]	[illegible]
2	[illegible]	[illegible]		[illegible]	
3	[illegible]	[illegible]		–	[illegible]
4	Aditi Paul	Consultant [illegible]		[illegible]	[illegible]
5	[illegible]	[illegible]		[illegible]	[illegible]
	R. M. NADEEM / S. B. SINGH	[illegible] / Consultant		[illegible]	[illegible]
8	[illegible]	[illegible]		[illegible]	[illegible]
9	[illegible]	SE PWD		[illegible]	[illegible]
10	[illegible]	JE - PWD		[illegible]	
11	[illegible]	[illegible]		[illegible]	[illegible]
12	[illegible]	[illegible]		[illegible]	[illegible]
13	[illegible]	[illegible]		[illegible]	[illegible]
14	[illegible]	Secretary VEC [illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	Chairman VEC [illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	9383284106	[illegible]
17	[illegible]	[illegible]		[illegible]	[illegible]
18	[illegible]	[illegible]		[illegible]	[illegible]
19	[illegible]	[illegible]		[illegible]	[illegible]
20	[illegible]	[illegible]		[illegible]	[illegible]
21	[illegible]	[illegible]		[illegible]	[illegible]
22	[illegible]	[illegible]			[illegible]
23	[illegible]	[illegible]		[illegible]	[illegible]
24	Killward [illegible]	[illegible]		9867856566	[illegible]
25	P [illegible]	Executive Member [illegible]	–	9612551710	[illegible]



Sl. No.	Name of Officials/Local Representatives	Designation	email id	Contact No.	Signature
	[illegible]	Member [illegible]		9856285191	[illegible]
27	Fernando Maurice	[illegible]		9774106775	[illegible]
28	FRANKLIN MAWRIE	R/S [illegible]		8837259416	[illegible]
29	J. [illegible]	[illegible]		7640882463	[illegible]
30	S. S. Syiem	[illegible]		9366973035	[illegible]
31	T. S. Kharkongor	R/S [illegible]		9458446519	[illegible]
32	Ritesh Pandey	Consultant		8426837349	Ritesh
33	A. F [illegible]	S.A (P.W.D)		9863100104	[illegible]

Registration/Attendance Sheet on the Consultation related to Environmental & Social Study under MIDFC on the 21st October 2019 at 02:00 P.M at Laitlyngkot village.

Name of Project : Improvement of Laitkor - Pomlakrai - Laitlyngkot road

Date of consultation : 21st October 2019

Sl No	Name of Officials/Local Representatives	Designation	email id	Contact No.	Signature
1	Shri Telling Bulphang	Headman Laitmawrih		8787831198	[illegible]
2	Shri Bakstar Majaw	(Laitmawrih) Member		6009104610	B. Majaw
3	Shri Aiton Nongkynrih	(Laitmawrih) Secretary		9612903846	[illegible]
4	Shri Jolonstar Myllem	Headman Umdatc		9862615108	[illegible]
5	Shri Rason Lyngdoh	Member Umdat		9774777135	[illegible]
6	Shri Rangkalling Lyngdoh	Headman Sawrangkynshiang		9863330352	[illegible]
7	Shri Shibanton Bulphang	(Member) Laitmawrih		8837359911	Bulphang
8	Shri Manuk K. Pamthet	Laitlyngkot		9823649293	[illegible]
9	Obing Star Nongrum	Laitlyngkot		8414809293	[illegible]
10	Victor Lolero	Laitlyngkot		8974946943	[illegible]
11	Chi Taranius Kharkongor	Headman		8974010528	[illegible]
12	Shri Rumstone Majaw	Headman Madanlynglah		9612951253 / 7005282476	Majaw
13	Shri Brabiang Sohkhlet	Headman Mawiong		9862400655	[illegible]
14	Thain Sing Nonglait	Secretary		6009571089	[illegible]
15	Everson Hayhlaw	Secretary		7005273546	[illegible]
16	Shri Bawan Sohtun	Headman Mawpdkhar		9612814011	[illegible]
17	Shri Klaw Khongsit	Laitmawrah Secretary		9774713489	Klau
18	Shri D.M. Pyngrope	E.E. PWD DC (Rds) Bye-pass		9436164714	[illegible]
19	Dr. Rezy Bulphang			9612249534	DR
20	Shri L. Kharmawlong	SE (NH)		9436994802	[illegible]
21	Shri M. Nongkynrih	AEE PWD (R)		9436164857	
22	Shri R.B. Singh	Director Consultant			
23	Shri R.M. Nadeem	ENV. Specialist			
24	Shri.	JE PWD (R)			

STAKEHOLDERS CONSULTATION PROGRAM CONDUCTED AT WORLD BANK HELD ON 22ND OCTOBER 2019 FOR THE PROJECT ON NARTIANG JONGLWIT BARATO ROAD BY SMT. ADITI PAUL - NARTIANG (AGRICULTURAL LAND).

REGISTRATION SHEET.

