# DRAFT

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

## Improvement of Ampati to Purakhasia Road (AP) from 19+000 to 26+770 Km

## Meghalaya Logistics and Connectivity Improvement Project (MLCIP)

**Submitted**
**to**


**Meghalaya Infrastructure Development Finance Corporation (MIDFC) Ltd.**
**House No. L/A-56, Lower Nongrim Hills,Top Floor,**
**Meghalaya Basin Development Authority (MBDA) Building,**
**Shillong East Khasi Hills, Meghalaya-793003**

**Disclaimer:** The is a draft version and is being reviewed by the World Bank.



Official Use Only

# TABLE OF CONTENTS

# LIST OF TABLES

## LIST OF FIGURES

# ACRONYMS

| | | |
|---|---|---|
| ASI | : | Archaeological Survey of India |
| BIS | : | Bureau of Indian Standards |
| BMC | : | Biodiversity Management Committee |
| CESMP | : | Contractor's Environmental and Social Management Plan |
| CGWB | : | Central Ground Water Board |
| CoI | : | Corridor of Impact |
| CPR | : | Common Property Resources |
| CTE/CTO | : | Consent To Establish/Consent to Operate |
| CW | : | Carriageway |
| DG | : | Diesel Generator |
| DPR | : | Detailed Project Report |
| E&S | : | Environment and Social |
| EHS | : | Environment Health and Safety |
| EIA | : | Environmental Impact Assessment |
| ESF | : | Environmental and Social Framework |
| ESIA | : | Environmental and Social Impact Assessment |
| ESMP | : | Environmental and Social Management Plan |
| E&S Cell | : | Environment& Social Cell, MPWD |
| ESMF | : | Environmental and Social Management Framework |
| ESS | : | Environmental and Social Standards |
| ESZ | : | Eco-Sensitive Zone |
| FPIC | : | Free, Prior, and Informed Consent |
| GBV | : | Gender-Based Violence |
| GIS | : | Geographic Information System |
| GoM | : | Government of Meghalaya |
| GRM | : | Grievance Redress Mechanism |
| GHADC | | Garo Hills Autonomous District Council |
| HIV | : | Human Immunodeficiency Virus |
| IBA | : | Important Bird Area |
| IBAT | : | Integrated Biodiversity Assessment Tool |
| IEC | : | Information, Education, and Communication |
| IFC | : | International Finance Corporation |
| IRC | : | Indian Road Congress |
| ISFR | : | India State of Forest Report |
| IUCN | : | The International Union for Conservation of Nature |
| KBA | : | Key Biodiversity Area |
| KII | | Key informant Interview |
| LHS | : | Left Hand Side |
| LULC | : | Land Use Land Cover |
| MDR/ SH | : | Major District Roads/State Highways |

| | | |
|---|---|---|
| MoEF&CC | : | Ministry of Environment, Forest and Climate Change |
| MLCIP | : | Meghalaya Logistics and Connectivity Improvement Project |
| MSPCB | : | Meghalaya State Pollution Control Board |
| MSDMA | : | Meghalaya State Disaster Management Authority |
| NATMO | : | National Atlas and Thematic Mapping Organization |
| NBSAP | : | National Biodiversity Strategy and Action Plan |
| NGO | : | Non-Governmental Organization |
| NH | : | National Highway |
| NOC | : | No Objection Certificate |
| $NO_x$ | : | Oxides of Nitrogen |
| NTFP | : | Non-timber forest product |
| OHS | : | Occupational Health and Safety |
| OIP | : | Other Interested Parties |
| PAP | : | Project Affected Person |
| PESO | : | Petroleum and Explosives Safety Organization |
| PIA | : | Project Influence Area |
| PM | : | Particulate Matter |
| POSH | : | Prevention of Sexual Harassment |
| PPE | : | Personal Protective Equipment |
| PUC | : | Pollution Under Control |
| PWD | : | Public Works Department |
| R&R | : | Resettlement and Rehabilitation |
| RAP | : | Resettlement Action Plan |
| RF | : | Reserve Forest |
| RFCTLARR | : | Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 |
| RHS | : | Right Hand Side |
| RoW | : | Right of Way |
| SBB | : | State Biodiversity Board |
| SEA | : | Sexual Exploitation and Abuse |
| SEIAA | : | State Environment Impact Assessment Authority |
| SEP | : | Stakeholder Engagement Plan |
| SH | : | Sexual Harassment |
| SIA | : | Social Impact Assessment |
| SOP | : | Standard Operating Procedures |
| ST | : | Scheduled Tribes |
| SC | : | Scheduled Caste |
| TSG | : | Technical Support Group |
| WB | : | World Bank |
| WHO | : | World Health Organization |
| WPA, 1972 | : | Wildlife Protection Act, 1972 |
| WPA, 2022 | : | Wild Life (Protection) Amendment Act, 2022 |

# EXECUTIVE SUMMARY

## E. 1Introduction

MLCIP includes roads totaling to approximately 300 km. The proposed AP Sub Project Road has a total length of 7.770 Km, commencing from Chopapara Village at chainage 19+000 and terminating at Purakhasia at chainage 26+770.

The proposed road improvement under the Meghalaya Logistics and Connectivity Improvement Project (MLCIP) aims to upgrade a 7.77 km stretch from Ampati to Purakhasia to enhance regional connectivity, improve access to markets, and support socio-economic development. The project focuses on upgrading the existing single-lane road to an intermediate lane with climate-resilient features suited to the high rainfall conditions of the region. The corridor passes through hilly terrain, agricultural land, and rural settlements, making environmental and social considerations critical.

## E.2 Project Description and Need

The project is designed to improve road infrastructure without requiring additional land acquisition, as adequate Right of Way (RoW) is available. However, about 0.35 ha land is temporarily required for spoil disposal. The intervention includes pavement strengthening, drainage improvement, slope stabilization, and safety enhancements. The road serves as a vital link connecting villages and economic centers, thereby improving mobility and reducing travel time and costs.

## E.3 Baseline Environmental Conditions

The project area experiences high rainfall and humid climatic conditions, making it prone to erosion, drainage congestion, and slope instability. The terrain is characterized by undulating topography with soil types vulnerable to erosion. Surface water bodies, streams, and riverbanks are present along the alignment, playing an important role in local hydrology and community use.

Air and noise quality in the region are generally within acceptable limits due to low industrial activity. The biological environment includes local vegetation and fauna typical of the Garo Hills, with no critical habitats significantly impacted by the project. The area also falls under a high seismic zone (Zone V), indicating vulnerability to natural hazards.

## E.4 Socio-Economic Profile

The project area is predominantly inhabited by tribal communities governed under the Sixth Schedule, with strong traditional institutions like Nokmas managing land and resources. Livelihoods are mainly dependent on agriculture, small businesses, and daily wage activities. The project affects a limited number of households (5 PAHs), with minor impacts on livelihoods and structures.

Consultations revealed key community concerns such as poor road conditions, flooding during monsoon, lack of drainage, and safety issues. Communities generally supported the project, expecting improved connectivity and economic benefits.

## E.5 Key Environmental and Social Impacts

During the construction phase, potential impacts include:

- Soil erosion and slope instability due to earthwork
- Air and noise pollution from construction activities
- Water contamination from runoff and waste
- Temporary disruption to local traffic and community access
- Occupational health and safety risks for workers

During the operation phase, impacts are relatively limited but may include:

- Increased vehicular emissions and noise
- Road safety concerns due to higher traffic speed
- Risk of erosion if drainage and slope protection are not maintained

Table: ESIA Observation and Compliance

| Sr. No. | Village name | Location Chainage | ESIA Observation | Compliance/ Proposal included in the DPR | Reference in the DPR |
|---|---|---|---|---|---|
| 1 | Chopapara | 19+500 | Signs of riverbank erosion and soil instability were visually observed near the river edge. | This location is situated on a hilltop, so no river protection works are required here. However, at critical locations along this road, protection works have been proposed parallel to the road to prevent river erosion. | Protection works for streams parallel to road Page No-53 [Vol-VIII Cost Estimate] |
| 2 | Chopapara | 19+150 to 19+700 | Protection wall is required for all streams location. | Protection works for all streams location parallel to road are proposed and its details are mentioned in drawing no. RC/1661/HO/HWB/RD/DWG/MISC/08/R0. | Page No-53 [Vol-VIII Cost Estimate] |
| 3 | Chopapara | 19+700 to 19+740 | Continuous bank erosion along the left-hand side riverbank was visually observed. | Protection wall required from Ch-19+700 to 19+740 on (LHS) for slope protection has been proposed | Table No-14, Page No-123 [Vol-1 Main Report] |
| 4 | Chopapara | 19+200 to 19+300 | Eroding riverbank protection work needed (LHS) | As per design we have proposed protection work on LHS from Ch-19+400 to 19+460. | Table No-14, Page No-123 [Vol-1 Main Report] |
| 5 | Chopapara | 20+200 | Spring water collection tank to store the water for public use. | Proposed Spring water collection tank at ch-20+200 to store water for public purpose (LHS) | Page No-128 [Vol-1 Main Report] |
| 8 | Chopapara | 22+200 | Apron repairing required at Culvert Location | Floor Aprons are quadrant pitching are proposed in all culverts including Ch-22+213 | Floor Apron Details are mentioned in Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/CUL/TYP-1/01/R1 |
| 9 | Chopapara | 22+800 | Require boundary wall to protect Sarv Shiksha Abhiyaan (SSA) school. | Proposed boundary wall at Ch-22+740 to 22+810 on (LHS) | Page No-129 [Vol-1 Main Report] |

| | | | | | |
|---|---|---|---|---|---|
| 10 | Mebitpara | 22+850 | Localized soil erosion was observed near the abutment location of a minor bridge, indicating the need for appropriate structural protection. | Stream protection works are proposed at MNB Ch. 22+843, and approach repair cost is also included in BOQ to prevent scouring of the approach embankment. | Page No-125 [Vol-1 Main Report] & Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/MISC/07/R1 |
| 12 | Mebitpara | 24+000 | Riverbank erosion was observed along the left bank of the river. | Proposed river training work from Ch-23+960 to 24+150 on LHS to protect soil erosion. | Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/MISC/07/R1 |
| 13 | Mebitpara | 24+300 | Protection work needed a Minor Bridge Section. Curve improvement needed. | Curve improvement and protection works at the minor bridge, together with approach repairs, have been incorporated in the DPR. Chainage updated as per final approved design.. | Page No-125 [Vol-1 Main Report] |
| 15 | Darong Adu | 26+460 | Curve improvement needed by reducing the Curve radius to protect the Building Structure. | Curve improvement incorporated to avoid impacts on the adjoining building structure. Chainage updated as per final approved design.). | - |
| 16 | DarongAdu | 26+770 | Junction Improvement by providing traffic islands. | Already incorporated in the junction design plan at Ch. 26+770. Chainage updated as per final approved design. | Volume-X Drawings-Sheet No. RC/1661/HO/HWB/RD/DWG/SD/02/R1 |

### E.6 Mitigation Measures and Design Interventions

To address these impacts, several mitigation measures have been integrated into the project design:

- Erosion control measures such as toe walls, gabion walls, stone pitching, and river training works at vulnerable chainages
- Improved drainage systems to prevent waterlogging and flooding
- Slope stabilization techniques including bio-engineering methods like turfing and vegetation
- Climate-resilient pavement design with durable materials and stress-absorbing layers
- Safety measures including curve improvements, junction design, and traffic calming features
- Spring Water Collection tank

Environmental management during construction will include dust suppression, proper waste management, noise control, and water protection measures.

### E. 7 Social Safeguards and Community Engagement

The project follows the World Bank Environmental and Social Framework (ESF), ensuring compliance with national regulations and international standards. Free, Prior, and Informed Consent (FPIC) has been undertaken to engage tribal communities and incorporate their feedback into project design.

A Resettlement Action Plan (RAP) and Indigenous Peoples Development Plan (IPDP) have been prepared to address

impacts on affected households and ensure fair compensation and livelihood restoration. A Grievance Redress Mechanism (GRM) is also established to address community concerns effectively.

### E. 8 Environmental and Social Management Plan (ESMP)

The ESMP outlines mitigation measures, monitoring requirements, institutional responsibilities, and budget allocation. It includes:

- Environmental monitoring (air, water, noise, soil)
- Social monitoring (livelihood restoration, community safety)
- Occupational health and safety measures
- Capacity building for implementing agencies

An estimated budgetary allocation of INR 59,62,800 has been earmarked for the implementation of the Environmental and Social Management Plan (ESMP). The allocated budget covers various mitigation and management measures, including environmental protection initiatives, occupational health and safety provisions, monitoring activities, waste management, community health and safety measures, capacity-building programmes, and institutional arrangements to ensure effective implementation and compliance throughout the project lifecycle.

### E. 9 Stackholder Consultations

Stakeholder consultations conducted between 22 August 2025 and 9 October 2025 reflected overall community support for the project along with key concerns and suggestions. On 22 August 2025, local residents appreciated the project's benefits but highlighted issues such as non-functional streetlights and the need for fair compensation and livelihood support. During the consultation with PCCF, Shillong on 28 August 2025, emphasis was placed on ecological sensitivity mapping within a 10 km radius, addressing human-wildlife conflict, and ensuring safety and effective governance. Further consultations held between 17 and 19 September 2025 with street vendors, village representatives, and women groups brought attention to the need for improved road conditions, safe drinking water, sanitation, health awareness, and local employment opportunities. Subsequent interactions on 17 September, 25 September, 3 and 9 October 2025, including youth groups and FPIC consultations, demonstrated strong community willingness to support the project, with agreements on road improvements, safety measures, drainage, sanitation facilities, and development of community infrastructure such as waiting sheds and footpaths.

### E. 10 Conclusion

The project is expected to bring significant socio-economic benefits by improving connectivity and access while incorporating climate-resilient and environmentally sustainable design features. Although the project has some environmental and social risks, these are manageable through the proposed mitigation measures and management plans. With proper implementation of the ESMP and continuous stakeholder engagement, the project can achieve its objectives while minimizing adverse impacts and enhancing overall community well-being.

# 1. INTRODUCTION

## 1.1 BACKGROUND

The Meghalaya Logistics and Connectivity Improvement Project (MLCIP), with a total investment of USD 300 million comprising USD 240 million from the World Bank and USD 60 million from the Government of Meghalaya (hereinafter refer to as the state government) aims to: a) enhance connectivity to key growth centers along identified road corridors; b) improved rural and district-level logistics infrastructure and services; c) provide greater market access and reduced average cost/time for select agriculture and horticulture products; and, d) strengthen institutional capacity for efficient, climate-resilient transport and logistics, West and East Meghalaya. The rehabilitation of the state roads will be carried out in phases.

MLCIP includes roads totaling to approximately 300 km. The proposed AP Sub Project Road has a total length of 7.770 Km, commencing from Chopapara Village at chainage 19+000 and terminating at Purakhasia at chainage 26+770.

No additional land is required for the proposed road improvement but for spoil disposal 0.35 ha land is temporarily required.

The sub-project would include reconstruction and upgradation of the existing pavement from a single lane carriageway to intermediate lane. The sub-project involves reconstruction and upgradation of the existing pavement from a single-lane carriageway to an intermediate lane, incorporating climate-resilient design measures suited to the high rainfall conditions of Meghalaya. Based on FPIC consultations, several location-specific interventions have been integrated into the DPR to address community concerns and site vulnerabilities. These include riverbank and erosion protection through toe walls, gabion walls, and river training works.

## 1.2 SCOPE FOR CONDUCTING THE ESIA STUDY

The sub-project is rated as Substantial risk based on the screening due to significant environmental and social sensitivities along the project corridor such as erosion, drainage issues, and 5 Project Affected Households (PAH), leading to notable livelihood concerns. During the consultations, it was also found that during monsoon, few sections of the road get inundated. Considering these factors, along with the need for climate-resilient measures such as improved drainage, slope protection, and durable pavement design to address high rainfall conditions, the sub-project has been classified as substantial Risk. [1]

- Collection of project information
- Literature review and data compilation
- Baseline environmental and social assessment
- Identification of potential impacts
- Stakeholder identification and consultation:
- Preliminary climate and cumulative impact assessment:
- Environmental and Social Management Plan (ESMP) preparation
- Monitoring framework:

[1] The project has obtained **53.125% as per environmental screening criteria and therefore categorize as Substantial risk**. The social risk is categorized as **Moderate** since the impact on affected households involves **less than 10% loss of assets, including both land and structures**, indicating temporary shifting and manageable livelihood impacts. Hence, the sub-project falls under the **Substantial risk**

## 1.3 APPROACH AND METHODOLOGY

The methodology adopted for the ESIA complied with the requirements of the World Bank ESF (ESSs), the EIA Notifications of the Ministry of Environment, Forest and Climate Change (MoEF&CC), the Indian Roads Congress (IRC) guidelines, the MoRTH Guidelines, and other national guidelines. The following table summarizes the approach adopted for conducting the ESIA study.

Table 1.1: Approach and methodology adopted for conducting the ESIA

| Sl. No. | Stages | Activities Done |
|---|---|---|
| 1. | Screening and Scoping | Identified key issues through primary and secondary surveys, assessed stakeholders, and analyzed potential impacts considered in the Environmental and Social Impact Assessment, following the Free, Prior, and Informed Consent (FPIC) process to ensure meaningful participation and consent of Indigenous Peoples and affected communities. . |
| 2. | Public Consultation for Scoping Report | Identified key issues to understand stakeholder concerns and inform sub-project design and build awareness on the project including the Free, Prior, and Informed Consent (FPIC) process. This involved engaging with Indigenous Peoples and affected communities through meaningful consultations in a transparent and participatory manner. Consultations were held with the community which includes village heads and community members to raise awareness about the project and the need for FPIC. These consultations allowed the community to be briefed on the role of the ESIA consultants and seek permission to meet and discuss the different components of the project activities. |
| 3. | Baseline Data Collection | Gathered and reviewed primary and secondary data on environmental and social conditions in and around the sub-project area, including air quality, water resources, biodiversity, cultural heritage, and socio-economic factors. Primary physical monitoring was carried out as per the EIA guidelines. For ecological monitoring, transect walks, quadrat analysis, community consultation were carried out. The Forest Department, GoM, provided the maps demarcating the legally protected forest including “community reserve”. Information was also providing about the Wildlife crossing/ wildlife corridors. Information was also collected for the Forest Department, GoM about the animal kills / collisions on these corridors. In addition to these data collection form secondary sources, primary data on natural environment was also collected. Potential areas of community health safety conflicts were also identified and the design team was informed about these. |
| 4. | Impact Assessment | Using baseline data, the AP sub Project road potential impacts on the environment and local communities were assessed, including direct and indirect effects, as well as short-term and long-term impacts. A targeted assessment was carried as a part of ESIA since the sub-project area falls under a Schedule VI region with the presence of tribal communities. The Second round of FPIC consultations were undertaken as part of the impact assessment to ensure meaningful engagement with Indigenous Peoples (IP’s) to further discuss the project design, benefits and impacts, and to provide the communities’ priorities and inputs to drafting of the mitigation plans and measures. During this consultation, IPs’ written consent to proceed with the Project has been recorded through a resolution and countersigned by the participants, with attendance sheets, photos, etc. and attached as Annexure 7.3. |
| 5. | Mitigation and Management Measures | Based on the impact assessment, measures were proposed to mitigate or minimize adverse environmental and social impacts while enhancing positive outcomes. These included exploring Project road design alternatives to reduce Involuntary resettlement and environmental degradation, community health safety conflicts etc were carried out. These measures have been integrated in the draft Environmental and Social Management Plan, Resettlement Action Plan, Indigenous People's |

| Sl. No. | Stages | Activities Done |
|---|---|---|
| | | Development Plan, including project-level Labor Management Procedures, Stakeholder Engagement Plan and SEA/SH Action Plan, among others. |
| 6. | Draft ESIA Report | A draft report summarizing the findings of the Environmental and Social Impact Assessment (ESIA) has been prepared. |
| 7. | Public Disclosure of ESIA | Public Consultations informed each stage of the ESIA development. In accordance with both GoM and WB requirements, the draft ESIA report and mitigation plans (ESMPs, RAP, IPDP) has been prepared for disclosure and public consultation. Stakeholders, including local communities, NGOs, government agencies, and experts, will be invited to provide feedback and the final report will be revised based on the feedback received.<br>In addition, No Objection Certificates (NOCs) will be obtained from the village-level traditional institutions to ensure community consent and administrative approval before proceeding with the project in the proposed area. |
| 8. | Final ESIA Report | The draft ESIA report and mitigation plans (ESMPs, RAP, and IPDP) will be finalized by incorporating feedback from the public consultation. Comments received will be addressed, and the assessment or proposed measures/plans will be revised as necessary. |
| 9. | Approval and Implementation | The final ESIA report along with mitigation plans will be submitted to the MPWD and the World Bank. |
| 10. | Monitoring | Monitoring of ESIA implementation and management of risks throughout the project implementation |