Sl no	Name of Participants	Designation	Contact No.	Signature
1	Shri. H. Khyriem	Chairman Madeph Hamlet village	9856081290	[signature]
2	Shri. Banio Dkhar	Headman Madeph village		[signature]
3	Ron K.C. Syiem	Member Madeph village	8837403102	[signature]
4	Mr. Y. Pale	Member Madeph village	9856386163	[signature]
5	Mr. E. Pale	Secretary Shnong Madeph	9857/19717	[signature]
6	" Kilinoy Syiem	E/C member "	8132840377	[signature]
7	" Ryudaplang Dkhar	E/C Members	8729826647	[signature]
8	Shri. Powar Dkhar	Member Shnong Madeph	8787556477	[signature]
9	Mon Pdangki	Waheh Shnongmarthiang	8732062721	[signature]
10	Hep Dkhar (Dolloi)	Dolloi Elaka	8174557179	[signature]
11	Bolt myrsia	Chairman Shnong	8257850617	
12	Nida Lamare	Member Shnong Nartiang Ahsam	8259019354 ~~76290~~	N.Lamare
13	Biang Lamare	— do —	8259019354	B.Lamare
14.	Hine Dymbki	— do —	9856962508	[signature]
15	Tymmen Nongjyrd	— do —		T-N
16.	Shri S. R. Nongkseh	J.E (WR) Jowai	9436810285	[signature]
17	Shri. Pran Kumar	— do —	8794488865	[signature]
18	Mr Rimaya Dkhar	[signature]	7406166510	[signature]
19	warith			wasi
20	Shri. Pulon Phalangki			Pulon
21	Shri. Rimi Dkhar			RD
22.	Shri. Michael Langlang	T/E	8787866048	[signature]
23	Shri Rockystar R. Lyngdoh	T/E	7005046072	[signature]
24	Shri Dakima Chyrmang	T/E	9131028445	[signature]

STAKEHOLDERS CONSULTATION PROGRAM CONDUCTED BY WORLD BANK HELD ON 22ND OCTOBER 2019 FOR THE PROJECT ON NARTIANG JONGLWIT RARATO ROAD BY SMT. ADITI PAUL - NARTIANG (AGRICULTURAL LAND)

REGISTRATION SHEET.

Sl no	Name of Participants	Designation	Contact No.	Signature.
25	Thandadmeki G Sungoh	J.E	8399882060	[signature]
26	A.J. Lamare	J.E	9366665265	[signature]
27	Misi Ammanda Sumer	AEE	9436106191	[signature]
28	Aditi Paul	Consultant, WB.	9711953953	[signature]

Appendix-6: Environment Management Plan

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
Pre- construction activities by Project Implementation Unit				
1	Land Acquisition	• The acquisition of land and private properties will be carried out in accordance with the RAP and entitlement framework for the project. PIU has to ascertain that any additional environmental impacts resulting from acquisition of land shall be addressed and integrated into the EMP and other relevant documents. • No land acquisition is involved in this road section.	PIU, Revenue Dept., NGOs, Collaborating Agencies	PIU
2	Preservation of Trees	• All efforts will be made to preserve trees including evaluation of minor design adjustments/alternatives (as applicable) to save trees. Specific attention will be given for protecting giant trees and locally important trees (religiously important etc.). • Tree cutting (approx. 85 nos.) is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances from the Forest Dept./DoEF/MoEF are completed and subsequently a written order is issued to the Contractor. • Particular species declared as 'protected' by the State's Forest Dept. in the private land will be felled only after due clearance from the Forest Dept. is obtained. In the event of design changes, additional assessments including the possibility to save trees shall be made. Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees cut and those saved will be maintained by the PIU.	PIU, Forest Dept., Contractor	Authority Engineer and PIU
3	Relocation of Community Utilities and Common Property Resources	• All community utilities and properties i.e., water supply lines, sewer lines, bank buildings, health centers, schools, health clinics and veterinary hospitals will be relocated before construction starts, on any section of the project corridor. The PIU will relocate these properties in consultation and written agreement with the agency/ owner/community. The schools and health centers will be constructed as per the relevant state norms. • All other community property resources within the corridor of impact such as hand pumps, ponds, grazing lands etc. will be relocated. The relocation sites for these schools will be identified in accordance with the choice of the community. • Environmental considerations with suitable/required actions including	PIU, Concerned Agencies, Contractor	PIU

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		health and hygiene aspects will be kept in mind while relocating all community utilities and resources.		
4	Relocation of affected Cultural and Religious Properties	• All religious property resources such as shrines, temples and mosques within the project zone will be relocated. Sites for the relocation of these religious structures will be identified in accordance with the choice of the community. • The NGO and PIU in consultation with local people will finalize design of these temples. As far as possible, the architectural elements of the structure should be conserved/ reflected/translated into the design of new structures. • The entire process (i.e. selection of relocation sites and designs) will be under supervision of Environmental Expert of the Authority Engineer. The relocation will be completed before the construction starts in these sites.	PIU, NGOs, Contractor	PIU
Pre-construction activities by the Contractor/Environmental Expert of Authority Engineer				
5 Field Verification and Suggested Changes in Design				
5.1	Joint Field Verification	• The Environmental Expert of the Authority Engineer and the Contractor will carry out joint field verification to ascertain the 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.	Contractor/ Environmental Expert of the Authority Engineer	PIU
5.2	Assessment of Impacts due to Changes/Additions in the Project	• The Environmental Expert of the Authority Engineer will assess impacts and revise/modify the EMP and other required sections of the project document/s in the event of changes/revisions (including addition or deletion) in the project's scope of work.	Contractor/ Environmental Expert of the Authority Engineer	PIU
5.3	Crushers, hot-mix plants and Batching Plants Location	• Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1000 m away from the nearest village/settlement preferably in the downwind direction. • The Contractor shall submit a detailed lay-out plan for all such sites and approval of Environmental Expert of the Authority Engineer shall be necessary prior to their establishment. • Arrangements to control dust pollution through provision of wind screens, sprinklers, dust encapsulation will have to be provided at all such sites. • Specifications of crushers, hot mix plants and batching plants will comply	Contractor/ Environmental Expert of the Authority Engineer	PIU

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		with the requirements of the relevant current emission control legislations and Consent/NOC for all such plants shall be submitted to the SC and PIU. • The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.		
5.4	Other Construction Vehicles, Equipment and Machinery	• All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. • Noise limits for construction equipment 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.	Contractor/ Environmental Expert of the Authority Engineer	PIU
6	**Identification and Selection of Material Sources**			
6.1	Borrow Areas	• Finalizing borrow areas for borrowing earth and all logistic 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 select borrow area until the formal agreement is signed between land owner and contractor and a copy is submitted to the SC and the PIU. • Locations finalized by the contractor shall be reported to the Environmental Expert of the Authority Engineer and who will in turn report to PIU. Format for reporting will be as per the Reporting Format for Borrow Area and will include a reference map. 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 SC, the environmental personnel of the SC will be required to inspect every borrow area location prior to approval (follow criteria for evaluation of borrow areas).	Contractor/ Environmental Expert of the Authority Engineer	PIU
6.2	Quarry	• Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials and other logistic arrangements In case the contractor decides to use quarries other than recommended by DPR consultant, then will be selected based on the	Contractor	Environmental Expert of the Authority Engineer

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		suitability of the materials. • The contractor will procure necessary permission for procurement of materials from Mining Department, District Administration and State Pollution Control Board and shall submit a copy of the approval and the rehabilitation plan to the PIU and Environmental Expert of the SC. • Contractor will also work out haul road network and report to Environmental Expert of the Authority Engineer and SC will inspect and in turn report to PIU before approval.		and PIU
6.3	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 the Authority Engineer before finalizing the locations. • The Contractor will provide a list of locations and type of sources from where water for construction will be used. • The contractor will not be allowed to pump from any irrigation canal and surface water bodies used by community. • The contractor will need to comply with the requirements of the State Ground Water Department and seek their approval for doing so and submit copies of the permission to SC and PIU.	Contractor	Environmental Expert of the Authority Engineer and PIU
6.4	Labor Requirements	• The contractor preferably will use unskilled labor drawn from local communities to give the maximum benefit to the local community.	Contractor	Environmental Expert of the Authority Engineer and PIU
6.5	Construction Camp Locations – Selection, Design and Lay-out	• Siting of the construction camps will be as per the guidelines below. Locations identified by the contractor will report as per format given. • 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 water courses. • The waste disposal and sewage system for the camp will be designed, built and operated such that no odor is generated. Unless otherwise arranged by the local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert of the Authority Engineer	Contractor	Environmental Expert of the Authority Engineer and PIU

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		will have to be provided by the contractor.		
6.6	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 Environmental Expert of the Authority Engineer will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the contract.	Contractor	Environmental Expert of the Authority Engineer and PIU
6.7	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 a sub-project). These sessions shall involve all staff of Environmental Cells, field level implementation staff of PIU, Environmental Experts of SCs and Contractors.	PMU/PIU	PIU
Construction Stage (Activities to be carried out by the Contractor)				
7 Site Clearance				
7.1	Clearing and Grubbing	• Vegetation will be removed from the construction zone before commencement of civil works. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is avoided or minimal. 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 the Authority Engineer. • The contractor, under any circumstances will not cut or damage trees. Trees identified under the project will be cut only after receiving clearance from the Forest Dept./MoEF/concerned authority (as applicable) and after the receipt of PIU's written permission in this regard. Vegetation with girth of over 30 cm only will be considered as trees and shall be compensated, in the event of PIU's instruction to undertake tree cutting.		
7.2	Stripping, stocking and preservation of top soil	• The top soil 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 piling will be pre-identified in consultation and with approval of Environmental Expert of the Authority Engineer. The following precautionary measures will be taken to preserve them till they are used: a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile will be protected by silt fencing. b) Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation. c) It will be ensured by the contractor that the top soil will not be unnecessarily trafficked either before stripping or when in stockpiles. • Such stockpiled topsoil will be utilized for -		