Table 1.2: Source and methodology for primary and secondary data collection

| Parameters | Secondary Source |
|---|---|
| | **Environment** |
| Air | **Primary Survey**<br>**Primary Monitoring (PM10, PM2.5, SOx, NOx) at 3 Locations**<br><br>**Secondary Source**<br>Central pollution control Board (CPCB, https://cpcb.nic.in/) / Meghalaya State Pollution Control Board (MSPCB, https://megspcb.gov.in/) |
| Water | **Primary Survey**<br>**Primary Monitoring at**<br><br>**Secondary Source**<br>1. District Survey Report, South West Garo Hills District, 2024(Announcements \| South West Garo Hills District \| India)<br>2.CGWBData 2024 (https://cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Meghalaya/SOUTH%20WEST%20GARO%20HILLS%20FINAL.pdf**)** |
| Noise | **Primary Survey**<br>**Primary Monitoring**<br>**Secondary Source**<br>CPCB (https://cpcb.nic.in/regulation-control/) |
| Soil | **Primary Survey**<br>**Primary Monitoring**<br>**Secondary Source**<br>1. District Irrigation Plan 2016-2020(https://pmksy.gov.in/mis/Uploads/2017/20170331051403254-1.pdf )<br>2.Mapping India's Climate Vulnerability A District Level Assessment (2021) (https://www.ceew.in/sites/default/files/ceew-study-on-climate-change-vulnerability-index-and-district-level-risk-assessment.pdf) |
| Biodiversity | **Primary survey**<br>1.Field observation<br>2.Vegetation assessment was conducted using Nested Quadrate method<br>4.Faunal assessment was conducted using Visual encounters, sign survey, line transect, and netting survey method<br>6.LULC analysis through ground truthing<br><br>**Secondary Source**<br>1.Desktop study/secondary data collection - Govt. notified acts, peer review published scientific articles, Govt. reports,<br>2.Online open-source biodiversity databases such as Meghalaya Biodiversity Portal (https://megbiodiversity.nic.in/), PARIVESH Portal (MoEF&CC) (https://parivesh.nic.in/), Global Forest Watch (https://www.globalforestwatch.org/), IUCN Red List of Threatened Species(https://www.iucnredlist.org/) |

| Parameters | Secondary Source |
|---|---|
| | 3.Stakeholder consultation |
| Hazards and Vulnerability | **Primary survey**<br>Field observation and Consultation with concerned departments and local community<br>**Secondary Source**<br>1. District Disaster Management Plan for South West Garo Hills, 2024 https://southwestgarohills.gov.in/disaster-management/)<br>2. Meghalaya State Disaster Management Authority (MSDMA) (https://msdma.gov.in/) |
| Natural Environment | **Secondary Source**<br>1.Customized Rainfall Information System, Hydromet Division, IMD (https://hydro.imd.gov.in/)<br>2. District Census Handbook South west Garo Hills (https://southwestgarohills.gov.in/demography/)<br>3.Geological Survey of India(https://www.gsi.gov.in/webcenter/portal/OCBIS)<br>4. District Irrigation Plan 2016-2020 (https://pmksy.gov.in/mis/Uploads/2017/20170331051403254-1.pdf)<br>5. Consultant's Analysis, Source IMD Gridded Data(https://www.imdpune.gov.in/cmpg/Griddata/Rainfall_25_NetCDF.html)<br>6. State Action Plan on Climate Change (SAPCC), Meghalaya(https://moef.gov.in/uploads/2017/08/Meghalaya.pdf)<br>7. Statistical Handbook, Meghalaya 2023 (https://des.megplanning.gov.in/documents/SHB2023-as-on-02-05-24.pdf) |
| Climate | **Secondary Source**<br><br>India Meteorological Department – Shillong Climatological Normals, (1991–2020) (https://dsp.imdpune.gov.in/home_normals.php#) |
| | **Land and Livelihood Impact** |
| Land, Livelihood and Common Property Resources | **Primary survey**<br>1.Census/Household Survey (PAH:5)<br>2.Focus Group Discussions (3)<br>3.Key Informants Interviews (25)<br>4.Field Observations<br>**Secondary Source**<br>Census 2011 (https://www.census2011.co.in/) |
| | **Other Socio-Economic Parameters** |
| Ethnicity | **Primary survey**<br>Consultation,<br>Focus Group Discussion<br>**Secondary Source**<br>Census 2011(https://www.census2011.co.in/) |
| Gender | **Primary Survey**<br>Focus Group Discussion |

| Parameters | Secondary Source |
|---|---|
| | Public Consultations<br>Interviews<br>**Secondary Source**<br>Workforce Participation Rate as per Census 2011 (https://www.census2011.co.in/)<br>National Family Heath Survey- 5<br>(https://mohfw.gov.in › files › NFHS-5_Phase-II_0) |
| Prevalence of GBV | **Primary survey**<br>Focus Group Discussions with women group<br>**Secondary Source**<br>Police records<br>National Crime Records Bureau (NCRB)<br>(https://ncrb.gov.in) |

## 1.4 STRUCTURE OF THE ESIA REPORT

This Environmental and Social Impact Assessment (ESIA) report has been structured into ten chapters including this introduction chapter as follows.

| CHAPTER | DESCRIPTION |
|---|---|
| Chapter 1 | INTRODUCTION |
| Chapter 2 | LEGAL AND INSTITUTIONAL FRAMEWORK |
| Chapter 3 | PROJECT ROAD DESCRIPTION |
| Chapter 4 | THE BASELINE ENVIRONMENT |
| Chapter 5 | ENVIRONMENTAL AND SOCIAL RISKS AND |
| Chapter 6 | ANALYSIS OF ALTERNATIVES, |
| Chapter 7 | STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE |
| Chapter 8 | ENVIRONMENTAL AND SOCIAL MONITORING & REPORTING PROGRAMME |
| Chapter 9 | GRIEVANCE REDRESSAL MECHANISM |
| Chapter 10 | CONCLUSION AND RECOMMENDATIONS |

# 2. LEGAL AND INSTITUTIONAL FRAMEWORK

This chapter reviews all acts, rules, and policies applicable to the proposed road development.

## 2.1 APPLICABLE ENVIRONMENTAL AND SOCIAL REGULATIONS/ ACTS/ POLICIES AT NATIONAL AND STATE LEVEL

To understand the scope of the environmental and social assessment for the proposed improvements or road works, the relevant laws, legislation, and policies at the national and state levels were reviewed and summarized in Table 2.1 below, including an examination of the legal and institutional frameworks applicable to indigenous and tribal communities as part of the targeted assessment.

Table 2.1: Applicable Environmental and Social Regulations/ACTs/Policies

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| **ENVIRONMENTAL REGULATIONS** | | | | | |
| 1 | Environment Protection Act/ Rules 1986 | The Environment Protection Act, 1986 (the "Environment Act") provides for the protection and improvement of the environment. Under the Environment Act, the Central Government issues notifications for the protection of ecologically sensitive areas or issues guidelines for matters under the Environment Act | The various environmental quality standards notified under this act apply to MPWD works. | | Meghalaya State Pollution Control Board (MSPCB) |
| 2 | EIA Notification 14th Sep 2006 and 17 March 2025 | Quarrying of minerals (earth, sand, aggregates, etc.) will require prior environment clearance under mining category | Quarrying of minerals (earth, sand, aggregates, etc.) for embankment, bridge, approach road construction | Environmental Clearance through Contractor | SEIAA Meghalaya |
| 3 | Air (Prevention and Control of Pollution) Act, 1981, 1987 | To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes. | Air pollution from proposed Batching Plant or Hot mix plants, stone crusher, DG set etc. during construction stage | Consent to Establish and operate through Contractor | Meghalaya State Pollution Control Board (MSPCB) |
| 4. | Water Prevention and Control of Pollution) Act, 1974, 1988 | To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water. | Water pollution during the construction stage from construction/labour camp | Consent to Establish and Operate through Contractor | Meghalaya State Pollution Control Board (MSPCB) |
| 5. | Noise Pollution (Regulation and Control Act) 2000 and amendment till date | The ambient noise standards for day and night across various land use categories were notified by the MoEF&CC under the Noise Pollution (Regulation and Control) Rules, 2000, based on recommendations of the CPCB | Noise emission from proposed activities during construction stage like operation of DG sets, equipment and concrete mixers should be within applicable standards | Regulatory clearance not required but noise monitoring results should be below applicable standard as per CPCB . | MSPCB |
| 6 | Hazardous & Other Wastes | Protection against improper handling, storage and disposal of | Hazardous waste generation from proposed activities like generation of | Contractor to obtain authorization for storage, | MSPCB |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | (Management and Trans-boundary Movement) Rules, 2016 and March, 2024 | hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal. | paints waste, used oil/waste oil, bitumen waste, etc. | transport, and disposal of hazardous and other wastes | |
| 7 | Construction and Demolition Waste Management Rules, 2016 | To manage the demolition and construction waste and prevent environmental degradation | Construction and demolition waste will be generated from proposed activities | Required permission will be obtained by Contractor for proper disposal as per the site specific waste management plan. | Village Council, Municipal Boards |
| 8 | Solid Waste management Rules, 2016 and amended thereof | To manage solid waste or semi-solid domestic waste, sanitary waste | Solid Waste will be generated from proposed activities due to influx of labour | Required permission will be obtained by Contractor for proper disposal as per the site specific waste management plan. | Village Council, Municipal Boards |
| 9 | Vehicle Act 1988 Central Motor Vehicle Rules 1989 | To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution. | Transportation of manpower and material will involve vehicular movement. Vehicles must have valid Pollution Under Control (PUC) certificates, Insurance, Fitness Certificate. Driver should have valid Driving License. | PUC and fitness certificates, Insurance. Driving License, Fitness Certificate should be submitted to the PMU before the vehicle is mobilized in the project | State Transport Authorities approved PUC certificate providers |
| 10 | The Gas Cylinder Rules 2016 | To regulate the storage of gas / possession of gas cylinder more than the exempted quantity. | Gas cylinders may be used during welding and other electromechanical work. Storage within threshold quantity and as per capability analysis. Handling with defined safe practices | Yes, Permission will be required by the Contractor if the storage of gas / possession of gas cylinder is more than the exempted quantity(i.e more than 25 cylinders of total weight exceeding 200 kg for flammable non-toxic gases). | Petroleum and Explosives Safety Organization (PESO) |
| 11 | The Mines and Minerals (Development and Regulation) Act, 1957 | For development and regulation of mines and minerals in a sustainable manner. The rules regulate the mining of mineral and dealerships for mining and trading. | The construction of works will require stones, aggregates, sand, earth, etc. | The mining permit,EC and CTO has to be submitted to the PMU for clearance .No material shall be procured without the approval .For material procured | Mines and Mineral Department |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | | | | during the constrction the e-transit pass would be submitted along with IUFR. | |
| 12 | Wildlife protection Act 1972, 2022 | Protection of wildlife in the state of Meghalaya | Wildlife impact is not anticipated in this project. | No | State Forest Department |
| 13 | Meghalaya Tree (Preservation) Act, 1976, and the Meghalaya Tree Felling (Non-Forest Areas) Rules, 2006 | Conservation of forest and controlled felling of trees | Approx. 14 nos of tree are falling within the ROW. | Permission for felling of trees | State Forest Department |
| 14 | Disaster Management Act, 2005 | The purpose is to have an effective management of disasters and for matters connected therewith or incidental thereto | The project area falls under the seismic (earthquake prone) zone V and hence construction activities/ interventions will be under purview of this act | No.<br>Contractor should be aware of Guidelines/SOPs/Advisory of MSDMA | Meghalaya State Disaster Management Authority (MSDMA)/MPWD |
| 15 | Meghalaya Disaster Management Rules, 2008 | The rule is to provide measures' to be adopted for prevention and mitigation of disaster; mitigation measure to be integrated with development plans and projects; build capacity and preparedness measure; and specify roles and responsibilities to each dept. in relation to adopted measure | During implementation, setting of labour camps and capacity building of contractor staff | No<br>Contractor should be aware of Guidelines/SOPs/Advisory of MSDMA<br>No tree felling shall be felled without permission from the Forest Department. | Meghalaya State Disaster Management Authority (MSDMA)/MPWD |
| 16 | Plastic waste management Rules, 2016 | The Plastic Waste Management Rules, 2016 provide a framework for the effective management of plastic waste. They aim to minimize the adverse environmental impact of plastic waste and promote sustainable practices for its handling and disposal. | Plastic waste generation from proposed activities. Safe disposal as per Rules | No.<br>Properly segregate plastic waste at source and hand it over to authorized waste collectors, local bodies, or MSPCB authorized agencies/Recyclers | Village Council/ Municipal Authority/MSPCB |
| 17 | Petroleum Act, 1934, Petroleum | Regulates the storage, transport, handling, and use of petroleum and | Storage of High Speed Diesel (HSD) at construction sites (above threshold limits | License for storage from PESO (Petroleum and Explosives | PESO, Nagpur (through Regional Office) & |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | Rules, 2002 (under the Petroleum Act, 1934) | diesel. Requires licenses for storage of petroleum products beyond prescribed limits. | of 2,500 liters in multiple barrels or 1,000 liters in a single tank requires license/approval. | Safety Organization) for >25000L; NOC from District Authority/Fire Department. (for >2500 L to 25000L) | District Magistrate/Chief Controller of Explosives. |
| 18 | Ground Water Regulation (Central Ground Water Authority – CGWA Guidelines, 2017, adopted by States) | Governs the extraction of groundwater for industrial, infrastructure, or commercial use. Requires NOC/permission prior to abstraction. | Applicable (if groundwater extraction proposed)<br>Groundwater extraction for construction, camp use, or dust suppression requires prior permission. | NOC for groundwater abstraction. | CGWA or State Ground Water Authority (if notified). |
| 19 | The Meghalaya Water Act, 2011 | State-level mandate for use of surface water from rivers, streams, ponds, lakes, etc. for non-domestic/commercial purposes. | Construction water requirements may involve use of surface water from nearby streams/rivers with state approval.<br>Surface water from the Didram river can be used for road construction with prior permission from the Water Resources Department, North Garo Hills District, Meghalaya. | Permission/Allocation order for surface water abstraction. | Water Resources Department, Government of Meghalaya. |
| **SOCIAL REGULATIONS** | | | | | |
| 1. | Article 244(2) &275(1) of the Constitution of India - The Sixth Schedule | Article 244(2) establishes Autonomous District Councils (ADCs) in tribal areas, granting them legislative and administrative powers, empowering them to legislate on land, resources, and local governance. Article 275(1) provides financial grants for the welfare and development of Scheduled Tribes and Scheduled Areas | Applicable in designated tribal areas under the Sixth Schedule | No | Government of India, Autonomous District Councils |
| 2. | The Meghalaya Transfer of Land (Regulation) Act, 1971 | The Act stipulates that no land (including immovable property of every description and any rights over such property) in Meghalaya can be transferred by a tribal to a non-tribal | Relevant to all project interventions involving land acquisition, leasing, or transfer. The project will ensure that all land-related activities including documentation, due diligence, and land management planning | Prior permission / No Objection from the concerned Autonomous District Council and compliance with the | Revenue Department; Village Councils-Autonomous District Councils (ADCs) |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | | or by a non-tribal to another non-tribal except with the prior sanction of the competent authority. | comply with this Act. No land transfer or use will be undertaken without approval from the competent authority, ensuring protection of tribal land rights and consistency with ESS5 (Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement).. | provisions of the Act before land transfer or acquisition. | |
| 3. | The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 | The Act ensures transparent land acquisition with fair compensation, rehabilitation, and resettlement. It sets minimum compensation norms, R&R entitlements, and facilities for the displaced, allowing states to enhance benefits.<br><br>The Act also includes special provisions to protect the interests of Scheduled Castes and Scheduled Tribes. | Yes, as the area falls under 6th schedule<br>A review of the legal and institutional framework applicable to indigenous/tribal communities. | No | Revenue Department, Government of Meghalaya, Garo Hills Autonomous District Council<br>The Sixth Schedule establishes the ADC or VC as institutional mechanisms for governing these areas. |
| 4. | Meghalaya Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2017 | Aim to provide a fair, transparent, and participatory process for land acquisition while ensuring adequate compensation and rehabilitation for affected families. These rules align with the broader objectives of the RFCTLARR Act to minimize the adverse impact of land acquisition and promote the welfare of those affected by it. | Impact on private Assets and properties | Ensure fair compensation and Guarantee transparency in the acquisition process. | Revenue Department/ District Administration, Village Council |
| 5. | Rights of Persons with Disabilities Act, 2016 | Ensures that the Persons with Disability (PWD) enjoy the right to equality, life with dignity, and respect for his or her own integrity equally with others. | For the entire Project road corridor where PwD are present and affected, and for designing the project in an inclusive manner. | No | Department of Social Welfare, Government of Meghalaya |
| 6. | Right to Information Act, 2005 | The Act provides for setting out the practical regime of right to | All documents pertaining to the project would be disclosed to public. | No | Public Information Officer (PIO) |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | | information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, the constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto. | | | |
| 7. | The Cadastral Survey and Preparation of Records of Rights Act, 1980 (as amended in 1991) | The Act provides for cadastral survey of lands and preparation of land records in the state. The 1991 amendment enables the ADCs to undertake cadastral surveys with financial and technical assistance from the State Government. | Applicable for project activities involving detailed mapping and verification of land ownership or tenure. Under Project, cadastral mapping and systematic land documentation will support preparation of RAP and verification of community and private ownership. Prior clearance from the concerned village councils will be obtained for all project interventions located on or adjacent to community forest land, in line with ESS1 and ESS5. | yes | Revenue and Disaster Management Department; Autonomous District Councils (ADCs) |
| 8. | GHAD (Land transfer regulation) 1958 | Regulates the transfer of land within the Garo Hills to protect tribal land ownership. It restricts transfer of land from tribal communities to non-tribals without prior approval of the Autonomous District Council. | Applicable where land within the jurisdiction of the Garo Hills Autonomous District Council is involved in acquisition, transfer, or use for development projects. If the project utilizes existing government ROW without land transfer, it may not require permission. | Prior permission/No Objection Certificate (NOC) may be required for transfer, lease, or use of land falling under the jurisdiction of the District Council. | Garo Hills Autonomous District Council |
| **LABOUR LAWS APPLICABLE** | | | | | |
| 1 | Building and Other Construction Workers (Regulation of Employment and | It regulates the employment and conditions of service of building and other construction workers and provides for their safety, health and welfare. | Applicable for all building or other constructions works under the project that employs 10 or more workers. | Establishment Registration is required | Labour Commissioner, Meghalaya |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | Conditions of Service) Act, 1996 | | | | |
| 2 | Workmen Compensation Act, 1923 | It provides for payment of compensation by employers to their employees for injury by accident i.e., personal injury or occupational disease. | Construction workers will be involved in the Project road corridors | Workmen compensation Insurance Policy | Commissioner for Workmen's Compensation |
| 3 | ESI Act, 1948 (Employees State Insurance Act, 1948) | Employees State Insurance Act provides for health care and hospitalization benefits for construction work force | Construction workers will be involved in the Project Road corridors | Insurance Policy. | Commissioner for Workmen's Compensation |
| 4 | Inter-state Migrant Workers Act, 1979 | It protects workers whose services are requisitioned outside their native states in India. A contractor who employs or who employed five or more Inter-State migrant workmen need to obtain registration under this act | Construction workers will be involved in the Project Road corridors | Registration/Labour license | Labour Commissioner, Meghalaya |
| 5 | The Child Labour (Prohibition & Regulation) Amendment Act, 2016 | It prohibits employment of children in specified hazardous occupations and processes and regulates the working conditions in others. | There should not be any child labour (less than 14 years) in any project activity and adolescents (above 14 and less than 18 years) in any hazardous activity. | No | Labour Commissioner, Meghalaya/ Department of Social Welfare, Government of Meghalaya |
| 6 | Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act) | It mandates every organization having more than ten employees to constitute an Internal Complaints Committee (ICC) in the prescribed manner to receive and address the complaints of any sort of sexual harassment from women in a time-bound and extremely confidential manner | Applicable to all implementing agencies | No | District Officer (District Magistrate or Additional District Magistrate) |
| 7 | Contract Labour (Regulation & Abolition) Act 1970 | To provide proper and habitable working conditions. To regulate the functioning of the advisory boards. | Applicable to all implementing agencies | Labour License Required | Labour Commissioner, Meghalaya |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | | To lay down the rules and regulations regarding the registration procedure of the establishments employing contract labour | | | |
| 8 | Payment of Wages Act, 1936 and the Minimum Wages Act, 1948 | Lays down as to by what date, wages are to be paid, when it will be paid and what deductions be made from the wages of the workers, if any. | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 9 | Payment of Gratuity Act, 1972<br>The payment of gratuity rules Meghalaya 1972 | Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation, if an employee has completed 5 years of service with employer | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 10 | Employees Provident Fund and Miscellaneous Provision Act, 1952 | Provides for monthly contributions by the employer and as well as by workers with a provision as return of pension of a lump sum (principal and interest accrued) at the end of his/her service term). | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 11 | Maternity Benefit Act, 1951<br>Meghalaya Maternity benefit Rules 1965 | Provides for maternity leave for women, during pregnancy and after giving birth and some other benefits to women employees, in case of medical recommendation of bed rest or miscarriage etc. | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 12 | Payment of Bonus Act, 1965<br>The Payment of Bonus Rules Meghalaya 1975 | Provides payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages. | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 13 | The Bonded Labour (Abolition) Act 1976<br>Bonded Labour System (Abolition) Rules 1976 | An Act to provide for the abolition of bonded labour system, with a view to prevent economic and physical exploitation of the weaker sections of the people and for all | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| | | matters connected there with or incidental thereto | | | |
| 14 | The Trade Union Act, 1926 | Lays down the procedure for registration of trade union of workers and employers. The trade unions registered under the Act have been given certain immunities for civil and criminal liabilities. | Applicable to all implementing agencies | No | Labour Commissioner, Meghalaya |
| 15 | Schedule Caste and Schedule Tribe (Prevention of Atrocities Act 1989) | Atrocity with SC and ST community is defined as an offense punishable under Section 3 of the Act | Project Area is protected under Sixth Schedule of the Constitution | No | Social Welfare Department, Meghalaya |
| 16 | Meghalaya Right to Public Services Act, 2020 | Ensures timely delivery of notified public services to citizens by government departments, enhancing transparency, accountability, and efficiency in governance. | Applicable to all government departments and public service providers in Meghalaya | No | Meghalaya State Public Services Delivery Commission (MSPSDC) |
| 17 | Occupational Safety, Health & Working Conditions (OSH) Code, 2020 + Meghalaya Factories Rules, 2015 | Site safety standards, PPE, welfare amenities, working hours, accident reporting, medical checks, registration of establishments. | Applicable to all construction, labour camps, work fronts, and site facilities | Yes* | Labour Commisioner, Government of Meghalaya |
| 18 | Code on Wages, 2019 + Meghalaya Minimum Wages Notifications (latest revision) | Minimum wages (Skilled/Semiskilled/ Unskilled), equal pay, wage slips, timely payment, prohibition of illegal deductions. | Applicable to all wage payments through contractors and subcontractors at MLCIP sites. | Yes* | Labour Commisioner, Government of Meghalaya |
| 19 | Industrial Relations (IR) Code, 2020 + Meghalaya Industrial Disputes Rules, 1973 | Conciliation, dispute settlement, prohibition of unfair labour practices, notice of changes in service conditions. | Applicable for grievance redress, worker disputes, conciliation and retrenchment-related issues. | Yes* | Labour Commisioner, Government of Meghalaya |

| Sl. No. | Relevant Acts and Policies | Mandate of the Act/ Policy | Reason for applicability/ Non-applicability | Regulatory Clearance Requirement | Authority |
|---|---|---|---|---|---|
| 20 | Code on Social Security, 2020 + Meghalaya BOCW Welfare Board Rules, 2006 | Social security benefits, maternity benefits, PF/ESI, construction worker registration, insurance and disability benefits. | Applicable to EPF/ESI coverage (where notified), worker registration, welfare board benefits. | Yes* | Central: EPFO, ESIC<br>State: Meghalaya BOCW Welfare Board; Labour Department<br>State Rules: Meghalaya BOCW (RE&CS) Rules, 2006 |

**The labour codes shall be applicable in the state of Meghalaya upon receiving notification from the Government of Meghalaya.*

## 2.2 IRC AND MORTH CODES APPLICABLE TO THE PROJECT

All road works in India must comply with the IRC, MoRTH guidelines and BIS Codes. Key relevant IRC codes that may directly or indirectly influence the environmental and social management during the design, construction and operational phases are given in **Annexure 2.1**.