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		– covering all disturbed areas including borrow areas (not those in barren areas) top dressing of the road embankment and fill slopes – filling up of tree pits, in the median and in the agricultural fields of farmers, acquired temporarily. • Residual topsoil, if there is any will be utilized for the plantation at median and side of the main carriageway. Construction on the cleared soils shall begin as soon as possible to avoid soil erosion. • Top soil shall not be unnecessarily trafficked either before stocking or when in stockpiles. Slope stabilization shall be done by turfing and planting bush grass. Stockpiled top soil shall be returned to cover the disturbed area & cut slopes. Residual top soil shall be used for redevelopment of borrow areas, landscaping along slopes, medians etc.		
7.3	Compaction of Soil	• Heavy, wide and slow-moving vehicles should be kept away from the sensitive routes such as agricultural land. Use of heavy machinery on productive land is to be minimized. • Limitation on the axle load shall be identified such that topsoil is protected from compaction.		
7.4	Generation of Muck, Debris from hill cutting and dismantling structures and road surface	• Debris generated due to the dismantling of the existing structures or scarification of the road will be suitably reused in the proposed construction, subject to the suitability of the materials and approval of the Authority • Engineer (Resident Engineer and Environmental Expert) as follows: – 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. • The contractor will suitably dispose off unutilized debris materials either through filling up pre-designated disposal locations, subject to the approval of the Environmental Expert of the Authority Engineer. • At locations identified for disposal of residual bituminous wastes, the disposal will be carried out over a 60-mm thick layer of rammed clay so as to eliminate the possibility of leaching of wastes into the ground water. The contractor will ensure that the surface area of such disposal pits is covered with a layer of soil. • All arrangements for transportation during construction including provision, maintenance, dismantling and clearing debris, will be considered incidental to the work and will be planned and implemented by the contractor as approved and directed by the Environmental Expert of the Authority Engineer. • The pre-designed disposal locations will be a part of Comprehensive Solid Waste Management Plan to be prepared by Contractor in consultation and with approval of Environmental Expert of the Authority Engineer. • 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. • The contractor shall identify dumping sites. The identified locations will be reported to the Environmental Expert of the Authority Engineer. These locations will be checked on site and accordingly approved by Environmental Expert of the Authority Engineer prior to any disposal of waste materials.		
7.5	Other	• The pre-identified disposal locations will be a part of Comprehensive Waste Disposal Solid Waste Management		

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	Construction Wastes Disposal including balance quantity of muck	Plan to be prepared by the Contractor in consultation and with approval of Environmental Expert of the Authority Engineer. Location of disposal sites will be finalized prior to completion of the earthworks on any particular section of the road. • The Environmental Expert of the Authority Engineer will approve these disposal sites after conducting a joint inspection on the site with the Contractor. • Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed off near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and low-lying areas located in barren lands along the project corridors (is so desired by the owner/community). • No muck will be disposed in any disposal site. Contractor will take care of residual muck, if any that remains after construction work. Either this will be returned to the source or used in construction of embankment elsewhere with proper protection measures. Authority Engineer will keep strict vigil on this aspect. • Non-bituminous wastes other than fly ash may be dumped in borrow pits (preferably located in barren lands) covered with a layer of the soil. No new disposal site shall be created as part of the project, except with prior approval of the Environmental Expert of the Authority Engineer. • All waste materials will be completely disposed, and the site will be fully cleaned and certified by Environmental Expert of the Authority Engineer before handing over. • The contractor at its cost shall resolve any claim, arising out of waste disposal or any non-compliance that may arise on account of lack of action on his part.		
8	**Procurement of Construction Material**			
8.1	Earth from Borrow Areas for Construction	• No borrow area will be opened without permission of the Environmental Expert of the Authority Engineer. The location, shape and size of the designated borrow areas will be as approved by the Environmental Expert of the Authority Engineer and in accordance to the IRC recommended practice for borrow pits for road embankments (IRC 10: 1961). The borrowing operations will be carried out as specified in the guidelines for siting and operation of borrow areas. • The unpaved surfaces used for the haulage of borrow materials, if passing through the settlement areas or habitations; will be maintained dust free by the contractor. Sprinkling of water will be carried out twice a day to control dust along such roads during their period of use. • During dry seasons (winter and summer) frequency of water sprinkling will be increased in the settlement areas and Environmental Expert of the Authority Engineer 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 the Authority Engineer.		
8.2	Quarry Operations	• The contractor shall obtain materials from quarries that are the licensed one. If new quarries are to be opened, the contractor shall obtain permission from Department of Mining & Geology of the respective state as well as from Environmental Clearance from SEIAA/MOEF&CC and consents from State Pollution Control Board. The		

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		quarry operations will be undertaken within the rules and regulations in force.		
8.3	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 Authority Engineer and PIU. • The contractor will source the requirement of water preferentially from ground water but with prior permission from the Ground Water Board. A copy of the permission will be submitted to Authority Engineer and PIU prior to initiation of construction. • The contractor will take all precaution to minimize the wastage of water in the construction process/ operation.		
8.4	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 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. The unloading of materials at construction sites in/close to settlements will be restricted to daytime only.		
9	**Safety During Construction**			
9.1	Increased Accident Risks in Work Zones - Planning for Traffic Diversions and Detours	• Detailed Traffic Management Plans prepared prior to commencement of works on any section of road shall be executed fully. Temporary diversions will be constructed with the approval of the Resident Engineer and Environmental Expert of the Authority Engineer. • Detailed Traffic Control Plans will be prepared and submitted to the Environmental Expert of the Authority Engineer for approval, seven days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures undertaken for transport of hazardous materials and arrangement of flagmen. • The Contractor will provide specific measures for safety of pedestrians and workers at night as a part of traffic control plans. The Contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. • The contractor will also inform local community of changes to traffic routes, conditions and pedestrian access arrangements with assistance from Authority Engineer 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). • The contractor shall make sure that adequate traffic measures are available especially near sensitive receptors. • The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect		

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		and maintain such barricades, including signs, marking flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic or closer of traffic on the highway shall be drawn up. • 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 shall 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 shall be equipped with red and green flags and lanterns/lights Temporary diversion shall be constructed with the approval of the Engineer. • The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. • The Contractor shall take all necessary measures for the safety of traffic during construction. Care shall be taken to ensure that the working conditions for the workers in stone quarries are up to the required standards. • Construction related activity resulting in direct release of criteria pollutants (CO, NO2, SO2, PM2.5, PM10) to be avoided at busy locations at night during winters.		
9.2	Traffic and Safety	• The contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan/Drawings and as required by the Environmental Expert of the Authority Engineer for the information and protection of traffic approaching or passing through the section of any existing cross roads. • The contractor will ensure that all signs, barricades, pavement markings are provided as per the MoRTH specifications. Before taking up of construction on any section of the existing lanes of the highway, a Traffic Control Plan will be devised and implemented to the satisfaction of the Environmental Expert of the Authority Engineer.		
9.3	Loss of Accessibility and Unsafe Access	• The construction works shall not interfere with the convenience of the public or the access to use and occupation of public or private roads, railways and any other access footpaths to or of properties, whether public or private. • Temporary access shall be built at the interchange of the project road and other roads. • 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 also ensure that the existing accesses will not be undertaken without providing adequate provisions and to the prior satisfaction of the Authority Engineer. • 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.		
9.4	Personal Safety Measures for	• Contractor will provide: – Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement,		

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	Labour	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 Factories Act, 1948 stone breaking activities and workers will be seated at sufficiently safe intervals – Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. – Adequate safety measures for workers during handling of materials at site are taken up. – The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. • The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. • The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. • The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. • Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. • The Contractor will mark ‘hard hat’ and ‘no smoking’ and other ‘high risk’ areas and enforce non -compliance of use of PPE with zero tolerance. These will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and will be approved by Authority Engineer and PIU.		
9.5	First Aid	• The contractor will arrange for - – a readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone – availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital equipment and trained nursing staff at construction camp.		
9.6	Risk from Electrical Equipment(s)	• The Contractor will take all required precautions to prevent danger from electrical equipment and ensure that - – No material will be so stacked or placed as to cause danger or inconvenience to any person or the public. – All necessary fencing and lights will be provided to protect the public in construction zones. • All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Environmental Expert of the Authority Engineer.		
9.7	Risk Force	• The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, flood		

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	Measure	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.		
9.8	Informatory Signs and Hoardings	• The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and local language, as required in line with IRC:55 or as suggested by the Environmental Expert of the Authority Engineer.		
10	**Management of Water**			
10.1	Loss of Community Water Resources	• Water reservoir enhancement measures shall be provided for community water sources/pond getting impacted to slight degree and falling within the right of way as per the design provided in annexure of specific EMP. • The enhancement measures shall include provision for stepped access to the edge of water, providing flat boulders for washing, stone pitching for slope stabilization etc. • Roadside water reservoir/streams shall also be enhanced as per the design general EMP.		
10.2	Drainage and Flood Control	• Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed off so as not to block the flow of water of any water course and cross drainage channels. • Contractor will take all necessary measures to prevent the blockage of water flow. In addition to the design requirements, the contractor will take all required measures as directed by the Environmental Expert of the Authority Engineer to prevent temporary or permanent flooding of the site or any adjacent area.		
10.3	Water logging	• Adequate water-harvesting structures shall be made part of the project design, all along the storm water drains, at appropriate intervals. • The contractor shall provide RCC covered drains in urban locations in areas with high water table for storm water runoff management. The drains shall be connected to proximal culverts.		
10.4	River Training and Disruption to Other Users of Water	• While working across or close to any perennial water bodies, contractor will not obstruct/ prevent the flow of water. • Construction over and close to the non-perennial streams shall be undertaken in the dry season. If construction work is expected to disrupt users of community water bodies, notice shall be served well in advance to the affected community. • The contractor will serve notice to the downstream users well in advance to divert the flow of water of any surface water body. Wherever excavation for diverting water flow will take place, contractor will ensure that the slopes are not steeper than 1:2 (vertical: horizontal) otherwise proper slope protection measures will be taken as approved by the Environmental Expert of the Authority Engineer. • The contractor will take prior approval of the River Authority or Irrigation Department or Authority Engineer for any such activity. The PIU will ensure that contractor has served the notice to the downstream users of water stream in advance.		
10.5	Disruption to	• While working across or close to the Rivers, the contractor shall not prevent the flow of water. If for any		