## 2.3 LAND REVENUE GOVERNANCE AND ADMINISTRATION IN GHADC

When Meghalaya was formed in 1972, the Garo Hills Autonomous District Council (GHADC) was retained with its mandate and governance framework largely unchanged. Over time, the Autonomous District Councils (ADCs) have undertaken efforts to codify tribal customary laws through legislations enacted under their authority. Traditional customary institutions have maintained a strong presence in the region, and despite the historical shifts introduced by the British administration and subsequently the Indian State, these institutions have continued to function adapting their practices to align with evolving legal and administrative frameworks.

The Sixth Schedule of the Constitution of India provides the framework for the establishment of Autonomous District Councils (ADCs) in tribal areas. Members of the ADCs are elected by the tribal population for a term of five years. The Garo Hills ADC functions with its own rural and urban local bodies, serving as an important institutional layer of governance.

ADCs act as a bridge between formal state structures and traditional tribal institutions, ensuring that governance reflects both constitutional provisions and customary practices. The Sixth Schedule establishes a system of autonomous, decentralized governance, endowing ADCs with legislative, executive, and judicial powers, including authority to adjudicate certain categories of civil and criminal cases.

In rural areas, traditional institutions such as the Nokmas a two-tier political system among the Garos continue to play a central role. In practice, it is not the State Government, but rather the Autonomous District Councils (ADCs) in conjunction with tribal institutions, that function as the primary authorities for the administration and management of natural resources, including land.

In the Garo Hills, the traditional village chief (Nokma) is regarded as the owner and custodian of community lands. In practice, the Nokma's husband exercises rights to manage the land through his wife, and may dispose of land only with her consent. Village inhabitants are entitled to cultivate as much land as they require, and may select plots within the village boundary, subject to the Nokma's approval. Outsiders are also permitted to settle in the village, provided they offer either an annual rent or a one-time gift/present to the headman.

Details of land procurement mechanisms are provided below in Table 2.2.

Table 2:2: land procurement mechanisms

| *Category* | *Garos* |
|---|---|
| Basis of classification | Ownership of land |
| Type of land | 2 types of ownership a)Community Land b) Private Property<br>5 Types of land: 1.A-king Land, 2.A-mate land, 3.A-jinma or A-joma land , 4.A-jikse land, 5. A-milam land |
| Control and Management | The ancestral head Nokma (head of the clan) manages and allots land to the community. While the Maharis (clan members) look after A-jinma land. |
| Inheritance | Women inherit and own property: It is usually the youngest daughter who inherits the property. |
| Records | *Pattas* are the primary records available in the region, dating from the colonial period.<br>In Garo Hills, land is primarily owned and managed by the |

| *Category* | *Garos* |
|---|---|
| | communities and land records are generally maintained through customary institutions, where the Nokma (village head) manages and allocates A'king land (clan/community land) to clan members for cultivation and settlement. The Hill areas of Garo Hills are the A'King lands, which belongs to the A'King Nokma (headman) of a particular clan. The entire A'King lands are managed by the A'King Nokma who is the guardian and custodian of a particular clan or motherhood.<br>J.D. Walker demarcated the A'King land boundaries and gave the *Nokma*s settled maps in the late 1920s. The availability of patta documents in the villages part of the study show the colonial legacy which is often the only record of the land. (Marak, 1986). Garo Hill Autonomous District Council (GHADC) is known to have the maps for large parts of the district in the Garo Hills. |
| Systems for sale/purchase/ mortgage | Pattas are instrumental in mortgaging land in the bank for loans.<br>Selling of the land in the village requires the Nokmas presence as witness. Any transactions or inheritance pertaining to the land is recorded in the patta at the District Council, Office. The District Council do not have direct control over the A'King lands and cannot take any arbitrary decisions in matters of sale, mortgage, gift, transfer, etc. Land Classification. |
| Managing private property | The *Nokna* (heiress) is the owner of family property and has a say in management of both movable and immovable property, whether ancestral or self-acquired. Customarily, no property can be disposed of without the consent of the heiress. However, there might be variations in practice. |
| Managing community property | For the community lands, the power to make decisions is vested in the *Nokma* of the village. For the clan land, the *Nokna* (in heiress) along with her husband and the *chras* (brothers and maternal uncles) decides together. Any such transaction undertaken without prior consent of the wife *(Nokna)* andher C*hra* is considered null and void (Marak, 1986).[2] |

[2] Source:Momin, M. (Ed.). (2003). Readings in History and Culture of the Garos (Essays in honour of Milton S. Sangma). Regency Publications

Awensing R. Sangma: Atchu Ambini Poedorang, p 39; Also see Wangalani Bimik by the same author, pp 31-32.

Marak, G. S. (1986). *Janggi Tangani*. Tura, West Garo Hills: Published by Surendra S. Marak.

# 3. SUB PROJECT ROAD DESCRIPTION

## 3.1 AMPATI TO PURAKHASIA ROAD (AP) SUB PRO ROAD

The proposed sub project road existed before the formation of Meghalaya state and ROW is limited only up to the existing Drain. The proposed sub project road has a total length of 7.770 Km, commencing from Chopapara Village at Chainage 19+000 to Purakhasia Village at Chainage 26+770

## 3.2 LOCATION DETAILS OF THE AP SUB PROJECT ROAD

This sub project road traverses a diverse landscape, including hilly terrains, agricultural lands, built-up areas, and passes through, 02 villages including 03 habitations. The AP Road serves as a critical regional connector, enhancing access to economic hubs, industrial centers, and tourism destinations.

**Table 3.1** presents the chainage-wise details of AP Sub Project Road ,while **Figure 3.1** illustrates the road alignment map.

Table 3.1: Chainage wise AP Sub Project Road details

| Sl. No. | Starting Chainage | End Chainage | Suproject | Project length as per DPR | Districts |
|---|---|---|---|---|---|
| 1 | 19+000 | 26+770 | AP road | 8 | South West Garo Hills |

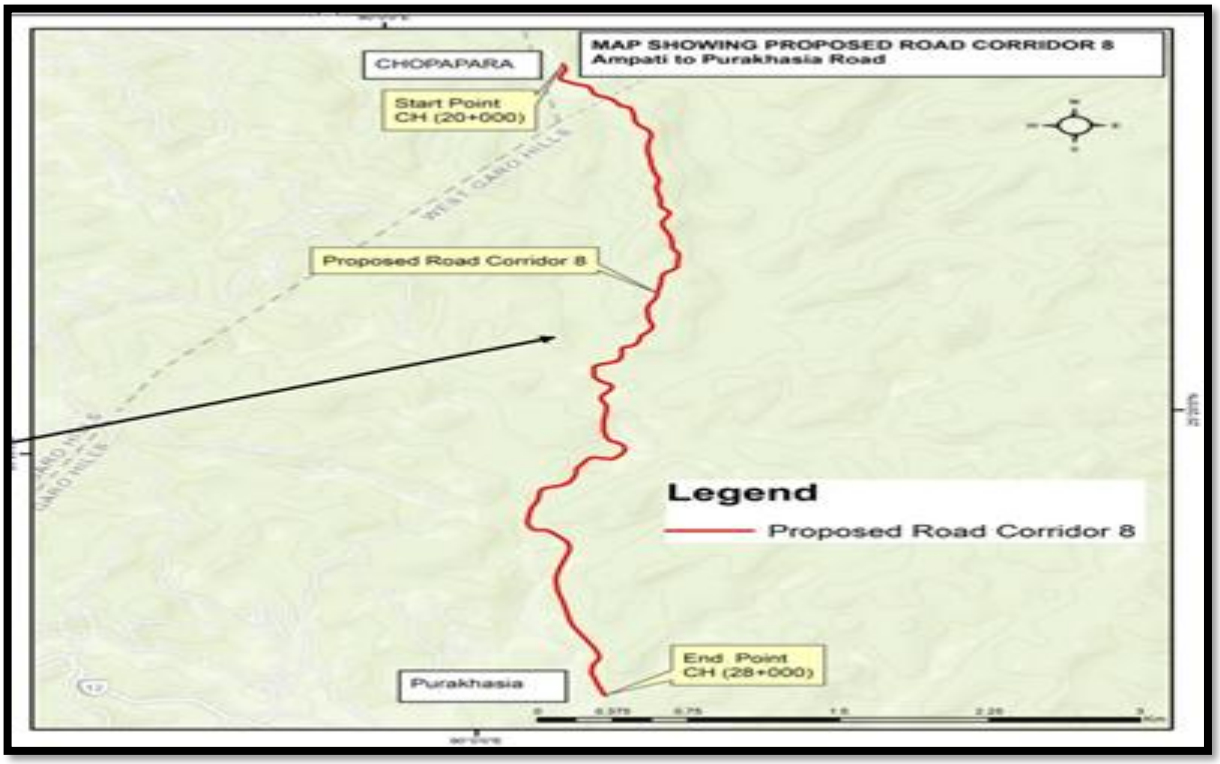



Figure 3.1: Road alignment map for AP Road

## 3.3 PROJECT INFLUENCE AREA

For the purpose of this study, the Project Influence Area has been categorized in three tiers to facilitate a holistic environmental and social impact assessment of the road stretch and to minimize potential environmental and social risks. Three tiers are given below

1. 12 m of ROW for Direct Impact (6m from Centre line) i.e. Corridor of Direct Impact (CoI)
2. 500 m buffer for indirect impact area [3] i.e. Corridor of Indirect Impact
3. 10 km of study area

The existing and proposed Right of Way (RoW) of the corridor has been considered adequate for characterizing baseline conditions and for assessing direct socio-economic impacts, including the profile of affected persons, religious structures, and common property resources.

The study impact area has been delineated as 0.5 km on either side of the RoW from the Centre line. This buffer has been considered adequate to cover drainage channels, biodiversity-rich zones, natural habitats, agricultural land, surface water bodies, physical features, and settlements, among others.

## 3.4 KEY EXISTING CONDITIONS AND PROPOSED IMPROVEMENTS OF THE AP ROADS

The key existing conditions and proposed improvements for the AP project road are presented in the following sub-sections. These have been compiled based on primary field surveys and the Detailed Project Report (DPR).

### 3.4.1 RIGHT OF WAY, CARRIAGE WIDTH AND PAVEMENT CONDITIONS

The Right of Way (RoW) and Carriage Way (CW) for the 7.770 Km sub-project road are summarized in **Table 3.2**. The existing road conditions are generally good, except potholes prevalent across some stretches. Inadequate drainage exacerbates deterioration during rainfall, making traffic movement difficult, particularly on earthen sections.

Existing Carriage width of Sub Project road is 3.75 m and proposed width is 5.5 m for intermediate lane. As per DPR design, the Sub project requires 11m – 12m. No land is required as ROW 12 m is available with PWD. Details of Available ROW are given in Table 3.7.

[3] Based on Earlier experiences it was observed that dust, noise and other environmental parameters would get attenuated/diluted to meet existing baseline conditions within 500 m from the source.

Table 3.2: Details of Available ROW

| Village | Chainge from | Chainage to | Length (m) | Available RoW as per Road inventry data 2023 |
|---|---|---|---|---|
| Chopapara | 19+000 | 21+515 | 2515.00 | 12.000 |
| Chopapara | 21+515 | 21+575 | 60.00 | 12.000 |
| Chopapara | 21+575 | 22+675 | 1100.00 | 12.000 |
| Chopapara | 22+675 | 22+800 | 125.25 | 12.000 |
| Chopapara | 22+800 | 22+814 | 13.50 | 12.000 |
| Chopapara | 22+814 | 22+950 | 136.25 | 12.000 |
| Chopapara | 22+950 | 23+010 | 60.00 | 12.000 |
| Chopapara | 23+010 | 23+134 | 124.00 | 12.000 |
| Chopapara | 23+134 | 23+172 | 38.00 | 12.000 |
| Chopapara | 23+172 | 23+300 | 128.00 | 12.000 |
| Chopapara | 23+300 | 23+830 | 530.00 | 12.000 |
| Chopapara | 23+830 | 24+644 | 813.75 | 12.000 |
| Chopapara | 24+644 | 24+720 | 76.50 | 12.000 |
| Chopapara | 24+720 | 24+810 | 89.75 | 12.000 |
| Chopapara | 24+810 | 24+940 | 130.00 | 12.000 |
| Chopapara | 24+940 | 25+020 | 80.00 | 12.000 |
| Mebitpara | 25+020 | 25+185 | 165.00 | 12.000 |
| Mebitpara | 25+185 | 25+256 | 70.50 | 12.000 |
| Mebitpara | 25+256 | 25+269 | 13.00 | 12.000 |
| Mebitpara | 25+269 | 25+308 | 39.50 | 12.000 |
| Mebitpara | 25+308 | 25+688 | 380.00 | 12.000 |
| Mebitpara | 25+688 | 25+760 | 72.00 | 12.000 |
| Mebitpara | 25+760 | 26+317 | 557.45 | 12.000 |
| Mebitpara | 26+317 | 26+329 | 11.10 | 12.000 |
| Mebitpara | 26+329 | 26+473 | 144.45 | 12.000 |
| DarongAdu | 26+473 | 26+533 | 60.00 | 12.000 |
| DarongAdu | 26+533 | 26+770 | 237.00 | 12.000 |
| **Total Length** | | | **7770** | |

**Pavement Details:**

The pavement design for the main carriageway has been carried out in accordance with the guidelines of IRC: SP: 72-2015 and IRC: 37-2018. The design is based on the following input parameters: a design life of 15 years, cumulative design traffic of 5 MSA, and an effective subgrade CBR of 5%. Based on these parameters, the adopted pavement composition comprises 40 mm Bituminous Concrete (BC), 170 mm Cement Treated Base (CTB), 200 mm Cement Treated Sub-Base (CTSB), and 500 mm prepared subgrade. To mitigate reflection cracking from the cementitious base to the bituminous surface, a Stress Absorbing Membrane Interlayer (SAMI) is proposed between the CTB and BC layers. The SAMI consists of an elastomeric modified binder applied at a rate of 10–12 kg per 10 $m^2$, followed by a cover of 0.1 $m^3$ of 11.2 mm size aggregates.

The pavement crust for the main carriageway has been designed and validated in accordance with IRC: 37-2018 and IRC: SP: 72-2015 using mechanistic–empirical analysis (IITPAVE). The computed critical strains are well within the allowable limits at 80% reliability, with horizontal tensile strain in the bituminous layer (54.21 με vs. allowable 416.8 με), vertical compressive strain on subgrade (316.3 με vs. allowable 784.4 με), and tensile strain in the CTB layer (81.88 με vs. allowable 271.9 με), indicating adequate structural performance. The tensile strain at the bottom of the CTB layer has also been verified, and cumulative fatigue damage analysis confirms that the damage under the expected axle load spectrum remains within permissible limits (less than unity). Accordingly, the proposed pavement crust comprising 40 mm BC, SAMI layer (as per MoRTH specifications), 170 mm CTB, 200 mm CTSB, and 500 mm subgrade is found structurally adequate. Although Indian Roads Congress recommends a minimum design life of 10 years, a more conservative design life of 15 years has been adopted to enhance durability and performance.

Recycling of pavement involves reclaiming and reusing existing pavement materials after suitable reprocessing for resurfacing, repaving, or full reconstruction, depending on pavement condition and material suitability. This approach offers significant environmental and economic benefits by conserving natural aggregates and reducing the demand for virgin bitumen. Disposal of existing pavement materials is minimized, thereby lowering environmental degradation associated with quarrying and dumping. In the present project, recycling of the existing bituminous pavement is proposed using milling and processing through a recycling plant for incorporation into new CTB/CTSB layers, in accordance with IRC:120-2015. The recycling strategy covers approximately 50% of the project length, with a salvage value of 20% considered in the analysis.

**Junctions Details:**

The details of major and minor junctions are provided in **Table 3.3**.

Table 3.3: List of Major and Minor Junctions of AP Road Section

| Sl.No | Chainage | Type | Side | Direction | Type of Junction |
|---|---|---|---|---|---|
| 1. | 23+200 | Y | RHS | Village | Minor |
| 2. | 26+770 | T | LHS | Village | Minor |

Details of Breast wall: Retaining and toe wall provisions have been proposed at vulnerable stretches to ensure slope stability and prevent erosion along the project corridor. A total of 450 m of retaining wall (left side) and 360 m of toe wall (right side), primarily in stone masonry, are planned at critical locations. Details of Retaining and Toe wall is given in 3.4.

Table 3.4**:** Summary of Retaining, Toe and breast wall

| Sl. No. | Chainage From | Chainage To | Length (m) | Height (m) | Type |
|---|---|---|---|---|---|
| Retaining wall | | | | | |
| 1 | 19190 | 19200 | 10 | 1 | Stone Masonry |
| 2 | 19240 | 19250 | 10 | 1 | Stone Masonry |
| 3 | 21610 | 21620 | 10 | 1 | Stone Masonry |

| | | | | | |
|---|---|---|---|---|---|
| 4 | 22220 | 22240 | 20 | 1 | Stone Masonry |
| 5 | 22760 | 22790 | 30 | 1 | Stone Masonry |
| 6 | 22870 | 22940 | 70 | 2 | Stone Masonry |
| 7 | 22980 | 22990 | 10 | 1 | Stone Masonry |
| 8 | 23140 | 23150 | 10 | 1 | Stone Masonry |
| 9 | 23610 | 23660 | 50 | 1 | Stone Masonry |
| 10 | 23700 | 23710 | 10 | 1 | Stone Masonry |
| 11 | 23750 | 23780 | 30 | 2 | Stone Masonry |
| 12 | 23860 | 23890 | 30 | 1 | Stone Masonry |
| 13 | 24130 | 24140 | 10 | 2 | Stone Masonry |
| 14 | 24200 | 24220 | 20 | 1 | Stone Masonry |
| 15 | 24280 | 24290 | 10 | 2 | Stone Masonry |
| 16 | 24430 | 24450 | 20 | 1 | Stone Masonry |
| 17 | 24650 | 24680 | 30 | 1 | Stone Masonry |
| 18 | 24720 | 24750 | 30 | 1 | Stone Masonry |
| 19 | 25220 | 25260 | 40 | 1 | Stone Masonry |
| Total Length = | | | **450 m** | | |
| **Toe Wall (Right Side)** | | | | | |
| 1 | **Start Chainage** | **End Chainage** | **Length (m)** | **Quantity / Side** | **Material Type** |
| 2 | 21610 | 21620 | 10 | 1 | Stone Masonry |
| 3 | 22520 | 22540 | 20 | 1 | Stone Masonry |
| 4 | 22610 | 22650 | 40 | 1 | Stone Masonry |
| 5 | 22690 | 22730 | 40 | 1 | Stone Masonry |
| 6 | 22750 | 22790 | 40 | 2 | Stone Masonry |
| 7 | 23140 | 23150 | 10 | 2 | Stone Masonry |
| 8 | 24650 | 24680 | 30 | 1 | Stone Masonry |
| 9 | 24720 | 24760 | 40 | 1 | Stone Masonry |
| 10 | 24950 | 24960 | 10 | 2 | Stone Masonry |
| 11 | 25000 | 25020 | 20 | 1 | Stone Masonry |
| 12 | 25230 | 25290 | 60 | 1 | Stone Masonry |
| 13 | 25670 | 25680 | 10 | 1 | Stone Masonry |
| 14 | 26520 | 26550 | 30 | 1 | Stone Masonry |
| 15 | **Total Length** | | **360** | | |

### 3.4.2 PROPOSED ROAD CROSS SECTIONS

The Ampati to Purakhasia Road (AP) Road traverses gently undulating to moderately rolling terrain with elevations ranging from 50 m to 212 m amsl. The project road stretch from Chainage 19+000 to 26+770 is predominantly designed as TCS-1 (normal fill/cut sections), forming the major portion of the alignment. Specialized treatments such as TCS-2 and TCS-4 are applied in localized stretches requiring cutting and protective works, while TCS-5 and TCS-6 are used for road widening and bioengineering measures in critical segments. Additionally, multiple bridge sections are interspersed along the alignment, indicating structural interventions at key crossings.

A total of 6 Typical Cross-Sections (TCS) have been proposed in the DPR (**Annexure 3.1**) for the 07.770 Km road stretch. These TCSs vary, with some sections incorporating intermediate lanes, and are specifically designed to address the terrain and infrastructure requirements of the corridor, including provisions for road widening, slope stabilization, drainage, and utility corridors.