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	other users	bridgework, etc., closure of flow is required, the contractor shall seek approval of the Engineer. • The engineer shall have the right to ask the contractor to serve notice on the downstream users of water sufficiently in advance. • Construction work expected to disrupt users and impacting community water bodies shall be taken up after serving notice on the local community.		
11	**Pollution**			
a	**Water Pollution**			
11.1	Water Pollution from Construction Wastes	• The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. Contractor will avoid construction works close to the streams or water bodies during monsoon. • All waste arising from the project is to be disposed off in the manner that is acceptable to the State Pollution Control Board or as directed by Environmental Expert of the Authority Engineer. • The Environmental Expert of the Authority Engineer will certify that all liquid wastes disposed off from the sites meet the discharge standards.		
11.2	Siltation of Water Bodies and Degradation of Water Quality	• The Contractor will not excavate beds of any stream/canals/ any other water body for borrowing earth for embankment construction. • Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including stream) adjacent to the RoW and around the stockpiles at the construction sites close to water bodies, specially at km 13.500. 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 road sections which are ultimately entering into any surface water bodies / water channels with a fall exceeding 1.5 m. • Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water course.		
11.3	Slope Protection and Control of Soil Erosion	• Slope protection shall be provided on embankments abutting water bodies by providing stone pitching for slopes b/w 1:4 (V:H) to 1:2 (V:H). Retaining walls shall be provided at high embankments. • 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. • The contractor will take slope protection measures as per design, or as directed by the Environmental Expert of the Authority Engineer to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fibber mats, mulches, grasses, slope, drains and other devices. • All temporary sedimentation, pollution control works and maintenance thereof will be deemed as incidental to the earth work or other items of work and as such as no separate payment will be made for them. • Contractor will ensure the following aspects: – During construction activities on road embankment, the side slopes of all cut and fill areas will be graded and		

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		covered with stone pitching, grass and shrub as per design specifications. – Turfing works will be taken up as soon as possible provided the season is favorable 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. – 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 horizontals, from the edge of the final section of the bank. – Along sections abutting water bodies, stone pitching as per design specification will protect slopes. Soil shall be monitored for erosion at select locations as per the monitoring plan mentioned in General EMP.		
11.4	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 refueling sites will be located at least 500 m from rivers and irrigation canal/ponds. • All location and lay-out plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Environmental Expert of the Authority Engineer and PIU. • Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refueling 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 refueling areas as per the design provided. • In all, fuel storage and refueling 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 Authority Engineer and PIU) and approved by the Environmental Expert of the Authority Engineer. • All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines. • Environmental Expert of the Authority Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.		
11.5	Contamination of Water Resources	• Silt fencing shall be provided along ponds within the direct impact zone intercepting highway to prevent siltation in water body. Such ponds shall not be getting impacted during construction. • Temporary drains shall be prepared to dispose off the eroded sediments and to prevent them from entering the surface water bodies. • To prevent contamination of water resources due to contaminants from construction camps, adequate sewage disposal measures shall be taken care of at construction camps. • Contaminated discharges containing oil/grease contributed by vehicle parking/repair areas and workshops and construction sites shall be collected and treated using oil interceptors. • Construction work close to water bodies shall be avoided during monsoon. The contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites shall be located at least 1000 m from rivers and stream/reservoir/tanks or as		

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		directed by the Engineer. • Both ground and surface water quality shall be monitored as per the monitoring plan at select locations.		
b	**Air Pollution**			
11.6	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 PCB shall be used. Required certificates and consents shall be submitted by the Contractor in such a case. • 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. • All crushers identified to be used in construction shall conform to relevant dust emission control legislation of the respective SPCB. • Clearance for siting shall be obtained from the respective SPCB. Alternatively, only those crushers that are already licensed by the SPCB shall be used. • All Hot mix plants shall be fitted with dust extraction systems SPM value at a distance of 40 m from a unit located in a cluster should be less than 600 microgram/m3. The monitoring is to be conducted as per the monitoring plan. • Excavation and transport of earth shall be done during the daytime only to minimize risks of the spills etc. from the earthwork on the community. • Transport of the soil/earth shall be done by covering the haulage vehicles with tarpaulin or any other good quality material. • Dust suppression measures in the form of water sprinkling on the lime / cement and earth mixing sites, asphalt mixing site and temporary service and access roads. • Traffic detours shall not be located on areas with loose soils. Temporary pavement shall be made by using dismantled pavement material from existing roads. • All construction workers shall be provided with pollution masks to mitigate the effect of dust generation on the health of workers. • Muck shall be transported in covered dump trucks to the project site and shall be directly dumped on the disposal sites. This shall not be stock piled at the project site.		
11.7	Emission from Construction	• All vehicles, plants and machinery used during construction shall conform to the emission standards promulgated under the Environment (Protection) Act, 1986. Contractor will ensure that all vehicles, equipment		