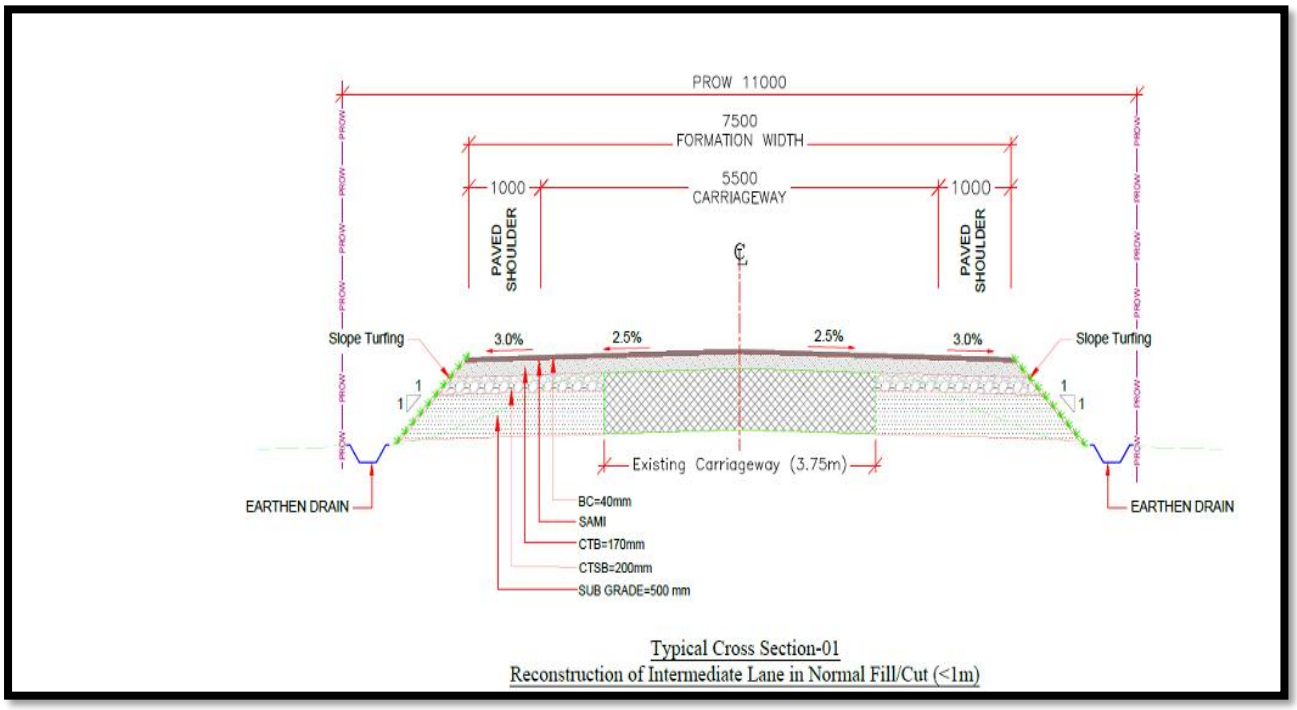
Based on these cross-sections, certain environmental and social impacts may arise, tree cutting, and disruption to local ecosystems, biodiversity loss, and alterations to the natural landscape

Details of the six different cross-sections, along with the chainage-wise designs adopted, are provided in **Annexure 3.1**. Design details are given in **Figure 3.2.**

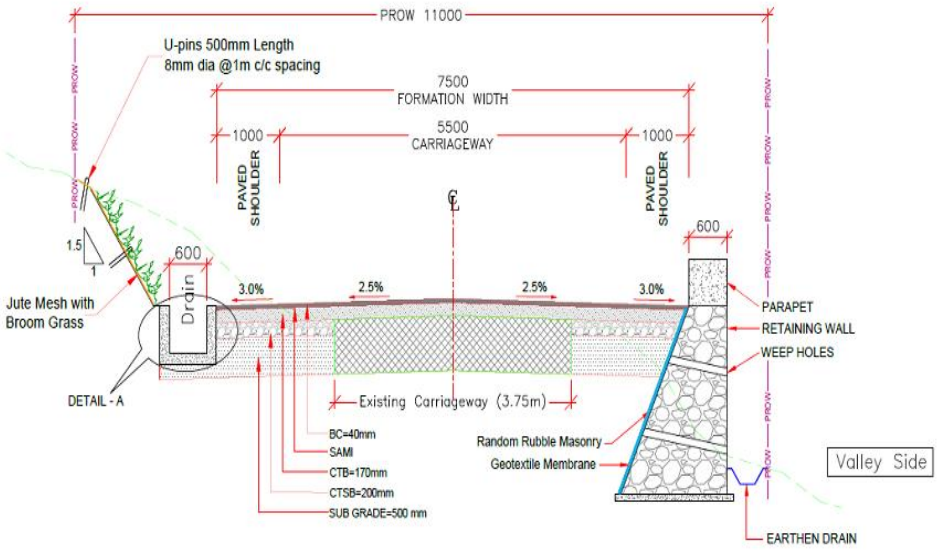
Table 3.5: TCS Types and their relevant Chainages

| Sl. No. | TCS Type | Updated Chainages |
|---|---|---|
| 1 | TCS-1 | 19+000–21+515; 21+575–22+675; 22+950–23+010; 23+172–23+300; 23+830–24+644; 24+810–24+940; 25+020–25+185; 25+308–25+688; 25+760–26+317; 26+329–26+473; 26+533–26+770 |
| 2 | TCS-2 | 22+675–22+800; 24+940–25+020; 26+473–26+533 |
| 3 | TCS-3 | 23+010–23+134 |
| 4 | TCS-4 | 22+814–22+950; 23+300–23+830 |
| 5 | TCS-5 | 24+720–24+810; 25+185–25+256; 25+269–25+308 |
| 6 | TCS-6 | 21+515–21+575; 25+688–25+760 |
| 7 | Bridge | 22+800–22+814; 23+134–23+172; 24+644–24+720; 25+256–25+269; 26+317–26+329 |

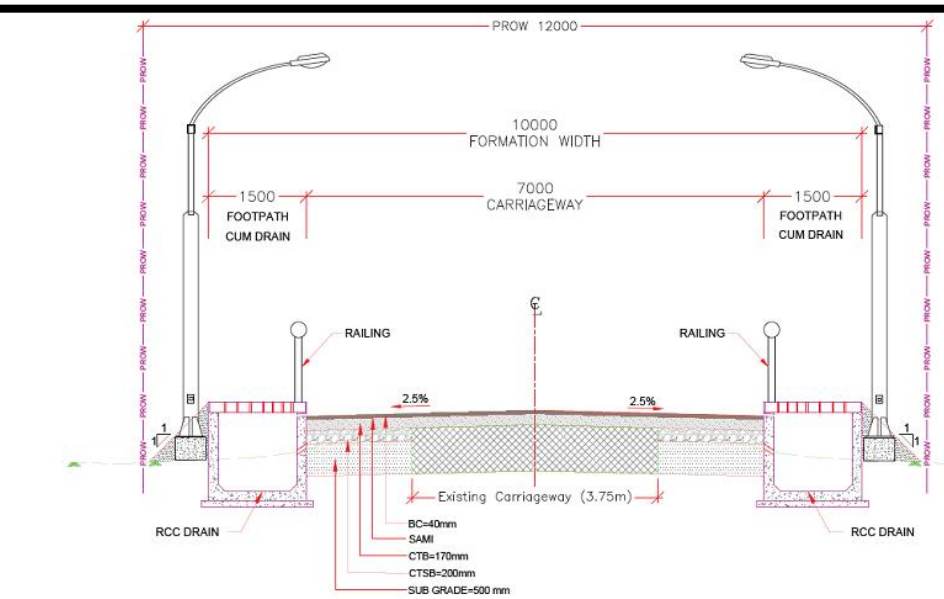
***Note: Bridge stretches have been excluded from TCS classification



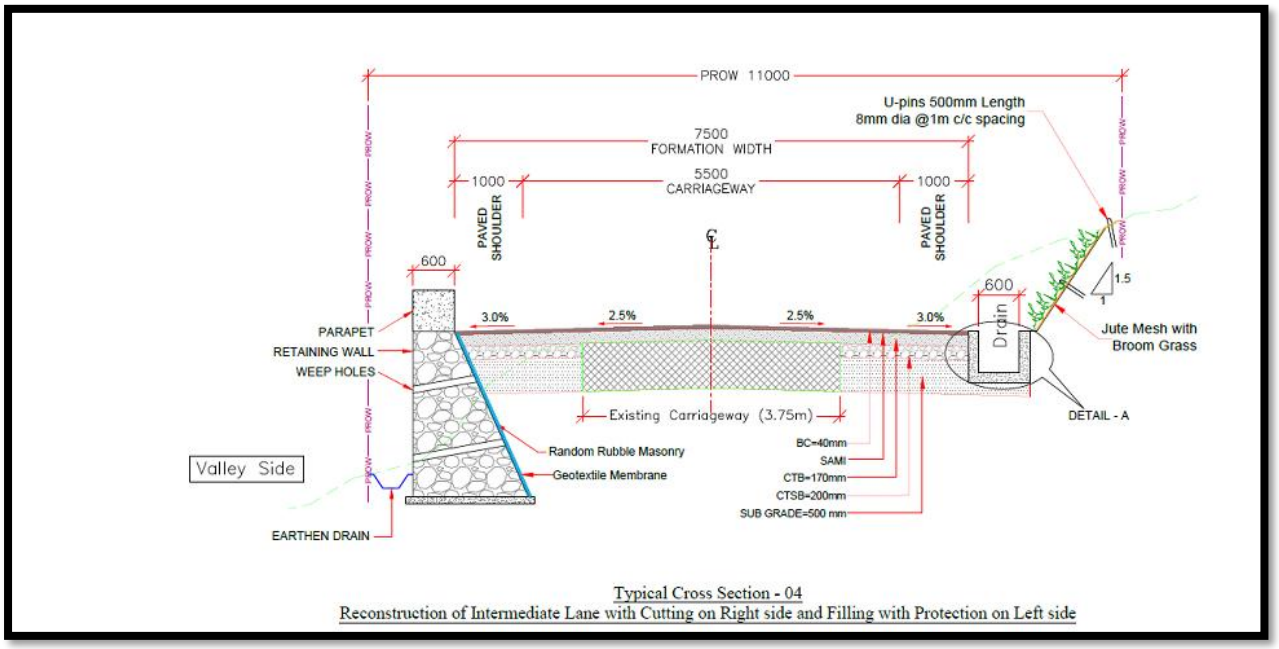

Typical Cross Section-01
Reconstruction of Intermediate Lane in Normal Fill/Cut (<1m)



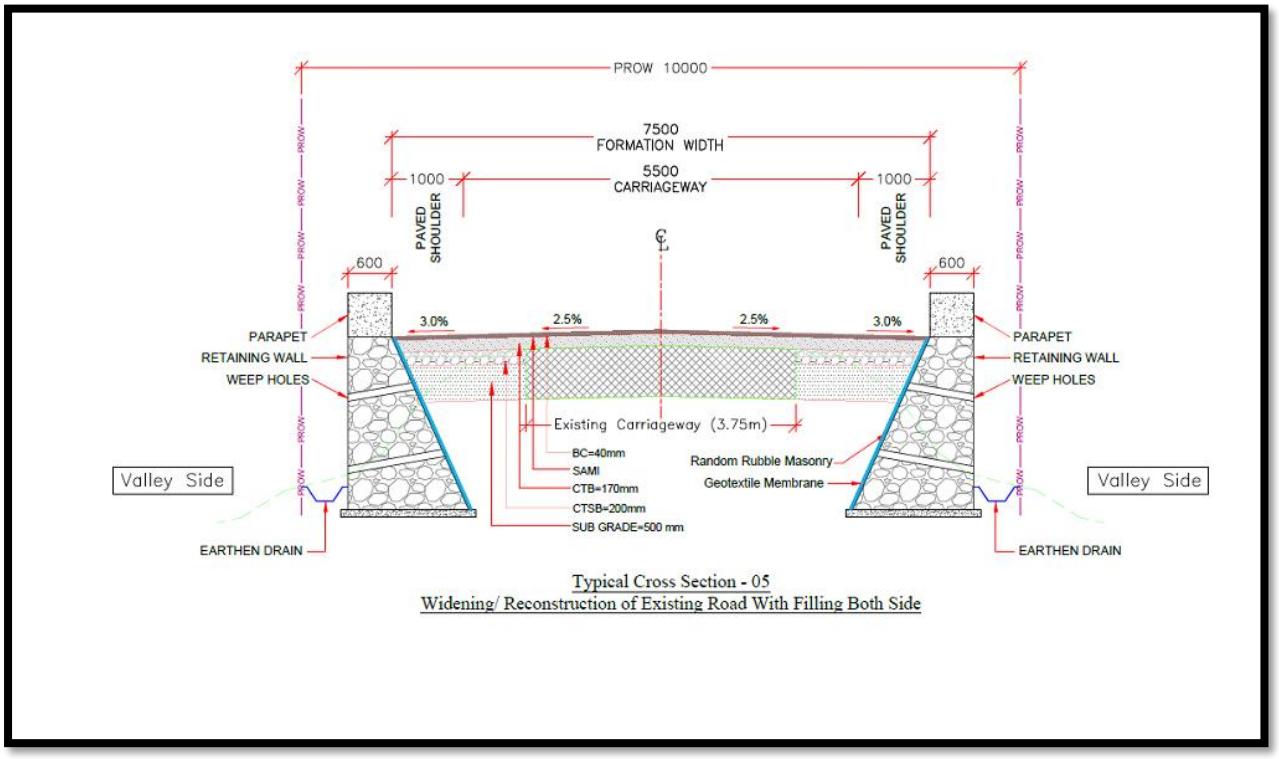

Typical Cross Section - 02
Reconstruction of Intermediate Lane with Cutting on Left side and Filling with Protection on Right side




Typical Cross-Section - 03
Reconstruction of Intermediate Lane for Built up Section with Both Side Drain Cum Footpath




Typical Cross Section - 04
Reconstruction of Intermediate Lane with Cutting on Right side and Filling with Protection on Left side




Typical Cross Section - 05
Widening/ Reconstruction of Existing Road With Filling Both Side

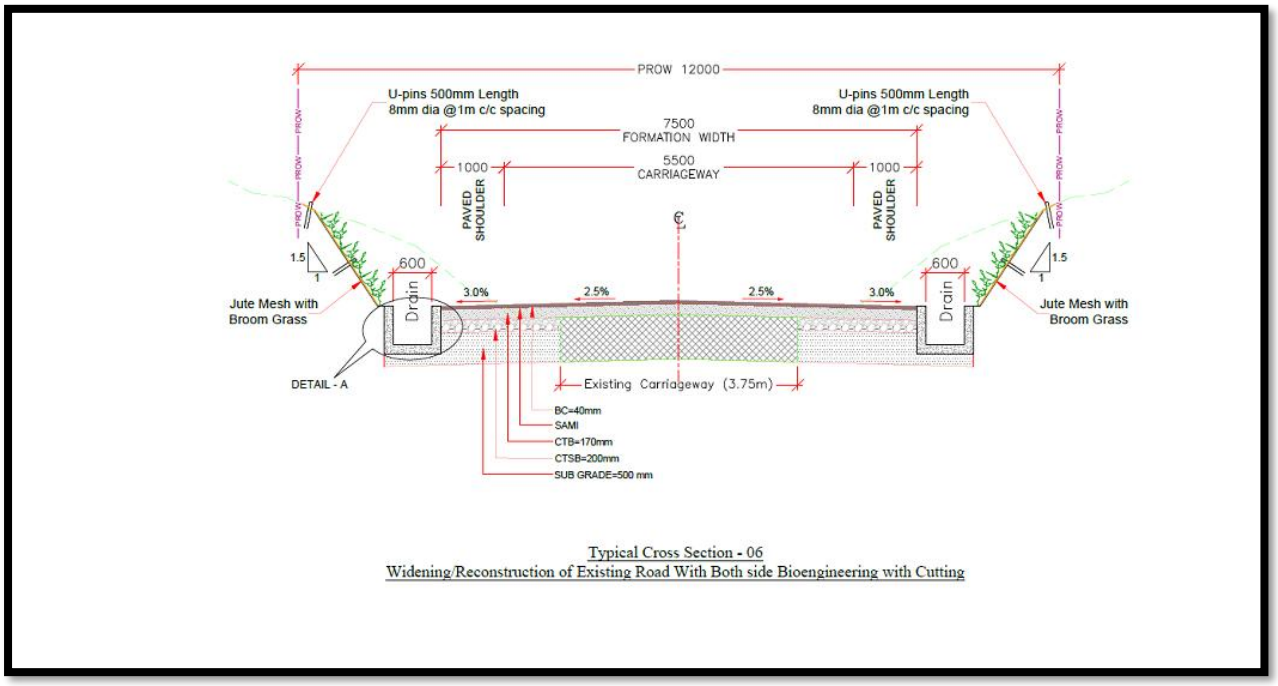



Figure 3.2: Typical Cross Sections

## 3.4.3 SETTLEMENTS AND CORRIDOR CHARACTERISTICS

### 3.4.3.1 Settlements:

The AP Road passes through hilly terrain, rural settlements and towns. The details of the settlements along the stretch are presented in **Table 3.6** below.

Table 3.6: Chainage wise List of villages along the project road

| Sl. No. | Chainage | | Settlements |
|---|---|---|---|
| 1 | 20+000 | 23+000 | Chopapara (village) |
| 2 | 23+000 | 28+000 | Mebitpara (village) |
| 3 | 26+000 | 26+770 | DarongAdu |

**Details of Protection work**

The project corridor includes a comprehensive drainage system comprising 13,792.30 m of earthen drains, 1,195 m of PCC roadside drains, and 248.00 m of footpath-cum-drains, ensuring effective surface water management along critical stretches. The drainage network is predominantly provided on both sides (LHS+RHS) in longer continuous sections, with earthen drains forming the major component supplemented by PCC drains in built-up and critical locations for durability and improved hydraulic performance.

The project includes repair and rehabilitation of available bus stops at chainages 23+310 and 26+740 (LHS) to restore structural integrity, functionality, and commuter safety. In addition, based on FPIC consultations, new bus stops are also proposed at chainage 20+160 locations, designed to integrate with the roadway and pedestrian facilities, ensuring improved accessibility and user convenience in line with standard engineering practices. The provision of new bus stops/sheds has been incorporated based on agreements reached with the community during the FPIC process. These facilities are additional to and go beyond the initial design provisions, reflecting community preferences and ensuring improved accessibility and convenience along the project corridor.

Separate toilet facilities for boys and girls have been proposed at Ch. 20+165 and Ch. 23+315, in response to community demand, to enhance sanitation infrastructure and ensure safe, gender-segregated amenities at key public locations along the project corridor. A public toilet block of size 3.0 m × 4.0 m is proposed under the project to enhance sanitation facilities along the corridor. The facility shall be constructed as per approved drawings, technical specifications, and Engineer's directions, comprising RCC and masonry works for structural durability. It will include sanitary fixtures, anti-skid flooring, water supply, lighting, ventilation, and a drainage system connected to a septic tank and soak pit to ensure hygienic and sustainable operation. The provision is intended to improve public convenience and sanitation infrastructure along the project corridor. Details of drains are given in Table 3.7.

Table 3.7: Details of Drain

| S. No. | Chainage From | Chainage To | Design Length (m) | Side | Net Length (m) | TCS |
|---|---|---|---|---|---|---|
| **Earthen Drain List** | | | | | | |
| 1 | 19+000 | 21+515 | 2515.0 | LHS+RHS | 5030.00 | TCS-1 |
| 2 | 21+575 | 22+675 | 1100.0 | LHS+RHS | 2200.00 | TCS-1 |
| 3 | 22+675 | 22+800 | 125.3 | RHS | 125.25 | TCS-2 |
| 4 | 22+814 | 22+950 | 136.3 | LHS | 136.25 | TCS-4 |
| 5 | 22+950 | 23+010 | 60.0 | LHS+RHS | 120.00 | TCS-1 |
| 6 | 23+172 | 23+300 | 128.0 | LHS+RHS | 256.00 | TCS-1 |
| 7 | 23+300 | 23+830 | 530.0 | LHS | 530.00 | TCS-4 |
| 8 | 23+830 | 24+644 | 813.8 | LHS+RHS | 1627.50 | TCS-1 |
| 9 | 24+720 | 24+810 | 89.8 | LHS+RHS | 179.50 | TCS-5 |
| 10 | 24+810 | 24+940 | 130.0 | LHS+RHS | 260.00 | TCS-1 |
| 11 | 24+940 | 25+020 | 80.0 | RHS | 80.00 | TCS-2 |
| 12 | 25+020 | 25+185 | 165.0 | LHS+RHS | 330.00 | TCS-1 |
| 13 | 25+185 | 25+256 | 70.5 | LHS+RHS | 141.00 | TCS-5 |
| 14 | 25+269 | 25+308 | 39.5 | LHS+RHS | 79.00 | TCS-5 |
| 15 | 25+308 | 25+688 | 380.0 | LHS+RHS | 760.00 | TCS-1 |
| 16 | 25+760 | 26+317 | 557.5 | LHS+RHS | 1114.90 | TCS-1 |
| 17 | 26+329 | 26+473 | 144.5 | LHS+RHS | 288.90 | TCS-1 |
| 18 | 26+473 | 26+533 | 60.0 | RHS | 60.00 | TCS-2 |
| 19 | 26+533 | 26+770 | 237.0 | LHS+RHS | 474.00 | TCS-1 |
| **Footpath-cum-Drain List** | | | | | | |
| 1 | 23+010 | 23+134 | 124.0 | LHS+RHS | 248.00 | TCS-3 |
| **PCC Roadside Drain List** | | | | | | |
| 1 | 21+515 | 21+575 | 60.0 | LHS+RHS | 120.00 | TCS-6 |
| 2 | 22+675 | 22+800 | 125.3 | LHS | 125.25 | TCS-2 |
| 3 | 22+814 | 22+950 | 136.3 | RHS | 136.25 | TCS-4 |
| 4 | 23+300 | 23+830 | 530.0 | RHS | 530.00 | TCS-4 |
| 5 | 24+940 | 25+020 | 80.0 | LHS | 80.00 | TCS-2 |
| 6 | 25+688 | 25+760 | 72.0 | LHS+RHS | 144.00 | TCS-6 |
| 7 | 26+473 | 26+533 | 60.0 | LHS | 60.00 | TCS-2 |

A spring chamber of size 2.0 m × 2.0 m is proposed at Chainage 20+510 on the LHS for collection and storage of water from a natural spring source. The chamber shall be constructed using masonry/RCC with proper sealing to prevent seepage and contamination. Suitable inlet arrangements with filter media such as boulders, gravel, and sand shall be provided to control sediment entry and maintain water quality. The structure shall include a covered slab, inspection opening, overflow arrangement, and outlet provision for safe discharge and controlled utilization of water.

**Bioengineering**

Bioengineering treatment using jute mesh with broom grass (*Thysanolaena maxima*) is proposed along cut slopes to ensure slope stabilization, erosion control, and ecological restoration. The system provides immediate protection through biodegradable jute mesh and long-term stability through vegetation root reinforcement, while integrated toe drainage prevents water-induced slope failure.
Bioengineering measures are proposed over a total length of 380 m, equally distributed on both sides of the road with 140 m on LHS and 190 m on RHS. The treatments are primarily provided at 1–2 m cut slope heights, targeting critical erosion-prone sections to enhance slope stability and ensure long-term protection. Details of cutting is given in Table 3.8.