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	Vehicles, Equipment and Machineries (Generation of Exhaust Gases)	and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of PCB. • The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Monitoring results will also be submitted to Authority Engineer and PIU as per the monitoring plan. • Traffic detours and diversions shall be designed such as to minimize bottlenecks and ensure smooth traffic. • Air pollution monitoring shall be carried out at specified locations as described in the monitoring plan to verify that air pollution norms are being followed by the contractor and the air quality at the construction site does not exceed the prescribed limits. 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 PCB.		
c	**Noise Pollution**			
11.8	Noise Pollution: Noise from Vehicles, Plants and Equipment	• The Contractor will confirm the following: – All plants and equipment used in construction (including the and PIU, MPWD aggregate crushing plant) shall strictly conform to the MoEF/CPCB noise standards. – All vehicles and equipment used in construction will be fitted with exhaust silencers. – Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. – Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. – Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Environmental Expert of the Authority Engineer 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 9.00 pm to 6.00 am. – No noisy construction activities will be permitted around educational institutes/health centers (silence zones) up to a distance of 100 m from the sensitive receptors i.e., school, health centers and hospitals between 9.00 am to 5.00 pm. – Contractor will provide noise barriers to the suggested locations of select schools (at km 5+860, 8+680 & 11+600) / health centers at km 11+950.. – Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB(A). – Blasting operations, if required shall be undertaken so as to produce minimum vibrations in sensitive areas. – Traffic management plans prepared during construction mobilization period shall also be implemented during construction stage. Effective traffic management shall especially be taken care of in sensitive locations, major built-up areas and along important highway junctions. – Asphalt mixing sites and the batching plants should be at a distance of at least 200 m from sensitive receptor		

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		locations. – Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to Authority Engineer and PIU. Environmental Expert of the Authority Engineer will be required to inspect regularly to ensure the compliance of EMP.		
12	**Land/Soil Pollution**			
12.1	Contamination of Soil	• Fuel shall be stored in proper bounded and covered areas. • All spills and collected petroleum products shall be disposed off in accordance with the guidelines framed by Ministry of Environment, Forests &, Climate Change and State Pollution Control Board. • Maintenance and refuelling of vehicles, machinery and other construction equipment shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. • An "Oil Interceptor" shall be provided for wash down and refuelling areas. • Debris generated due to the dismantling of the existing road shall be suitably reused in the proposed construction, subject to the suitability of the materials and approval of the Engineer as follows: – The sub-grade of the existing pavement shall be used as embankment fill materials – 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, temporary traffic diversions, haulage routes etc. – The contractor shall suitably dispose off un-utilized debris materials including spoils of material unsuitable for embankment; either through filling up of borrow area located in wasteland or at pre-designated dump locations, subject to the approval of the Engineer. – At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60 mm thick layer of rammed clay so as to eliminate the possibility of leaching of wastes into the ground water. – The contractor shall ensure that the surface area of such dumping pits is covered with a layer of preserved topsoil. – All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary shall be considered incidental to the work and shall be planned and implemented by the contractor as approved and directed by the Engineer. – The pre-designed dump locations shall be a part of comprehensive solid waste management plan to be prepared by Contractor in consultation with Engineer. – 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. The contractor shall identify dumping sites. The identified locations shall be reported to the Engineer. Location of dump sites shall be finalised prior to earth works on any particular section of the road. – No fly ash shall be disposed in any disposal site. Care shall be taken to return the remaining fly ash after construction work to the source or to use it in construction of embankment elsewhere with proper construction measures. IE shall keep strict vigil on this aspect.		

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		– Non-bituminous wastes other than fly ash may be dumped in borrow areas covered with a layer of the conserved topsoil. No new disposal sites shall be created as part of the project, except with prior approval of the Engineer. – All waste materials shall be completely disposed and the site shall be fully cleaned before handing over. – Soil shall be monitored for contamination as per the monitoring plan at locations to be identified by the Engineer. The Engineer shall certify the site after approval. – The contractor at his cost shall resolve any claim arising out of waste disposal.		
13	**Flora and Fauna: Plantation/Preservation/Conservation Measures**			
13.1	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 80 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 Project Authority. • The Environmental Expert of the Authority Engineer will inspect regularly the survival rate of the plants and compliance of tree plantation guidelines.		
13.2	Flora and Chance found 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 the Authority Engineer and carry out the Authority Engineer's instructions for dealing with the same. IE shall be responsible to intimate the wildlife protection authorities in the area. • The Environmental Expert of the Authority Engineer will report to the nearby forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.		
14	**Archeological Resources and Cultural Properties**			
14.1	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 the Authority Engineer of such discovery and carry out the Authority Engineer's instructions for dealing with the same, waiting which all work shall be stopped. • The Authority Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.		
14.2	Impact/s on	• All necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural		