Table 3.8: Details of Cutting

**Left Hand Side (LHS) - Cutting Section**

| From (Chainage) | To (Chainage) | Length (m) | Height (m) | Protection Type |
|---|---|---|---|---|
| 19+390 | 19+420 | 30 | -1 | Bioengineering |
| 20+360 | 20+380 | 20 | -1 | Bioengineering |
| 21+520 | 21+550 | 30 | -1 | Bioengineering |
| 22+690 | 22+740 | 50 | -1 | Bioengineering |
| 25+710 | 25+720 | 10 | -2 | Bioengineering |
| **Total** | | **140** | | |

**Right Hand Side (RHS) - Cutting Section**

| From (Chainage) | To (Chainage) | Length (m) | Height (m) | Protection Type |
|---|---|---|---|---|
| 20+480 | 20+530 | 50 | -1 | Bioengineering |
| 20+860 | 20+870 | 10 | -1 | Bioengineering |
| 21+500 | 21+590 | 90 | -2 | Bioengineering |
| 22+970 | 22+990 | 20 | -1 | Bioengineering |
| 25+710 | 25+730 | 20 | -2 | Bioengineering |
| **Total** | | **190** | | |

**UTILITY DETAILS**

The project road corridor, classified as a Major District Road (MDR) with a total length of approximately 07.770 Km, is equipped with several essential utility infrastructures. Electric poles, overhead electric lines, and Optical Fiber (OFR) cables run parallel to the road alignment, serving as key associated facilities that support both local communities and regional connectivity. These utilities are critical for ensuring uninterrupted power supply and communication services in the project area and will be duly considered during road improvement and construction activities to avoid any disruption or damage.

A total of 44 electric poles, 1 transformer, and 32 electric line crossings are identified along the AP road corridor for shifting. Of these, 15 poles are on the LHS and 29 on the RHS. A total of 9 OFC pillars is identified for shifting along the AP road corridor, comprising 3 on the LHS and 6 on the RHS. Details of utilities are given in **Annexure1.1.**

### 3.4.3.2 Corridor Characteristics

The salient features of the AP road are summarized in **Table 3.9** below.

Table 3.9: Current Salient features of the AP Road

| Sl. No. | Characteristics | Features |
|---|---|---|
| 1 | Name of Road | Improvement of Ampati to Purakhasia Road (AP)) |
| 2 | Project road corridor road Length | 7.770 Km (including approaches of Bridge) |
| 3 | District | South West Garo Hills |
| 4 | Villages/settlements enroute | 02 villages |
| 5 | Terrain | Plain/Hilly/Rural |
| | Existing | The road is affected by various surface damages, including potholes, cracks, and other deterioration |
| 6 | Proposed treatment | Brownfield. Improvement of sharp curves within the RoW, reconstruction of weak and damaged/ new culverts and bridges, rehabilitation and strengthening of existing pavement to intermediate lane and protection works. |
| 7 | Bridges | No. of Major Bridge – 1<br>No. of Minor Bridges - 04 |
| 8 | Junction | 10 |
| 9 | Culverts | 22 Pipe culverts, |
| 10 | Forests / environmentally sensitive areas | - |
| 11 | Religious Structures Affected | Nil |
| 12 | Impacted Structures (including Temporary Structures of NTHs) | 05 |
| 13 | Fifth/Sixth Scheduled Areas | Sixth Schedule Area |
| 14 | River crossings | Proposed road is crossing the Daru River |
| 15 | Water bodies / ponds | 1 Daru River (25+000) |
| 16 | Sensitive receptors | 2 School, 2 community halls, 1 power house office, 3 Churches in COI 50 m |
| 17 | Transshipment areas/truck parking locations | - |
| 18 | Other features / issues if any | - |

### 3.4.4 TREES

The vegetation along the project road comprises a diverse mix of trees, shrubs, herbs, climbers, ferns, and grasses. 14 trees are likely to be impacted or require removal due to the proposed widening.

Table 3.10:Chainage wise list of Trees

| S. No. | Chainage (km) | Common Name | Botanical Name | Girth at Breast Height (cm) |
|---|---|---|---|---|
| 1 | 19+800 | Indian Jujubee | *Ziziphus mauritiana* | 100 |
| 2 | 19+870 | Arecanut Palm | *Areca catechu* | 30 |
| 3 | 19+930 | Indian Jujubee | *Ziziphus mauritiana* | 200 |
| 4 | 19+950 | Indian Jujubee | *Ziziphus mauritiana* | 120 |
| 5 | 21+130 | Indian Jujubee | *Ziziphus mauritiana* | 60 |
| 6 | 21+150 | Arecanut Palm | *Areca catechu* | 44 |
| 7 | 21+170 | Arecanut Palm | *Areca catechu* | 38 |
| 8 | 22+580 | Indian Jujubee | *Ziziphus mauritiana* | 32 |
| 9 | 22+670 | Indian Jujubee | *Ziziphus mauritiana* | 32 |
| 10 | 22+980 | Indian Jujubee | *Ziziphus mauritiana* | 70 |
| 11 | 23+395 | Indian Jujubee | *Ziziphus mauritiana* | 175 |
| 12 | 23+400 | Indian Jujubee | *Ziziphus mauritiana* | 43 |
| 13 | 23+550 | Indian Jujubee | *Ziziphus mauritiana* | 50 |
| 14 | 24+680 | Indian Jujubee | *Ziziphus mauritiana* | 110 |

*Source: EIS Field Survey*

To mitigate the ecological impact of tree loss, plantation at the ratio of 1:10 will be carried out. These mitigation measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP). The ESMP is attached as **Annexure 3.2.**

### 3.4.5 SLOPE PROTECTION WORKS

The project corridor in South West Garo Hills, Meghalaya, encounters significant challenges due to its rugged terrain, characterized by high hills and deep valleys. The topographic profile of the Ampati to Purakhasia Road (AP) indicates a gently undulating to moderately rolling terrain, with elevation ranging between 50 m and 212 m above mean sea level (amsl). The alignment traverses through shows three major elevation peaks and two depressions along the 07.770 Km stretch, suggesting alternating cut and fill sections. The highest elevation zones occur near the mid and terminal sections of the corridor, whereas the lowest points are located in valley sections characterized by seasonal drainage or stream crossings. This topographical variation implies moderate earthwork requirements during



Official Use Only

construction, particularly in sections with steeper gradients. The general slope direction varies locally but follows the natural drainage. To address these issues, slope stabilization measures are essential to enhance the safety and resilience of the corridor, particularly given the district's susceptibility to landslides and the complexity of the topography. The sub-project proposes geotechnical solutions designed to stabilize both hillside cuts and valley-side slopes. The existing slopes along several chainages are steep and prone to erosion, especially near riverbanks, bridges, and sharp curves. Proposed measures include reducing slope angles to safer design values (1V:2H to 1V:3H) and providing protection such as stone pitching, gabion walls, toe walls, turfing, and river training works. These measures will improve long-term stability and protect nearby structures and settlements. Location wise slope protection works proposed along with project is given in **Table 3.11** below.

Table 3.11: Slope protection works

| Chainage (Km) | Side | Existing Angle (°) | Height of Cut (m) | Modified Angle of Repose (°) | Proposed Slope / Riverbank Protection |
|---|---|---|---|---|---|
| 19+500 | Both (riverbank) | 60° | 1.0 m | 26.56° (1V:2H) | Stone pitching / gravity retaining wall with toe protection; vegetative slope dressing above pitching |
| 19+150–19+170 | LHS | 55° | 1 m | 18.43° (1V:3H) — for long term slope stability | Gabion wall / revetment + local benching; toe riprap and geotextile; re-vegetation (bioengineering) |
| 22+850 | Both (near minor bridge abutment) | 65° | 2.0 m | 26.56° (1V:2H) for immediate; 18.43° (1V:3H) if space permits | Apron protection, abutment slope strengthening, concrete/stone revetment, scour apron with filter layer |
| 24+000 | LHS | 58° | 2.0 m | 26.56° (1V:2H) | River training works: localized bank stabilization, stone pitching, toe protection and geogrids |
| 22+200 | Both (curve near minor bridge) | 50° | 1 m | 26.56° (1V:2H) or 21.80° (1V:2.5H) if adjacent settlement constraints require gentler slope | Toe wall + turfing; gabion toe + surface turfing; mattress & rock toe where flow exposure |
| 26+460 | Both (sharp curve near settlement) | 55° | 2.0 m | 21.80° (1V:2.5H) target for curve improvement; 26.56° (1V:2H) if reinforced | Curve radius improvement (cut & fill), flatten slopes (benching), retaining toe wall, geogrid/reinforced fill near settlement; monitoring & protective toe structure |

## 3.5 COMPONENTS & ACTIVITIES OF THE PROPOSED PROJECT

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

### 3.5.1 DETAILED DESIGN AND PRE-CONSTRUCTION STAGE

- Carrying out ESIA studies & preparation of ESMP and other Environmental and Social management instruments such as RAP, IPDP, LMP, SEA/SH plan and OHS plan
- Finalization of alignment with incorporation of environmental, social and community concerns in addition to the design and safety aspects



Official Use Only

- Community consultation for land identification for disposal sites, water availability, siting of camps, tree felling permission
- Identification of sources of construction material
- Contractor mobilization
- Setting of Construction Camp

### 3.5.2 CONSTRUCTION STAGE

- Site clearing & construction camp establishment
- Construction Material procurement & transportation
- Earthwork, hillside cutting, if required, embankment construction, GSB, WBM, operation of equipment, plant and machinery
- Structure demolition & construction work, if required
- Disposal site management
- Surfacing and shoulder protection & road furniture

### 3.5.3 POST-CONSTRUCTION, OPERATIONS & MAINTENANCE STAGE

- Decommissioning and restoration of camp area, removal of Construction & demolition waste, Restoration of disposal sites.
- Operation of vehicles and safety of road users



Official Use Only

## 3.6 RESOURCE REQUIREMENTS

Details of construction material required for this project, their Source and Lead are given in **Table 3.12**.

Table 3.12: Source and Lead of Construction Materials

| S. no | Item | Unit | Quantity | Querry Name | Lead Km | APR Length | | Total lead upto Plant |
|---|---|---|---|---|---|---|---|---|
| 1 | Fine Sand | cum | 4,005.2 | Tura Quarry | 47 | 19.000 | 28.039 | 52 |
| 2 | Coarse sand | cum | 2,670.2 | Tura Quarry | 47 | 19.000 | 28.039 | 52 |
| 3 | Agreegate | cum | 33,200.6 | Pipulbari quarry | 53 | 19.000 | 28.039 | 58 |
| 4 | Bitumin | MT | 571 | Guwahati IOCL refinery | 292 | 19.000 | 28.039 | 297 |
| 5 | Emulsion | MT | 48 | Haldia to Site | 1180 | 19.000 | 28.039 | 1185 |
| 6 | TMT Bars | MT | 14 | Guwahati SAIL | 284 | 19.000 | 28.039 | 289 |
| 7 | Cement | MT | 405 | Virgo Cement plant Damas | 166 | 19.000 | 28.039 | 171 |
| 8 | Water | KLD | 15.233 | Daru River | | | | |

Assessing the availability of suitable construction materials near the project road is crucial for a road project. Surface water from the Daru river can be used for road construction with prior permission from the Water Resources Department, Government of Meghalaya.

### 3.6.1 VOLUME OF CIVIL WORKS

The volume of civil works for MLCIP will be influenced by the type of construction methods, typical cross sections and specific materials used in the sub-project area. These civil works are essential for ensuring the highway's stability, safety and environmental sustainability thereby contributing to the long-term success of the road project. List of materials used such as Bituminous Concrete (BC), Dense Bituminous Macadam (DBM), Prime Coat (PC), Tack Coat (TC), Granular Sub Base (GSB), Wet Mix Macadam (WMM), and Shoulder treatments are included in the DPR. This comprehensive range of materials ensures the road's strength, durability and overall performance.

Based on the information provided in the DPR, the embankment protection measures are designed according to the height of the embankment to ensure slope stability and minimize erosion. For embankments having a height of less than 2.0 m, turfing with suitable grass species will be carried out on the side slopes to prevent soil erosion and maintain surface stability. For embankments with heights ranging between 2.0 m and 3.0 m, a toe wall is proposed at the base of the slope to provide additional structural support and prevent scouring at the toe. In cases where the embankment height exceeds 3.0 m, a retaining wall will be provided on the fill side to retain the earth mass, while a breast wall will be constructed on the cut side to support the excavated slope and prevent slope failure. These protective measures have been proposed as per standard engineering practices and IRC guidelines to ensure the durability and safety of the road embankment structure.



Official Use Only

As per the earthwork estimation for the project corridor, the total fill quantity is 2341 $m^3$, and the cut quantity is 23041 $m^3$. After balancing cut and fill requirements, there remains a surplus of approximately 22770 $m^3$ of excavated material. Contractor will utilize the excess material to the extent feasible or dump the same only at designated sites. As per the approved BoQ (Page no 162) of Chapter 8 of Vol 1 main DPR and Bill no. 13 in BOQ, the scope includes excavation of unsuitable soil, Spoil/debris removal, loading, transportation, and disposal at identified dumping locations, along with spreading, leveling, and compaction at disposal sites. The total quantity covered under the BoQ for disposal is 22770 $m^3$ out of which recyclable material such as suitable excavated earth and granular material will be reused for embankment formation, shoulder filling, backfilling as per site suitability.

Further, recycling and reuse of existing pavement materials shall be carried out as per MoRTH Specifications for Road and Bridge Works (latest revision) and IRC:120 guidelines. This approach promotes cut-and-fill optimization, reduces the requirement for fresh quarry materials, minimizes construction waste, and ensures compliance with the Solid Waste Management Rules, 2016 and Environmental (Protection) Act, 1986.

No additional land is required for the proposed road improvement but for spoil disposal 0.35 ha land is required. One disposal site has been identified during joint verification with PWD, ESIA and DPR consultants.

Only the balance non-recyclable and excess Spoil is proposed for disposal at the identified chainages. Disposal site with more than 3 m height will require Benching and gabion protection.

. Details of spoil disposal site are given in Table 3.13.

Table 3.13: Details for the Spoil disposal sites

| Dumping Location | | | Coordinate | | Area $m^2$ | Approx. Quantity ($m^3$) |
|---|---|---|---|---|---|---|
| SL. NO | LOCATION CHAINAGE | SIDE | Latitude | Longitude | | |
| 1 | 19+850 | RHS | 25.361713° | 90.010025° | 3500 | 22770 |

## 3.6.2 LAND REQUIREMENTS

No additional land is required for the proposed road improvement but for spoil disposal 0.35 ha land is required. The majority of the works will be accommodated within the existing Right of Way (RoW). The required land for spoil disposal site will be taken on lease and will be returned to the land owner after project completion and after having redeveloped in accordance to the community/landowner requirements. The Consultants along with the officials of the PWD and members of the village community including the Nokma jointly identified 1 location for dumping of spoils.

## 3.6.3 WATER REQUIREMENTS

The overall water requirement of the project is 15.233 KLD, of which 10.733 KLD will be used for construction activities and 4.5 KLD is required for domestic purposes. Details of Water requirement is given in Table 3.14.

Table 3.14: Water Requirement for Construction Works

| Activity | Daily Demand (Liters/km) | Total for 7.770 Km (Liters/day) | Remarks |
|---|---|---|---|
| Concreting and curing | 1259.5 | 10076 | Concrete mixing, compaction, culverts, drains. |
| Dust Suppression at Work Zone | 82.19 | 657.34 | Reduced due to frequent rain; use only on dry days. |
| | | | |
| Domestic Purpose | ------- | 4500 | For 50 workers (drinking, cooking, sanitation). |
| **Total** | — | **15233.34 Liters/day** | — |



Official Use Only

### 3.6.4 MANPOWER REQUIREMENT AND IMPLEMENTATION SCHEDULE FOR THE SUB PROJECT

The workforce requirement, as per consultations with the DPR, will vary during different stages of construction, with peak manpower estimated at about 85 persons. Around 60–70% of the labour force is expected to be sourced locally, while skilled personnel such as machine operators, concrete casting crews, supervisors, and engineers may be engaged from outside the project area and accommodated in construction camps. The project construction period for 7.770 Km subproject stretch is considered as 18 months. The total estimated cost of the project is approximately 43.88Crore (as per DPR).



Official Use Only

# 4. ANALYSIS OF ALTERNATIVES

## 4.1 INTRODUCTION

In line with best practices for managing environmental and social impacts, several alternative approaches have been considered for the proposed road widening and upgrade project. The design is being refined to enhance safety, improve the road structure, and accommodate both current and future traffic demands. This chapter presents an analysis of the potential impacts under the "With Project" and "Without Project" scenarios.

## 4.2 WITH AND WITHOUT PROJECT ALTERNATIVES

Alternative analysis was carried out for the project stretch vis-à-vis design scenarios and one scenario of without project. These are described in the following sections.

### 4.2.1 WITHOUT PROJECT SCENARIO

The road traverses areas with high population densities, particularly in Gambegre Development Block, as well as hilly and rural stretches where traffic is frequently disrupted due to poor road conditions and the demand for efficient through-traffic movement.

The continued growth in population, rising traffic volumes, and expanding economic activity along the corridor are likely to exacerbate the existing challenges. Without the proposed upgrades, current road safety hazards and adverse environmental impacts along the route are expected to persist and worsen. Additionally, the limited socioeconomic development of these remote and underdeveloped areas would remain constrained. Therefore, halting the project would not be practical or justified, as it would impede essential improvements and limit the potential for economic growth in the region.

### 4.2.2 WITH PROJECT SCENARIO

The "With Project" scenario is expected to generate positive long-term impacts across social, environmental, economic, and financial dimensions. Key interventions include widening the existing roadway to intermediate lanes, in line with the project's objectives.

From an economic perspective, the project is viable and is anticipated to substantially improve current conditions, supporting the development goals set by the Government of Meghalaya and enhancing the region's growth potential.

While the project promises multiple developmental benefits, it is important to recognize that, like all infrastructure initiatives, it may also result in certain impacts on the environment and local communities.

Potential environmental and social impacts can be mitigated through the adoption of best environmental management and social development practices. Where impacts cannot be fully avoided, suitable mitigation measures will be implemented to minimize and offset adverse effects. A detailed comparison of the "With Project" and "Without Project" scenarios, along with the anticipated benefits of the proposed project, is presented in **Table 4-1** below

Table 4.1: "With and Without" Project Scenarios – A Comparative Assessment

| Component | "With" Project Scenario | 'Without" Project Scenario |
|---|---|---|
| Highway Geometry | Intermediate lane with shoulder and paved surface is being developed with geometric improvements | Existing Single/Intermediate Lane carriageway with poor geometry |
| Design Speed | (30-50 kmph for Intermediate Lane) | 30-40 kmph entire project section. |
| Congestion in Settlements | Improved carriageway with good surface and separated footpath with | Lack of road or lack of good road surface with shoulder and foot path, congestion and |



Official Use Only

| | | |
|---|---|---|
| | railing in built-up area reduces interaction of pedestrians with through traffic resulting in reduction of vehicular emissions, reducing travel time and vehicle operating cost. This in turn contributes to lowering of GHG emission; and may improve people/public health due to no or low exposure period. | frequent vehicle stoppage due to mixing of local, pedestrian and through traffic will increase localized accumulation of vehicular emission with potential impacts on human health and contribute to generation of GHG emission. |
| Felling of roadside trees | Felling of both old and young trees. Old and weak trees near the road edge shall be a road hazard and shall be felled. Ten times of felled trees, the number of new young and healthy saplings to be planted as compensation. | No Felling of trees hence maintaining the healthy local ecology. |
| Pedestrian safety | Pedestrian facilities in the form of footpath, lightning, etc. are to be provided in built-up area locations. | Lack of dedicated pedestrian facilities such as footpaths and adequate lighting making it unsafe for pedestrians. |
| Road Safety Measures | Provision of proper road markings, zebra crossings, crash barriers and improvement of geometry to reduce accidents. | Accident incidents will rise with an increased traffic volume. |
| Environmental Quality | Development of roads in hilly and urban settlements improves environmental quality within the urban areas due to lowered pollution levels and relieving of congestion. Besides, an aggressive tree plantation and provision of enhancement features shall not only provide aesthetics but also improve the quality of air. | Poor in settlement areas due to non-motorable road conditions, congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion. |
| Drainage | Will be improved due to reconstruction of culverts / bridges/ side drains with adequate hydraulics. | These issues remain un-addressed without the project |
| Roadside Amenities | Appropriate roadside amenities to be provided at various locations along the corridor. | Not adequate in the present scenario. |
| Wayside Facilities | Wayside facilities are proposed at several locations, where necessary like rest areas, with appropriate facilities for recreation, road public toilets, telephones etc. | Not of adequate standards, quality and number in present scenario. |
| Environmental Enhancement | Enhancement of landslides/water bodies, community and cultural properties | No enhancement measures involved. |



Official Use Only

| | | |
|---|---|---|
| Social Development | Higher potential for social development due to improvement in access and consequent increase in connectivity. | Social development activities are likely to be significantly constrained due to the severe inadequacy of infrastructure. |
| Financial and Economic Analysis | Project financially viable for upgrading from existing lane configuration to intermediate lane configuration. | The cost of maintenance while catering to the projected higher traffic, accident cost, Vehicle operating cost & travel time cost shall be higher. |

## 4.3 ENVIRONMENTAL AND SOCIAL ALTERNATIVES CONSIDERED FOR THE PROPOSED STRETCH

Various avoidance measures have been developed to minimize environmental and social impacts and to protect sensitive features along the proposed sub-project road. No land requirement as the road improvement will be undertaken within the available Right of Way (ROW) to the maximum possible extent. **Table 4.2** summarizes the measures adopted to offset these impacts, and a detailed description of each measure is presented in the following sections.

Table 4.2: Alternative considerations for Minimization of Environmental Impacts

| Sr. No. | Village name | Location Chainage | ESIA Observation | Compliance/ Proposal included in the DPR | Reference in the DPR |
|---|---|---|---|---|---|
| 1 | Chopapara | 19+500 | Signs of riverbank erosion and soil instability were visually observed near the river edge. | This location is situated on a hilltop, so no river protection works are required here. However, at critical locations along this road, protection works have been proposed parallel to the road to prevent river erosion. | Protection works for streams parallel to road Page No-53 [Vol-VIII Cost Estimate] |
| 2 | Chopapara | 19+150 to 19+700 | Protection wall is required for all streams location. | Protection works for all streams location parallel to road are proposed and its details are mentioned in drawing no. RC/1661/HO/HWB/RD/DWG/MISC/08/R0. | Page No-53 [Vol-VIII Cost Estimate] |
| 3 | Chopapara | 19+700 to 19+740 | Continuous bank erosion along the left-hand side riverbank was visually observed. | Protection wall required from Ch-19+700 to 19+740 on (LHS) for slope protection has been proposed | Table No-14, Page No-123 [Vol-1 Main Report] |
| 4 | Chopapara | 19+200 to 19+300 | Eroding riverbank protection work needed (LHS) | As per design we have proposed protection work on LHS from Ch-19+400 to 19+460. | Table No-14, Page No-123 [Vol-1 Main Report] |
| 5 | Chopapara | 20+200 | Spring water collection tank to store the water for public use. | Proposed Spring water collection tank at ch-20+200 to store water for public purpose (LHS) | Page No-128 [Vol-1 Main Report] |



Official Use Only

| | | | | | |
|---|---|---|---|---|---|
| 8 | Chopapara | 22+200 | Apron repairing required at Culvert Location | Floor Aprons are quadrant pitching are proposed in all culverts including Ch-22+213 | Floor Apron Details are mentioned in Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/CUL/TYP-1/01/R1 |
| 9 | Chopapara | 22+800 | Require boundary wall to protect Sarv Shiksha Abhiyaan (SSA) school. | Proposed boundary wall at Ch-22+740 to 22+810 on (LHS) | Page No-129 [Vol-1 Main Report] |
| 10 | Mebitpara | 22+850 | Localized soil erosion was observed near the abutment location of a minor bridge, indicating the need for appropriate structural protection. | Stream protection works are proposed at MNB Ch. 22+843, and approach repair cost is also included in BOQ to prevent scouring of the approach embankment. | Page No-125 [Vol-1 Main Report] & Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/MISC/07/R1 |
| 12 | Mebitpara | 24+000 | Riverbank erosion was observed along the left bank of the river. | Proposed river training work from Ch-23+960 to 24+150 on LHS to protect soil erosion. | Volume-X Drawings-Sheet No.RC/1661/HO/HWB/RD/DWG/MISC/07/R1 |
| 13 | Mebitpara | 24+300 | Protection work needed a Minor Bridge Section. Curve improvement needed. | Curve improvement and protection works at the minor bridge, together with approach repairs, have been incorporated in the DPR. Chainage updated as per final approved design.. | Page No-125 [Vol-1 Main Report] |
| 15 | Darong Adu | 26+460 | Curve improvement needed by reducing the Curve radius to protect the Building Structure. | Curve improvement incorporated to avoid impacts on the adjoining building structure. Chainage updated as per final approved design.). | - |
| 16 | DarongAdu | 26+770 | Junction Improvement by providing traffic islands. | Already incorporated in the junction design plan at Ch. 26+770. Chainage updated as per final approved design. | Volume-X Drawings-Sheet No. RC/1661/HO/HWB/RD/DWG/SD/02/R1 |

The Environmental and Social Impact Assessment conducted during the pre-design stage helped identify and mitigate potential negative impacts of the project. While the project is expected to provide numerous benefits, the assessment highlighted potential adverse effects associated with widening the road within the proposed 12 m right-of-way. In line with the mitigation hierarchy for managing environmental and social risks, alternative analyses were conducted to minimize direct negative impacts. Based on these analyses, the design team was advised to limit road widening to within the available right-of-way.



Official Use Only

Mitigation measures primarily focus on settlements along the project road, particularly villages and towns or areas with the highest potential impacts. Stakeholder recommendations have been incorporated into the designs wherever feasible.

The following is a summary of the considerations incorporated into the road design to mitigate environmental and social impacts:

- Widening of the road within the available ROW in order to avoid structures and livelihood.
- Curve improvements will be taken up wherever feasible to minimize impacts that may affect the local settlements especially in built up areas.
- Paved shoulders will be provided wherever possible to accommodate non-motorized traffic.
- Displacement will be avoided by adjusting the alignment, narrowing the impact zone, or tailoring designs to meet both rural and urban cross-section requirements.
- Safety features, including speed control measures near schools, healthcare facilities, religious institution, built up areas and other sensitive areas have been incorporated in the DPR.
- Ensure continuous access to businesses and residential properties throughout the construction period.

In addition, the following specific measures are suggested as ESIA inputs for incorporation into the DPR

- A Government School located at chainage 22+800 within the project corridor. To ensure the safety of students, speed reduction measures and cautionary signage are recommended near these locations.
- Curve and junction improvement measures are proposed at specific locations along the project road to enhance traffic safety and visibility. At chainage 24+300 and 26+450, sharp curves were observed, where realignment and curve radius improvement are recommended to ensure safe vehicle movement and prevent potential accidents. Additionally, at chainage 27+600, a junction improvement is proposed by providing traffic islands and proper signage to regulate vehicle flow and reduce congestion, ensuring smoother and safer traffic operations.
- Two Churches are present at chainage 25+200 and 27+100 respectively. Both structures are situated at a safe distance (Beyond 6m from existing CL) from construction activities, and therefore no direct impact is anticipated in these areas.
- Erosion and scouring issues are concentrated across six specific locations. In Chopapara, riverbank erosion and parallel stream protection are addressed between chainages 19+150 to 19+700 and 19+200 to 19+300, while culvert scouring is noted at chainage 22+200. In Mebitpara, bridge abutment erosion and scouring require protection at chainage 22+850, severe riverbank soil erosion is identified at chainage 24+000, and additional bridge-section scouring occurs at chainage 24+300.



Official Use Only

# 5. BASELINE ENVIRONMENT

## 5.1 GENERAL

This chapter presents the existing environmental and social conditions of the AP subproject area, compassing natural, physical, biological, cultural, and socio-economic components. Based on this baseline scenario, potential impacts of the proposed sub-project will be identified. The approach and methodology for baseline data collection are detailed in Section 1.3 of Chapter 1

This section describes the current meteorological conditions of the area, including climate, temperature, rainfall, and relative humidity.

## 5.2 CLIMATE

### 5.2.1 CLIMATIC CONDITIONS

The climate in the project area is moderate and highly humid, with three distinct seasons: summer, rainy, and winter. The summer season occurs from March to May, followed by the southwest monsoon, which lasts until September. The winter season begins in November and continues through February

### 5.2.2 TEMPERATURE

In South West Garo Hills, winter generally begins in mid-November, with January being the coldest month. During this period, maximum temperatures range from 24–26°C, while minimum temperatures can drop to 10–12°C. Summer starts in March, with July and August typically being the hottest months. During summer, maximum temperatures range between 30–33°C, and minimum temperatures are around 22–24°C. The monthly mean maximum and minimum temperatures for the nearest location, Shillong, as recorded by the India Meteorological Department (IMD), are presented in **Table 5.1**.

Table 5.1: Monthly Mean Maximum and Minimum Temperature

| Month | Maximum Temperature in °C | Minimum Temperature in °C |
|---|---|---|
| January | 24.5 | 12.5 |
| February | 25.0 | 13.0 |
| March | 30.0 | 18.0 |
| April | 31.0 | 20.5 |
| May | 32.5 | 22.0 |
| June | 31.5 | 23.5 |
| July | 33.0 | 25.0 |
| August | 32.8 | 25.2 |
| September | 32.0 | 24.0 |
| October | 30.5 | 21.5 |
| November | 28.5 | 17.0 |
| December | 25.5 | 13.5 |

Source: Climatological Table, 2020

**Temperature Projection and Implications for AP Road**

According to the Meghalaya State Action Plan on Climate Change (SAPCC, 2022), the South West Garo Hills region, including the Ampati–Purakhasia (AP) Road corridor, is projected to experience a rise in mean annual temperature of approximately 1.6–1.9°C by the mid-century period (2021–2050) relative to the 1975 baseline, based on the HadRM3 (PRECIS) regional climate model under the A1B scenario. This gradual warming is expected to increase surface heat exposure, particularly during the summer months, and lead to a higher frequency of hot days. For the AP Road, such temperature rise may accelerate softening of bituminous pavements, cause rutting and surface deformation, especially in exposed or low-lying segments. To enhance climate resilience, it is recommended to adopt higher performance grade or polymer-modified bitumen, ensure optimum pavement compaction during construction, and incorporate roadside vegetation or tree cover to reduce thermal stress. Integrating these measures into the road

design and maintenance strategy will help mitigate the effects of projected warming and maintain long-term pavement performance.

### 5.2.3 RAINFALL AND HUMIDITY

South West Garo Hills experiences a subtropical monsoon climate with high humidity throughout the year. Pre-monsoon showers occur during April and May, often accompanied by thunderstorms and occasional hailstorms, followed by a brief dry spell. The southwest monsoon typically begins in late May or early June, with peak rainfall occurring between June and August. The hilly terrain, particularly in the southern and central parts of the district, receives the heaviest rainfall, which contributes to slope instability and increases the risk of landslides along the road corridor. The average annual rainfall during 2018-2020 is presented in **Table 5.2**, while **Table 5.3** provides the month-wise relative humidity for the year 2020 (nearest location: Shillong, IMD data).

Table 5.2: Last 5 years rainfall data for South West Garo Hills District

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Rainfall |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | 15.2 | 18.0 | 50.0 | 80.0 | 200.0 | 400.0 | 350.0 | 320.0 | 250.0 | 80.0 | 20.0 | 10.0 | 1,693.2 |
| 2019 | 10.0 | 12.0 | 40.0 | 90.0 | 310.0 | 380.0 | 370.0 | 300.0 | 240.0 | 100.0 | 15.0 | 5.0 | 1,872.0 |
| 2020 | 12.0 | 15.0 | 55.0 | 100.0 | 320.0 | 420.0 | 360.0 | 330.0 | 260.0 | 90.0 | 10.0 | 8.0 | 2,020.0 |

Source: Customized Rainfall Information System, Hydromet Division, IMD

Table 5.3: Month-wise Relative Humidity

| Month | 08.30 Hrs. | 17.30 Hrs. |
|---|---|---|
| January | 88 | 75 |
| February | 85 | 70 |
| March | 80 | 65 |
| April | 82 | 73 |
| May | 87 | 78 |
| June | 93 | 90 |
| July | 92 | 88 |
| August | 90 | 85 |
| September | 88 | 82 |
| October | 85 | 78 |
| November | 83 | 73 |
| December | 87 | 75 |

**Rainfall Projection and Implications for AP Road**

South West Garo Hills is expected to see an overall increase in annual rainfall, although the total rise is modest, around 0–5% by mid-century compared to the 1975 baseline, as per the SAPCC (2022). However, rainfall distribution is likely to become more erratic, with intense short-duration events and longer dry spells, particularly during the southwest monsoon (June to September). For the AP Road corridor, this change could increase surface runoff, soil erosion, and waterlogging, especially in hilly sections and low-lying areas. The risk of slope instability and localized landslides may also rise, given the combination of steep terrain and heavy rain events. To address these risks, the road design should incorporate adequate cross-drainage capacity, lined roadside drains, bioengineering measures for slope protection, and properly managed rainwater outlets. Regular maintenance of drainage infrastructure and embankments will be essential to ensure resilience against increased peak flows and to prevent erosion, flooding, and pavement damage during extreme rainfall events.

For bridge/cross drainage hydrology analysis, observed hourly rainfall records and local IDF (Intensity–Duration–Frequency) curves are presently unavailable for the project area. Therefore, in the absence of observed short-duration rainfall records, shorter-duration rainfall estimates required for hydrological assessment have been derived using standard hydrological conversion procedures and provisions of IRC SP:13-2022, together with conservative engineering assumptions.

**District wise Daily Rainfall Data in the project corridor**

A number of rain gauge stations were installed in Meghalaya under the hydrometeorological modernization programme of the Indian Meteorological Department (IMD) during 2009, supported through World Bank and Central Government funding initiatives. Daily rainfall data from IMD rain gauge stations located in West Garo Hills, South Garo Hills, East Garo Hills, and North Garo Hills were analyzed for the period 2009–2025 and attached as Annexure I. The maximum observed one-day rainfall values from the available 16-year record are summarized below:

| District | Date | 1 day (24 hr) Max Rainfall in mm |
|---|---|---|
| West Garo Hills | 31-05-2021 | 245.83 |
| South Garo Hills | 15-06-2021 | 248.71 |
| East Garo Hills | 15-06-2021 | 231.56 |
| North Garo Hills | 31-05-2021 | 237.68 |

The observed rainfall data is available only for a limited period of 16 years. Therefore, IMD Gridded Rainfall Data (0.25° × 0.25° resolution), available for approximately 110 years, was also studied for regional assessment. The IMD Gridded data series also have 1 day (24hr) rainfall data. The maximum one-day rainfall of year 1980 to 2025 has been attached as Annexure II.

However, a major limitation of the IMD gridded rainfall data (0.25° × 0.25° resolution),in Meghalaya is the highly complex topography and localized microclimatic conditions of the state. Due to steep terrain and orographic effects, adjacent regions often experience significantly different rainfall intensities. Consequently, regional-scale gridded rainfall data may not accurately represent localized extreme rainfall events required for hydrological design. Similar inconsistencies were observed during comparison between observed rain gauge data and IMD gridded rainfall data.

Considering the above, the design rainfall corresponding to 24-hour duration and 100-year return period has been adopted from the CWC Flood Estimation Report, which represents standard engineering practice for hydrological design of bridges and cross-drainage structures in ungauged catchments in India.

Further, historical IMD daily rainfall observations from nearby districts indicate that observed extreme one-day rainfall events are generally lower than the adopted regional design rainfall values, supporting the conservative nature of the selected design rainfall for hydrological assessment.

**As per the CLIMATE CHANGE VULNERABILITY AND PROJECTIONS FOR PROJECT MITP (MEGHALAYA) annex1, it is recommended that the climate** change factors shall be applied to "increase *in **1-day maximum rainfall (Rx1day)** is a critical hydrological variable for calculating **design discharge, flood levels, and flow velocity**, and must therefore be used as the **climate change adjustment factor** in the design of road and bridge infrastructure."*

The MITP report recommends climate adjustment factors of approximately:

- +15% for drainage systems,
- +25% for culverts and minor bridges, and
- up to +35% for major bridge hydrological design parameters,

Accordingly, climate resilience considerations have been incorporated in the adopted design rainfall through application of the recommended climate adjustment factor, enhanced hydraulic capacity, additional freeboard above expected flood levels, and sensitivity assessment for future extreme rainfall scenarios.

Estimation of One Hour Rainfall for hydraulic assessment

| | | | |
|---|---|---|---|
| 100 Year Return Period rainfall for 24 hr, | = | 360 | mm |
| (CWC Flood Estimation Report for Sub Zone 2b) | | | |
| As per MITP Report Climate change factor for rainfall | = | 1.252 | |
| Considering Climate Change 100 year 24 hr Rainfall | = | 450.7 | mm |
| Adopted 100 year 24 hr Rainfall | = | 450.7 | mm |
| Intensity of Rainfall Ic for tc=24hr (Considering 100 year 24 hr rainfall) | | | |
| Ic = (F/T) x((T+1)/(tc+1)) | = | 234.75 | mm/hr |
| Conversion ratio for 1 hrs as per CWC Flood Estimation Report | = | 0.48 | |
| 100 year maximum 1 Hr Rainfall | = | 216.336 | mm/hr |

The project catchments are steep and hilly with short flow paths, resulting in low time of concentration, generally less than one hour. Such catchments respond rapidly to intense rainfall and generate high peak runoff within a short duration. Therefore, the Critical Intensity Method as per IRC SP:13–2022, Clause 4.7.6 has been adopted for estimation of design discharge.

The critical intensity is given by:

$$I_c = \frac{F}{T}\left(\frac{T+1}{t_c+1}\right)$$

$$I_c = I_o\left(\frac{2}{t_c+1}\right)$$

The time of concentration is calculated using:

$$t_c = 0.87\left(\frac{L^3}{H}\right)^{0.385}$$

The calculated 1-hour rainfall intensity of 234.75 mm/hr is nearly equivalent to the maximum observed 24-hour district rainfall of approximately 245 mm, reflecting a highly conservative design approach. Accordingly, the adopted short-duration rainfall values and supplementary hydraulic safety provisions adequately account for extreme rainfall conditions, future climate variability, and uncertainties associated with projected extreme storm events. The incorporation of these conservative hydraulic and climate resilience measures is expected to enhance the long-term safety, reliability, and performance of the infrastructure under future hydrological extremes.

**Adequacy Check as per IRC SP 13:2022**

After incorporating the resilience factor into the design rainfall, the adequacy of both existing and proposed bridges was evaluated using the methodology explained below. Bridges found to be inadequate have been proposed for reconstruction, while those meeting the required capacity criteria have been recommended for retention.

Considering that the average catchment area is ranging between 1.5 to 3 sq.km and the existing bridge widths range between 7 m and 15 m, a detailed adequacy check was performed. The analysis indicated that at many locations, the existing bridge sizes were adequate; accordingly, the proposed bridge dimensions have been kept the same and revised accordingly. The details are provided in the inventory.

The detailed adequacy check is given below:

**Example for Discharge calculation and adequacy check proposed box type MNB**

Catchment Area (A) = 1.61SQKM =161 ha

Length of Longest stream (L) = 2

Rational Formula

Design Discharge Q 100Design Discharge Q 100 =0.028 x Px f xA xIc

H- Elevation Difference between critical point to the structure= 75 m

Time of Concentration tc is given by Eq 4.9 = (0.87 x L3/H)0.385

= (0.87 x 1.1^3x75) ^0.385

= 0.20 hrs

Design Rainfall = 45.072 cm

From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic = 45.072/ 24 x ((24+1)/0.2+1)

= 39.10 cm/hr

From IRC SP 13, Spread Factor "f" from f curve fig 4.2From IRC SP 13, Spread Factor "f" from f curve fig 4.2 = 0.99

From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics

P = 0.4

Design Discharge Q 100 = 0.028 x Px f xA xIc =0.028 x0.4 x 0.99 x 161 x 39.10

= **69.80 Cumecs**

**Adequacy check for Box type bridge**

size of box - 10.60m x 2.178m

IRC SP 13 clause 19.2.8

Area 23.0868 Sqm

Wetted Perimeter, P = 14.956 m

R= A/P 1.54

**As RC SP:13 Clause 19.2.8**

Entry loss Ke= 0.572 $R^{0.3}$ 0.65

Friction loss -0.035 $L/R1^{.25}$ 0.461

λ -$A/(1+ke+kf)^{1/2}$ 15.88

Height of box 2.178 m

Q capacity =λ*$(2gH)^{0.5}$ =**103.82 Cumecs**

or

**By Mannings formula** =Ax 1/n x $R^{2/3}$ x $S^{0.5}$ =

= 1/0.013 x $1.54^{0.66\,x}$ x $(1/750)^{0.5\,x}$ 23.0868

=86.1 Cumecs

n for concrete 0.013, s slope for box type of bridge can be adopted between 500-1000 in std practice

**Q design=69 < Q capacity= 103cumecs**

Based on both methods, the box culvert is hydraulically adequate to safely convey the design discharge

**Adequacy check for deck type proposed bridge**

The longitudinal slope of the stream has been obtained from the surveyed longitudinal section (L-section), while the cross-section has been established based on detailed topographical survey data. The High Flood Level (HFL) has been assumed considering the design discharge and site conditions, and the corresponding cross-sectional flow area has been determined. Using the computed longitudinal slope and hydraulic parameters, the discharge has been evaluated using Manning's equation. The discharge thus obtained has been compared with the discharge estimated using the Rational Method, and the higher of the two values has been adopted for design to ensure a conservative approach. Based on the assessed HFL, the soffit level of the proposed bridge has been fixed by providing the requisite freeboard in accordance with relevant codal provisions.

**The longitudinal slope calculated based on survey =0.069**

The cross-section at the bridge location has been developed based on the actual bed levels of the nala/stream obtained from topographical survey (indicated in blue). The High Flood Level (HFL) has been marked in red at the bridge location on the cross-section, as depicted below.

HFL= 264.250m

Cross - Sectional Area of Flow, A = 12.830 Sqm

Wetted Perimeter , P = 20.264 m

Hydraulic Mean Radius, R = A / P = 0.633 m

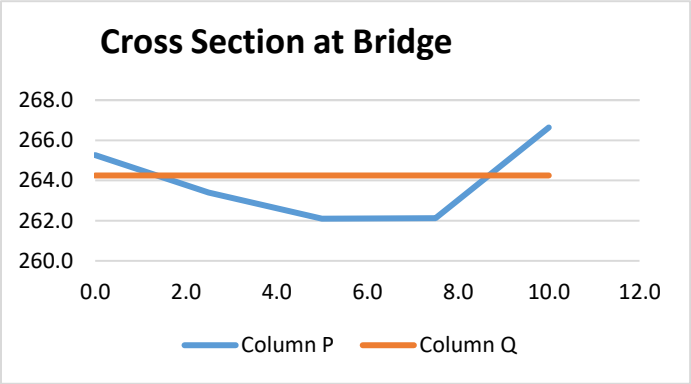
Longitudinal Slope ( as calculated), S = 0.069

n 0.030

V=1/n x $R^{2/3}$ x $s^{1/2}$= 6.462m/s

Q= V x A = 6.642 x 12.833

Discharge = 82.905 cumecs




at the bridge location, the discharge corresponding to the assumed High Flood Level (HFL) of 264.25 m has been found to be greater than the estimated design discharge of 69 cumecs. Hence, the adopted HFL is considered adequate for safely passing the design flood. The same HFL has been used for fixing the soffit level of the proposed bridge

In a similar manner, the hydraulic capacity of the existing bridge has also been assessed using the same methodology to evaluate its adequacy in safely conveying the design discharge.