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
	Cultural/Religious Properties	sites and remains, places of worship including temples and shrines, etc., graveyards, monuments and any other important structures as identified during design. All conservation and protection measures shall be taken up as per design. Access to such properties from the road shall be maintained clear and clean.		
15	**Labor Camp Management**			
15.1	Accommodation	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. • The location, layout and basic facility provision of each labour camp will be submitted to Authority Engineer and PIU prior to their construction. • The construction will commence only upon the written approval of the Environmental Expert of the Authority Engineer. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Authority Engineer.		
15.2	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. • The contractor will also guarantee the following: a) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities. b) If any water storage tank is provided that will be kept such that the bottom of the tank at least 1mt. from the surrounding ground level. c) If water is drawn from any existing stream/reservoir/well, which is within 30mt. proximity of any toilet, drain or other source of pollution, the water from source will be disinfected before water is used for drinking. d) All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. e) A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. f) Testing of water will be done every month as per parameters prescribed in IS 10500:1991. g) Environmental Expert of the Authority Engineer will be required to inspect the labour camp once in a week to ensure the compliance of the EMP.		
15.3	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 places – separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women		

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		– adequate water supply is to be provided in all toilets and urinals – all toilets in workplaces are with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition – night soil is to be disposed off by putting layer of it at the bottom of a permanent tank prepared for the purpose and covered with 15 cm. layer of waste or refuse and then covered with a layer of earth for a fortnight.		
15.4	Waste Disposal	• The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of the Authority Engineer. • 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 the Authority Engineer will have to be provided by the contractor.		
15.5	Health and Hygiene Impacts on Construction Camps	• The contractor shall provide erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour up to living standards and scales approved by the IE at the locations identified for such facilities in pre-construction phase. • The contractor shall also guarantee the following: – Supply of sufficient quantity of potable water (as per IS) in every work place/labour campsite at suitable and easily accessible places and regular maintenance of such facilities. – If any water storage tank is provided it shall be kept at a distance of not less than 15m from any latrine drain or other sources of pollution. – If water is drawn from any existing reservoir which is within close proximity of any latrine, drain or other source of pollution the well shall be disinfected before water is used for drinking. – All such reservoir shall be entirely covered and provided with a trap door, which shall be dust proof and waterproof. – A reliable pump shall be fitted to each covered well. The trap door shall be kept locked and opened only for cleaning or inspection, which shall be done at least once a month. – Testing of water shall be done every month as per parameters prescribed in IS 10500:1991. – Engineer shall be required to inspect the labour camp once in a week to ensure the compliance of the EMP. – Contractor shall be responsible for proper functioning and management of sanitation and sewage system as per applicable national and state regulations. – All latrines shall be provided with dry-earth system (receptacles), which shall be cleaned at least four times daily, and at least twice during working hours and kept in a strict sanitary condition. Receptacles shall be tarred inside and outside at least once a year. – Adequate health care is to be provided for the work force. On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, excreta tank and other disposal pits or trenches filled in and effectively sealed off and the outline site left clean and tidy, at the Contractor's expense, to the entire		

S.No.	Environmental Issue / Component	Management Measures	Institutional Responsibility	
			Planning	Supervision
		satisfaction of the engineer.		
15.6	Deterioration of indoor air quality and risk of water borne diseases	• It shall be the responsibility of the contractor to make adequate provisions for workers at labour camps under the Factories Act, 1948. Dwelling units shall be supplied with clean fuel for domestic purpose. Generation of carbon monoxide under any circumstance shall not be allowed. • Contractor shall make sure that no water stagnation happens in the vicinity of construction camp as well as anywhere along the project stretch to prevent spread of malaria & other water borne diseases		
16	**Contractor's Demobilization**			
16.1	Clean-up Operations, Restoration and Rehabilitation	• Contractor will prepare site restoration plans, which will be approved by the Environmental Expert of the Authority Engineer. The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL waste as per Comprehensive Waste Management Plan and as approved by Authority Engineer. • All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by Environmental Expert of the Authority Engineer 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 the Authority Engineer.		

Appendix-7: Trees in the Corridor of Impact

Chainage		Number of Trees to be Cut		Chainage		Number of Trees to be Cut	
From (Km)	To (Km)	Carriageway	Shoulder	From (Km)	To (Km)	Carriageway	Shoulder
2220	2400		1	9600	9800		
2400	2600	1	1	9800	10000		
2600	2800		1	10000	10200		
2800	3000	4	8	10200	10400		2
3000	3200		4	10400	10600	1	
3200	3400		2	10600	10800		4
3400	3600			10800	11000		
3600	3800			11000	11200		1
3800	4000			11200	11400	1	1
4000	4200		3	11400	11600		
4200	4400			11600	11800		
4400	4600			11800	12000	1	1
4600	4800		1	12000	12200		
4800	5000		1	12200	12400		
5000	5200	1	2	12400	12600		
5200	5400	2	9	12600	12800		2
5400	5600		2	12800	13000		1
5600	5800			13000	13200		
5800	6000			13200	13400		
6000	6200			13400	13600	1	2
6200	6400		1	13600	13800		3
6400	6600		1	13800	14000		1
6600	6800					14	71
6800	7000				**Total**	**85**	
7000	7200						
7200	7400		3				
7400	7600		3				
7600	7800						
7800	8000						
8000	8200		1				
8200	8400		3				
8400	8600						
8600	8800	2					
8800	9000		3				
9000	9200		1				
9200	9400						
9400	9600		2				