**Adequacy check for deck type existing bridge**

**Rational Formula**

| | | | |
|---|---|---|---|
| Design Discharge Q $_{100}$Design Discharge Q 100 | = | 0.028 x Px f xA x$I_c$ | |
| Catchment area | = | 121 | Ha |
| H- Elevation Difference between critical point to the structure= | | 40 | m |
| Time of Concentration tc is given by Eq 4.9 | = | $(0.87 \times L^3/H)^{0.385}$ | |
| | = | 0.18 | hrs |
| 100 years return period rainfall for 24hrs as per CWC flood estimation report Subzone 2b | | | |
| | = | 45.072 | cm |
| From IRC SP 13 eq. 4.10a Intensity of rainfall, Ic | = | 45.072/ 24 x (24+1)/0.18+1) | |
| | = | 39.89 | cm/hr |
| From IRC SP 13, Spread Factor **"f" from** f curve fig 4.2From IRC SP 13, Spread Factor **"f" from** f curve fig 4.2 | = | 0.995 | |
| From IRC SP 13, table 4.1, coefficient of runoff for the catchment characteristics | | | |
| P | = | 0.4 | |
| Design Discharge Q $_{100}$ | = | 0.028 x P x f x A x $I_c$ | |
| | = | **53.79 cumecs** | |

| | | |
|---|---|---|
| Existing size of box | 10.60 | x 2.971 |
| IRC SP 13 clause 19.2.8 | | |
| Area | 31.4926 | Sqm |
| Wetted Perimeter , P = | 16.542 | m |
| R= | 1.90 | |
| Entry loss Ke= 0.572 $R^{0.3}$ | 0.69 | |
| Friction loss -0.035 $L/R^{1.25}$ | 0.355028 | |
| λ -A/(1+ke+kf) $^{1/2}$ | 22.00126 | |
| Height of box | 2.971 | m |
| $Q=\lambda*(2gH)^{0.5}$ | **167.976** | Cumecs |

Discharge carrying capacity of box is more than calculated discharge therefore it is safe

Design calculations justifying consideration of Climate resilience factor in design of hydrology for culverts is attached below:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Hydrology at CA CH-0+600 RBB Road** | | | | | | | | |
| | **HYDROLOGY OF Culvert AT KM 0+600** | | | | | | | |
| 1 | Name of River / Stream / Nala | = | Local | | | | | |
| 2 | Catchment Area ( **A)** | = | 0.22 | SQKM | | | | |
| 3 | Length of Longest stream (L) | = | 0.091 | KM | | | | |
| 4 | Point Rainfall in mm | = | 36 | cm | | | | |
| 5 | CWC Subzone | = | 2b | | | | | |
| 6 | **Modified rainfall after application of Climate resilience factor 1.252** | = | 45.072 | cm | | | | |
| | | | | | | | | |
| **A** | **Estimation of Design Discharge by Emperical Formula as per** | | | | | | | |
| | **IRC SP-13-2004, Article 4** | | | | | | | |
| **1** | **Dickens Formula** | | | | | | | |
| | **Q** | **=** | **CA^(3/4)** | | | | | |
| | C =14-19 where annual rainfall is more than 120cm | | | | | | | |
| | For 1500mm rainfall | = | 18 | | | | | |
| | | | =18x0.091^ (3/4) | | | | | |
| | Q | = | 5.78 | Cumecs | | | | |
| **B** | **Rational Formula** | | | | | | | |
| | Design Discharge $Q_{100}$ | = | 0.028 x Px f xA x$I_c$ | | | | | |
| | Rational can be used for small culverts with basin upto 15 Sqkm | | | | | | | |
| | | = | 22 | Ha | | | | |
| | H- Elevation Difference between critical point to the structure= | | 4.14 | m | | | | |
| | Time of Concentration tc is given by Eq 4.9 | = | $(0.87 \times L^3/H)^{0.385}$ | | | | | |
| | | | = (0.87 x 0.091^3x4.14)^0.385 | | | | | |
| | | = | 0.03 | hrs | | | | |
| | 100 years return period rainfall for 24hrs as per CWC flood estimation report Subzone 2b and application of climate resilience factor | = | 45.072 | cm | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | From IRC SP 13 eq. 4.10a Intensity of rainfall , Ic | = | 45.072/ 24 x ( 24+1)/0.03+1) | | | | | |
| | | = | 45.39 | cm/hr | | | | |
| | From IRC SP 13, Spread Factor **"f"** from f curve fig 4.2 | = | 0.995 | | | | | |
| | From IRC SP 13, table 4.1, coefficient of runofff for the catchment characterstics | | | | | | | |
| | P | = | 0.6 | | | | | |
| | Design Discharge $Q_{100}$ | = | 0.028 x Px f xA x$I_c$ | | | | | |
| | | = | **16.69** | Cumecs | | | | |
| | | | | | | | | |
| **D** | **Design Discharge : ( Refer IRC - SP : 13 - 2004, Clause : 6.2 )** | | | | | | | |
| | | | | | | | | |
| | Discharge by Dicken's Formula = | 5.78 | $m^3/s$ | | | | | |
| | Discharge by Rational Formula = | 16.69 | $m^3/s$ | | | | | |
| | Maximum Discharge = | 16.69 | $m^3/s$ | | | | | |
| | **Hence, Design Discharge =** | **8.67** | $m^3/s$ | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | Design discharge from observed flood | 8.67 | Cumecs | | | | | |
| | | | | | | | | |
| | Dimension of Culvert | 1 | m dia. | | | | | |
| | Area of flow (A) | 0.7854 | $m^2$ | | | | | |
| | Perimeter of flow | 3.1416 | m | | | | | |
| | Slope of flow | 0.454945 | | | | | | |
| | Hydraulic mean depth (R) = A/P | 0.250001 | m | | | | | |
| | Rugosity coefficient (n) | 0.033 | | | | | | |
| | Conveyance factor (λ) = (A.R^2/3)/n | 9.440687 | | | | | | |
| | Capacity of culvert | 6.367707 | $m^3/s$ | | | | | |
| | | **Revise** | | | | | | |
| | | | | | | | | |
| | Revised section of Culvert due to lower capacity of Culvert. Revision in design discharge calculation are mentioned below | | | | | | | |
| | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dimension of Culvert | 1 x 5 x 2.8 | m Box | | | | | |
| | Area of flow (A) | 11.9000 | $m^2$ | | | | | |
| | Perimeter of flow | 9.7600 | m | | | | | |
| | Slope of flow | 0.028867 | | | | | | |
| | Hydraulic mean depth (R) = A/P | 1.219262 | m | | | | | |
| | Rugosity coefficient (n) | 0.033 | | | | | | |
| | Conveyance factor (λ) = (A.R^2/3)/n | 411.5853 | | | | | | |
| | Capacity of culvert | 69.9296 | $m^3/s$ | | | | | |
| | | Safe | | | | | | |
| | | | | | | | | |

**Note: The additional structures proposed on the project roads to address climate-resilient design considerations have been incorporated in the submitted Final Detailed Project Report under Chapter 6, Clause 6.19, Page No. 132. Kindly refer to the attached image below.**

### 6.19 Climate Resilient Feature

| Climate-Resilient Design | | Upgradation of Rongsai Borjhora Bajengdoba Road from single to intermediate lane. (RBB) |
|---|---|---|
| 1.Climate Vulnerability Assessment During Design | Roads and bridges undergo systematic climate vulnerability assessments early in design to identify hotspots prone to extreme rainfall, flooding, erosion, waterlogging, landslides and submergence. | Based on the findings of these assessments, climate-resilient design measures have been incorporated into the project. The design discharge for bridges and culverts has been increased by 25.2%, and the design discharge for cross-drainage structures has been enhanced by 14.5% as per (Shared Socioeconomic Pathways) SSP 5-8.5 data from IITM (Indian Institute of |

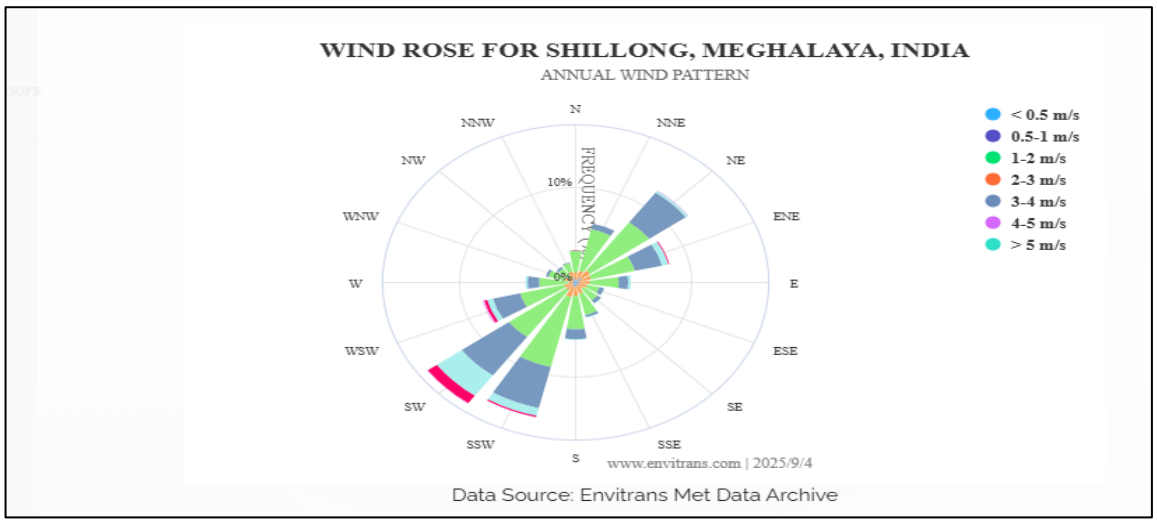




| Climate-Resilient Design | | Upgradation of Rongsai Borjhora Bajengdoba Road from single to intermediate lane. (RBB) |
|---|---|---|
| | | Tropical management) Pune in consultation with MITP to account for projected increases in rainfall intensity under future climate scenarios. |
| | | Considering future climate vulnerability and |
| 2. Enhanced Drainage & Flood Management | Larger culverts, | At critical locations where the existing culvert dimensions were found to be insufficient, the size of the culverts has been increased by converting 2 Pipe culverts to Box Culverts and additional 15 no. of Pipe culverts have been proposed for improving drainage. These measures have been adopted to improve hydraulic capacity, prevent flooding and damage to the road, and ensure uninterrupted connectivity, thereby achieving an all-weather road. |
| | cross-drainage structures, | Specific provisions for cross-drainage structures are made to enhance hydraulic efficiency, prevent clogging, and ensure the stability of both the structures and their approaches. These provisions include floor aprons, cut-off walls, quadrant pitching, stream-protection works, return walls, and retaining walls. |
| | properly graded roadside drains prevent waterlogging and lower flood damage. | Proper gradient to road side drain are provided parallel to road and their connectivity with existing and newly proposed culverts are done to avoid any kind of flooding on the road section. |
| | Road designs incorporate improved cross-drainage systems, culverts, and surface water management to remain serviceable during intense monsoon rainfall common in Meghalaya's wet | Improved Cross Drainage system |

### 5.2.4 WIND SPEED AND DIRECTION

Wind Rose diagram was prepared for 1 year, for the wind data recorded at Shillong (nearest station taken) is given in **Figure 5.1**. Average Wind speed of 1.6 m/s in the direction of NE to South west is observed.




Source: Envitrans

Figure 5.1: Wind rose Diagram

## 5.3 LAND ENVIRONMENT

### 5.3.1 PHYSIOGRAPHY AND ELEVATION

South West Garo Hills district, located in the western part of Meghalaya, is characterized by a predominantly hilly and undulating terrain forming part of the ancient Meghalaya Plateau. The district is bounded by Bangladesh to the south and west, while it shares its other boundaries with West Garo Hills and South Garo Hills districts. The landscape is composed of rolling hills, hillocks, and intervening valleys with elevations generally ranging between 50-212 meters above mean sea level. The district is drained by several important rivers, including the Daru and Bhogai Rivers and tributaries of the Simsang River, drain the area, creating fertile valleys and wetlands that support agriculture and diverse aquatic habitats. The terrain's undulating nature, combined with rich forest cover and water bodies, significantly influences local climate, biodiversity, and land use patterns.

**Baseline Scenario for AP Road**

As per elevation map of South West Garo Hills District, the AP project road stretch lies in the range of 50-212 m. The corridor wise elevation map of the project stretch is given in **Figure 5.2**.

The proposed road of is 7.770 Km length, where the terrain is comparatively stable. Out of the total length, approximately 6.5 km of the alignment runs along the flat terrain with elevations 50-212 m above mean sea level. Bioengineering protection is proposed for cutting sections on both sides of the Ampati Purakhasia Road. On the Left Hand Side (LHS), works span five sections: from chainage 19+390 to 19+420 (30m length), 20+360 to 20+380 (20m length), 21+520 to 21+550 (30m length), 22+690 to 22+740 (50m length), and 25+710 to 25+720 (10m length), totaling 140 meters. On the Right Hand Side (RHS), stabilization covers five sections: from chainage 20+480 to 20+530 (50m length), 20+860 to 20+870 (10m length), 21+500 to 21+590 (90m length), 22+970 to 22+990 (20m length), and 25+710 to 25+730 (20m length), totaling 190 meters. In addition to the protective measures proposed for the road works, gabion-type retaining walls have been recommended to stabilize vulnerable sections. These structures will cover a cumulative length of 38 0 m across all locations within the sub project road to prevent slope instability and erosion.

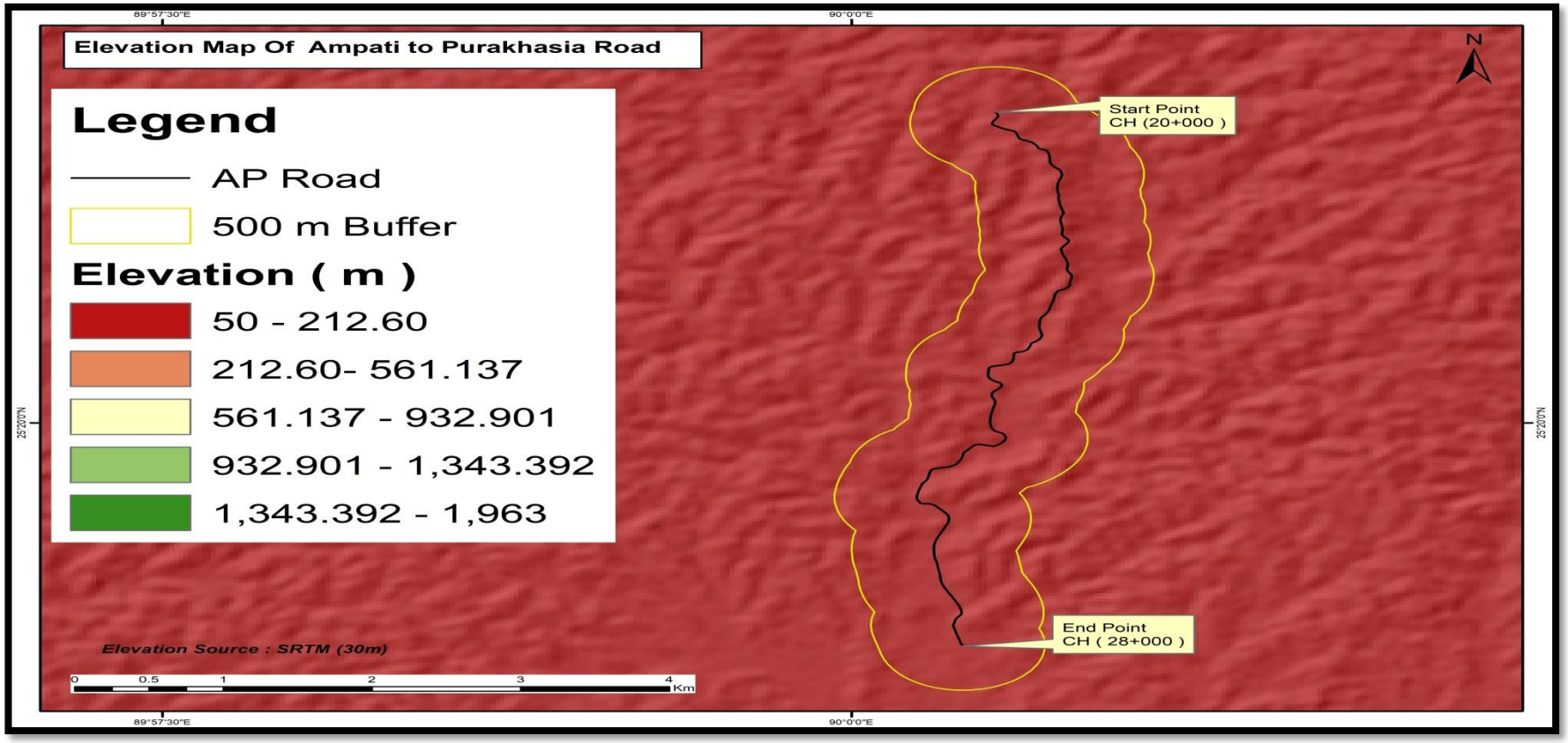



Figure 5.2: Elevation map of the AP project area (Elevation Source: SRTM (30m)

## 5.3.2 GEOLOGY

**Baseline Scenario for Sub- Project Road**

**Geology of the Sub Project Road**

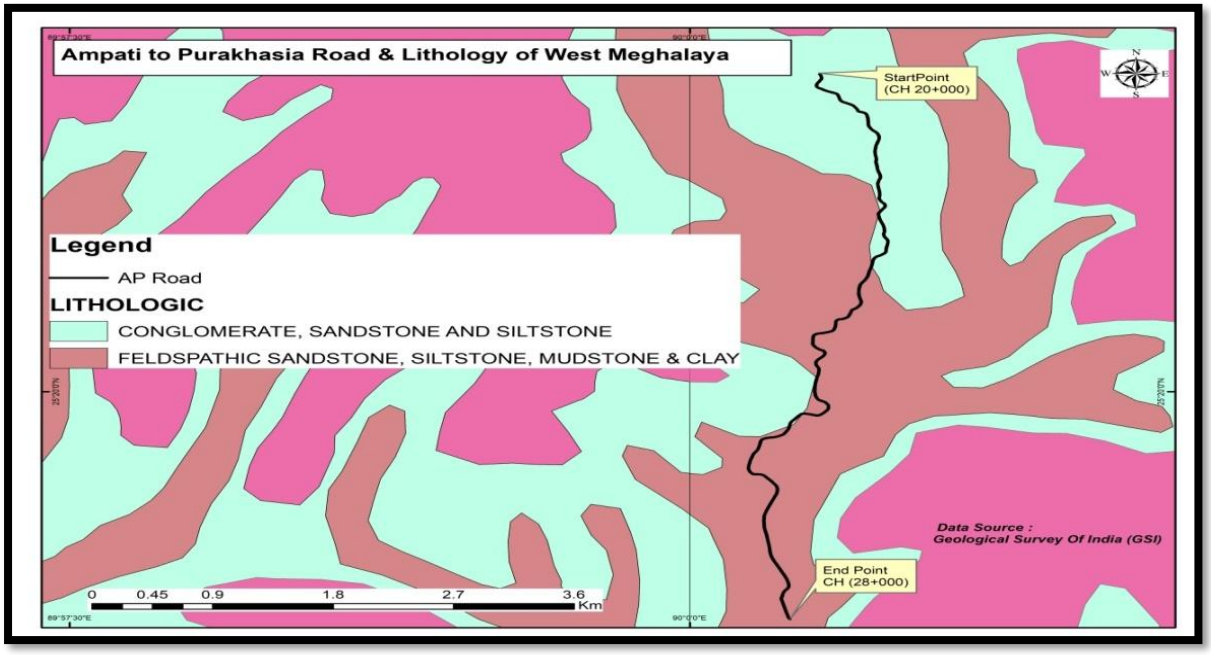
- Dominated by Precambrian crystalline basement rocks (gneiss, granite, quartzite).
- Patches of Gondwana sediments with coal measures are found along valleys and river sections.
- Alluvial deposits occur in the plains.
- The terrain is rugged and hilly in the south, gently sloping towards the north.
- Economic geology: Small coal deposits (Siju–Dudnai belt), building stones, laterite, and minor limestone.

**Seismicity**

- Corridor lies in **Seismic Zone V** (IS 1893 zoning). Use **importance factor per IRC:6**; detail retaining walls, culverts, and bridges for seismic earth pressures and bearings for PGA ≈ **0.36 g** design basis.

**Environmental & construction notes**

- **Monsoon window:** Avoid deep cuts/excavations Jun–Sep; stage construction with temporary drains & silt traps.
- **Spoil management:** Designated tips on stable benches (>10 m from drainage), compacted in layers, with toe bunds.
- **Biodiversity:** Riparian buffers at stream crossings; avoid natural slopes with dense canopy.




The geology of the AP Road is depicted in **Figure 5.3**, below.

Figure 5.3: Local geology of the road stretch of sub–Project Road AP

### 5.3.3 GEO-MORPHOLOGY AND SOILS

Geomorphologically, the soils of South West Garo Hills are mainly lateritic and shallow on the hill slopes, with alluvial pockets in the valley floors, and are widely reported to be acidic, non-saline and variable in fertility (pH, available P and K vary locally). Soil-fertility surveys and recent GIS mapping show a mosaic of soil conditions: many locations have reasonably high organic carbon because of forest and jhum fallows, but nutrient availability (especially phosphorus) is often low and soil pH commonly acidic conditions that limit crop response unless amended. (Mapping of soil fertility status of South West Garo hills district of Meghalaya, May 2020)

The soil quality of the Ampati–Purakhasia Road corridor, is generally lateritic to sandy loam in texture, acidic in nature (pH 4.5–6.0), and moderate to low in fertility. The soils have good organic carbon content due to forest cover and shifting cultivation residues but are often deficient in available phosphorus and potassium. In valley areas, the soils are more fertile and deeper, while on hill slopes, they are shallow, erodible, and prone to surface runoff during heavy rainfall. Overall, the soils support forest and plantation crop well but require lime application, organic manure, and soil conservation measures for sustainable agricultural use and to maintain stability along the road alignment. (Source: National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), ICAR – *Soil Series of Meghalaya (NBSS Publication No. 141, 2017)*

Given the terrain and soil characteristics, the AP Road requires adequate slope stabilization, drainage, and erosion-control measures such as check walls, bio-engineering techniques, and roadside plantation to minimize soil loss and maintain road stability While the soil's acidity and high organic content support a variety of crops, the lack of adequate irrigation limits the successful cultivation of all crops[4].

Table 5.4: South West garo Hills District - Block wise major soil class area in Ha. and Land Slope

| Name of the Block | Soil Type | | | Land Slope (%) | | | |
|---|---|---|---|---|---|---|---|
| | Major Soil Classes | Major Soil Type | Area (Ha) | 0-3% (Ha) | 3-8% (Ha) | 8-25% (Ha) | >25% (Ha) |
| Gambegre Development Block (South West Garo Hills) | Sandy loam to clay loam | Laterite & Lateritic soils | 62,000 | 3,800 | 9,500 | 18,700 | 30,000 |

Source: District Irrigation Plan 2016–2020, North Garo Hills, Government of Meghalaya

Geomorphological map of South west Garo Hills district is depicted in the **Figure 4.4** below.

[4]District Irrigation Plan 2016–2020, North Garo Hills, Government of Meghalaya.

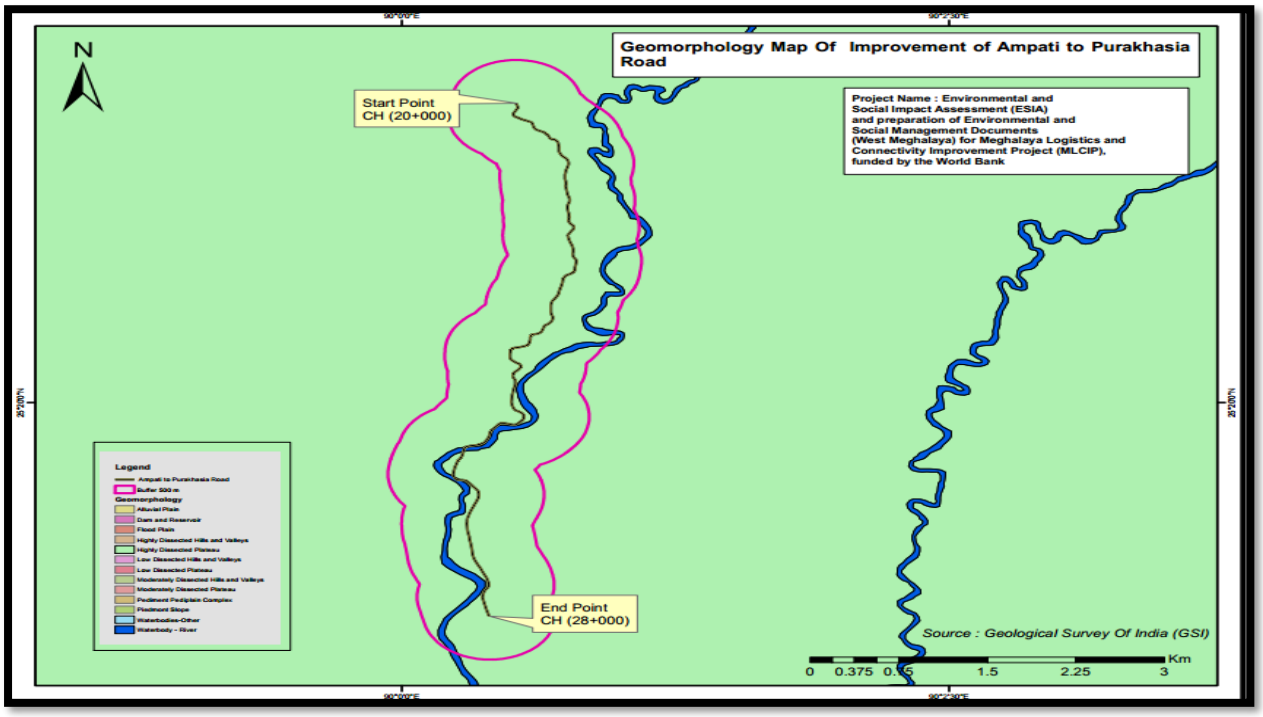



Figure 5.4: Geomorphological map

### 5.3.4 LAND USE PATTERN

The LULC map[5] of 500m reveals that the AP stretches area comprises of 33.73%, reflecting significant natural vegetation. This is followed by plantation at 20.12%, suggesting notable managed vegetation or agroforestry presence. Settlement (13.72%) and wasteland (13.67%) contribute nearly equal shares, indicating moderate human habitation and underutilized land. Cropland accounts for 8.40%, showing limited agricultural extent, while water bodies cover 7.30%, supporting local hydrology. Rural settlements constitute the smallest share at 3.04%, indicating relatively low dispersed habitation. The LULC map of 500m on either side of the road is presented in **Figure 5.5** below

[5] LULC Data source: NRSC: LULC (10 k) SIS-DP Phase-2: 2018-23

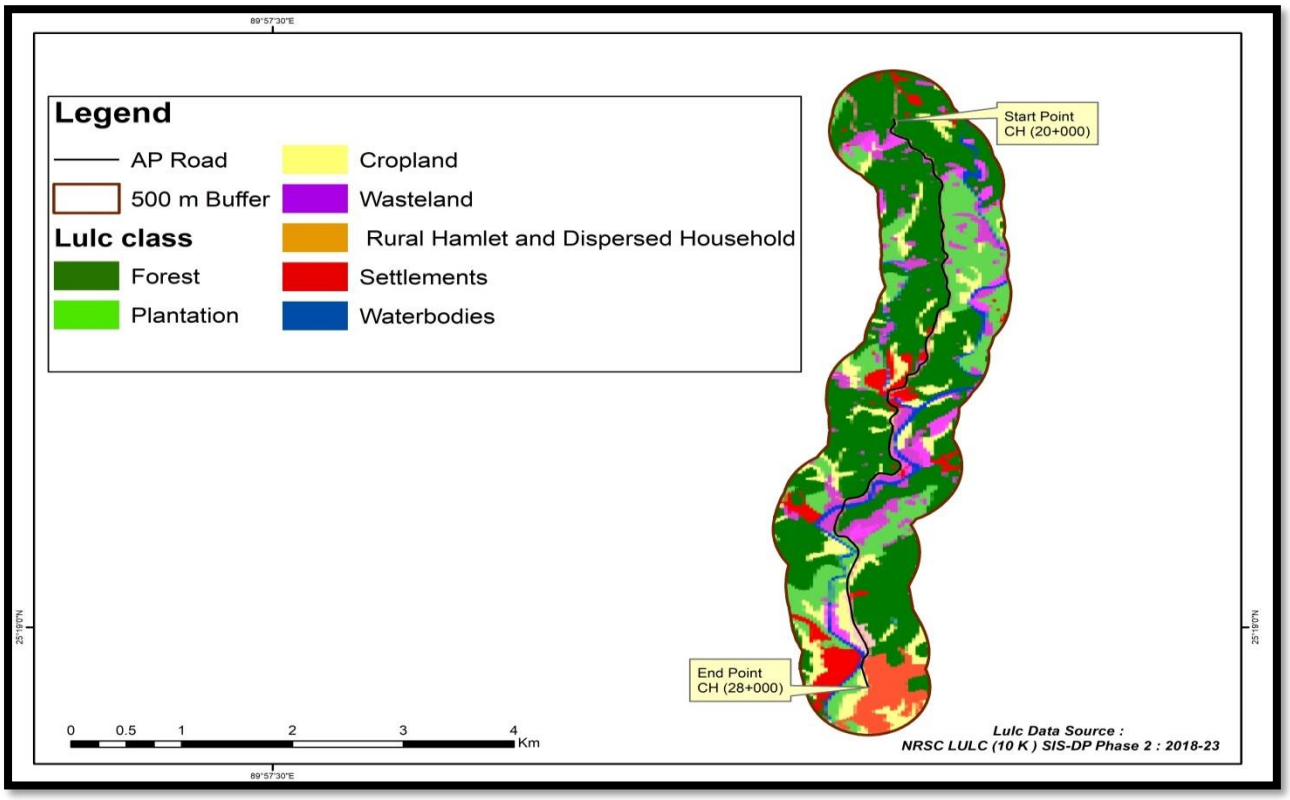



Figure 5.5: Land Use / Land Cover map of AP road corridor

The following sections of this chapter provide details of the existing road characteristics, key project components, resource requirements and proposed improvements.

## 5.3.5 AGRICULTURE

**Baseline Scenario in Project Corridor Area**

According to the consultations that were organized with Indigenous communities, the majority of the population in the sub-project area relies on agriculture as their primary source of livelihood, with Jhum cultivation being the predominant farming practice among local communities. Key crops grown in the AP road area include paddy, maize, sesame, cauliflower, cabbage, chilli, bitter gourd, tomatoes, lettuce, pumpkin, betel nut, betel leaf, pineapple, and banana. Farmers primarily sell their products in local markets, while surplus yields are supplied to other districts or states through vendors.

## 5.3.6 SOIL QUALITY

Details of the soil sampling locations are presented in **Table 5.5** and shown in **Figure 5.6**. The collected soil samples were analyzed for various parameters in an NABL-accredited laboratory. The soil monitoring results are presented in the **Table 5.6.**

Table 5.5: Soil Monitoring Locations

| Sl.No. | Details of Road | Monitoring Locations | Location Code | Latitude | Longitude |
|---|---|---|---|---|---|
| 1 | AP Road<br>7.770 Km | Chopapara Agricultural Field | SQ1 | 25°21'51.95"N | 90° 0'30.87"E |

| | | | | | |
|---|---|---|---|---|---|
| 2 | | Mebitpara Agricultural Field | SQ2 | 25°19'14.59"N | 90° 0'18.51"E |


Figure 5.6: Soil monitoring locations

Table 5.6: Soil Monitoring Results in the sub-project area

| Sl. No. | eters | Units | SQ1 | SQ2 | Test Method |
|---|---|---|---|---|---|
| 1 | Colour | | Brown | Brown | STRL/STP/SOIL/01 |
| 2 | Textural Class | | Sandy Loam | Sandy Loam | IS2720 (P-4),1985 (Reaff: 2015) |
| 3 | Bulk Density | gm/cm$^3$ | 1.27 | 1.24 | IS 14765: 2000, RA 2010 |
| 4 | Water Holding Capacity | % | 30.4 | 29.6 | STRL/STP/SOIL/01 |
| 5 | Sand | % | 54.0 | 53.1 | IS2720 (P-4),1985 (Reaff: 2015) |
| 6 | Silt | % | 27.9 | 27.0 | IS2720 (P-4),1985 (Reaff: 2015) |
| 7 | Clay | % | 19.2 | 21.0 | IS2720 (P-4),1985 (Reaff: 2015) |
| 8 | pH (1:2 Suspension) | - | 5.99 | 5.89 | IS:2720 (P-26), 1987 (Reaff:2011) |
| 9 | Electrical Conductivity (1:2) | µmhos/cm | 229.0 | 228.5 | IS: 14767(2000), RA 2016 |
| 10 | Organic Matter | %W/W | 3.31 | 3.46 | STRL/STP/SOIL/01 |
| 11 | Exchangeable Calcium | mg/kg | 1266.0 | 1238.5 | IS 2720 (Part 24): 1976, RA 2010 |
| 12 | Exchangeable Magnesium | mg/kg | 515.4 | 518.2 | IS 2720 (Part 24): 1976, RA 2010 |

| Sl. No. | eters | Units | SQ1 | SQ2 | Test Method |
|---|---|---|---|---|---|
| 13 | Copper | mg/kg | 10.3 | 9.5 | IS 2720(Part-27): 1977 |
| 14 | Nickel | mg/kg | 7.4 | 7.9 | IS 2720(Part-27): 1977 |
| 15 | Chromium | mg/kg | 10.3 | 9.2 | IS 2720(Part-27): 1977 |
| 16 | Iron | mg/kg | 78.6 | 83.6 | IS 2720(Part-27): 1977 |
| 17 | Lead | mg/kg | 0.2 | 0.3 | IS 2720(Part-27): 1977 |
| 18 | Sulphate | mg/kg | 13.1 | 14.9 | IS 2720(Part-27): 1977 |
| 19 | Nitrogen (as N) | Kg/Ha | 261.0 | 259.9 | IS: 10158:1982, RA 2009 |
| 20 | Phosphorous | Kg/Ha | 109.6 | 102.8 | IS: 10158:1982, RA 2009 |
| 21 | Exchangeable Potassium | Kg/Ha | 68.4 | 73.9 | STRL/STP/SOIL/01 |

Soils along the AP Road corridor are sandy loam, well-drained and moderately acidic (pH 5.85–6.12), which is typical for the region's high rainfall conditions. Organic matter levels are moderately high, reflecting good natural leaf-litter enrichment. Major nutrients (N & P) are moderate, whereas Potassium is slightly low due to natural leaching. No heavy metal contamination is observed, indicating the soil is suitable for plantation and greenbelt development.

## 5.4 WATER ENVIRONMENT

### 5.4.1 Water

Water bodies in the AP project area of 7.770 Kms stretch mainly comprise Daru River which was observed during the field study. The water from Daru River is used for domestic needs, irrigation, livelihood activities like fishing, and plays a key role in supporting local ecology and riverbank stability. Several small perennial and seasonal streams intersect or run adjacent to the Ampati to Purakhasia (AP) Road corridor in South West Garo Hills District. These streams serve as vital sources of domestic water, livelihood support for nearby communities, and ecosystem linkages within the local drainage network. Local villages use the stream water primarily for washing, bathing, small-scale irrigation, and livestock watering, particularly during the dry months when groundwater availability is low. In some sections, community fish rearing and bamboo growth are also supported by these watercourses. The streams contribute to local groundwater recharge and wetland formation, enhancing biodiversity along riparian stretches. However, unregulated runoff from roads and nearby settlements occasionally leads to siltation and turbidity, affecting water quality and downstream use. The project design therefore emphasizes protection of natural flow channels, provision of cross-drainage structures, and controlled discharge of construction runoff to prevent any disruption or contamination of these locally significant water bodies. The below section describes the Surface and Ground water conditions in the sub-project area as well as the relevant water quality standards.

### 5.4.2 SURFACE WATER

01 Surface water samples have been selected from sources present along the project roads to ascertain the baseline conditions of the surface water quality. The surface water samples collected included samples from river in the month of October. Location details of the surface water samples are presented in **Table 5.7** and shown in **Figure 5.7**.

Table 5.7: Surface Water Monitoring Locations

| S. No | Source of Sample | Sample Code | Geographical Coordinate | |
|---|---|---|---|---|
| | | | Latitude | Longitude |
| 1 | Daru River | SW1 | 25°20'18.06"N | 90° 0'30.74"E |

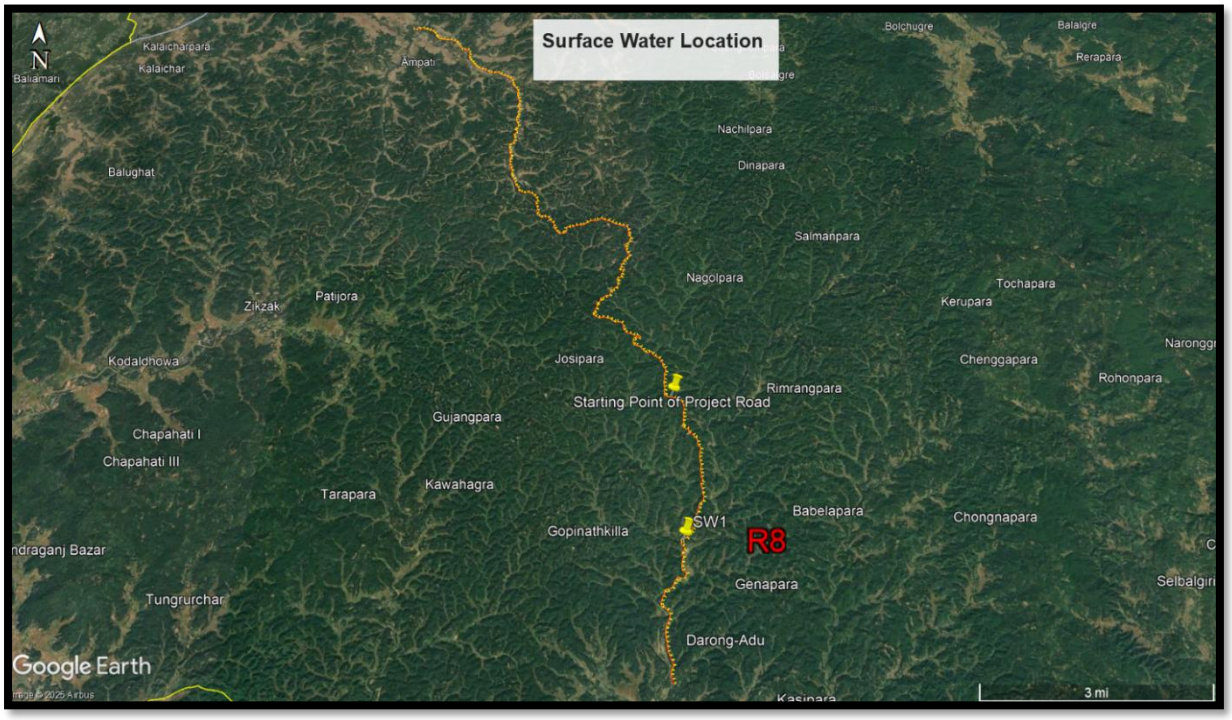



Figure 5.7: Surface Water monitoring locations

pH values in the surface water samples were observed at 7.32, indicating a neutral to slightly alkaline nature. Dissolved Oxygen (DO) levels were found at 7.35 mg/l, showing adequate oxygen availability. The Biochemical Oxygen Demand (BOD) was recorded at 5.60 mg/l, reflecting low organic pollution. Nitrate concentration was recorded at 2.1 mg/l, which is within permissible limits for Class C water quality. Heavy metals (such as Pb, Cd, Cr, Hg) were found below or near detectable limits (e.g., Pb: 0.02 mg/l, Cd: 0.001 mg/l, Cr+6: 0.02 mg/l, and Hg: <0.001 mg/l), indicating absence of significant industrial contamination.

Table 5.8: Surface Water Quality Monitoring results in the project area

| Sl. No. | Parameters | Unit | IS: 2296 -1992 (Class C) Tolerance Limit | SW-1 | Test method |
|---|---|---|---|---|---|
| 1 | pH | - | 6.5 -8.5 | 7.32 | IS: 3025(Pt-11)1983, RA. 2002 |
| 2 | Temperature | °C | - | 19.3 | APHA 23nd Edn.2017-2550 B |
| 3 | D.O | mg/l | Minimum -4 | 7.35 | IS 3025(Part-38): 2006 |
| 4 | BOD | mg/l | 30 | 5.60 | IS 3025(Part-44):1993, RA 2009 |
| 5 | Colour | Hazen | 300 | 5 | IS: 3025 (Pt-4) 1983, RA 2017 |
| 6 | Odour | - | - | Agreeable | IS: 3025(Pt-5) |
| 7 | TDS | mg/l | 1500 | 233.6 | IS 3025(Part-16): 1984, RA 2006 |
| 8 | TSS | mg/l | - | 21.0 | IS 3025(Part-17) |
| 9 | TKN | mg/l | | 2.2 | IS: 3025(Pt-34)1988, RA. 2003 |
| 10 | Ammonical Nitrogen | mg/l | | 0.46 | IS: 3025(Pt-34)1988, RA. 2003 |
| 11 | Nitrate (as $NO_3$) | mg/l | 50 | 2.1 | IS: 3025(Pt-34)1988, RA. 2003 |
| 12 | Free Ammonia | mg/l | | <0.1 | IS: 3025(Pt-34)1988, RA. 2003 |
| 13 | Chlorides (as Cl) | mg/l | 600 | 29.2 | IS 3025(Part-32): 1988 |
| 14 | Sulphates (as $SO_4$) | mg/l | 400 | 30.3 | IS 3025(Part-24):1986, RA 2003 |
| 15 | Fluoride (as F) | mg/l | 1.5 | 0.41 | APHA 21st Ed., 4500F(D) |
| 16 | Oil & Grease | mg/l | 0.1 | <0.1 | IS 3025(Part-39):1991, RA 2009 |

| Sl. No. | Parameters | Unit | IS: 2296 -1992 (Class C) Tolerance Limit | SW-1 | Test method |
|---|---|---|---|---|---|
| 17 | Phenolic Compound (as $C_6H_5OH$) | mg/l | 0.005 | <0.001 | 5530-B, C&E, APHA 23nd 2017 |
| 18. | Arsenic | mg/l | 0.2 | <0.1 | 3110- B, APHA 23nd Ed. 2017 (AAS) |
| 19 | Mercury (as Hg) | mg/l | - | <0.001 | 3110- B, APHA 23nd Ed.2017 |
| 20 | Lead (as Pb) | mg/l | 0.1 | 0.02 | 3110- B, APHA 23nd Ed. 2017 (AAS) |
| 21 | Cadmium (as Cd) | mg/l | 0.01 | 0.001 | 3110- B, APHA 23nd Ed. 2017 (AAS) |
| 22. | Chromium (as $Cr^{+6}$) | mg/l | 0.05 | 0.02 | IS 3025(Part-52): 200 |
| 23. | Copper (as Cu) | mg/l | 1.5 | 0.12 | 3110- B, APHA 23nd Ed. 2017 (AAS) |
| 24. | Zinc (as Zn) | mg/l | 15 | 0.18 | 3110- B, APHA 23nd Ed. 2017 (AAS) |
| 25 | Selenium (as Se) | mg/l | - | <0.1 | IS: 3025 (P- 56) |
| 26. | Anionic detergents (as MBAS) | mg/l | 1.0 | <0.1 | Annexure K Of IS 13428 |
| 27. | Iron (as Fe) | mg/l | 50 | 0.43 | 3500-Fe- B, APHA 23nd Ed. 2017 |
| 28. | Sulphide (as $H_2S$) | mg/l | - | 0.17 | IS-3025 (P-29) |
| 29. | Phosphate (as $PO_4$) | mg/l | - | 5.19 | APHA 22nd Edn.2012-4500-P C |
| 30. | Cyanide (as CN) | mg/l | 0.05 | <0.1 | 4500-CN-B, C & E, APHA 23nd Ed.2017 |
| 31. | Manganese (as Mn) | mg/l | - | 0.03 | 3110- B, APHA 23nd Ed.2017 |
| 32. | COD | mg/l | - | 22.1 | IS 3025(Part-58): 2006 |
| 33. | Total Coli form | MPN/100ml | 5000 | 970 | IS: 1622-1981 |
| | | | | | |

## 5.4.3 GROUND WATER

02 Ground water samples have been selected from sources present along the project roads to ascertain the baseline conditions of the ground water quality. The Ground water samples collected included samples in the month of October. Location details of the groundwater samples are presented in **Table 5.9** and shown in **Figure 5.8** and results are presented in **Table 5.10.** Ground water samples have been analyzed in accordance with the Drinking Water Quality Standards of IS 10500:2012.

Table 5.9: Ground Water Sample Locations in the sub-project area

| Sl. No | Project Area | Monitoring Location | Sample Code | Geographical Co-ordinates | |
|---|---|---|---|---|---|
| | | | | Latitude | Longitude |
| 1 | AP Sub Project Road | Chopapara LP School | GW1 | 25°22'6.43"N | 90° 0'32.12"E |
| 2 | | Grazing field Baptist Church | GW2 | 25°19'0.95"N | 90° 0'20.63"E |

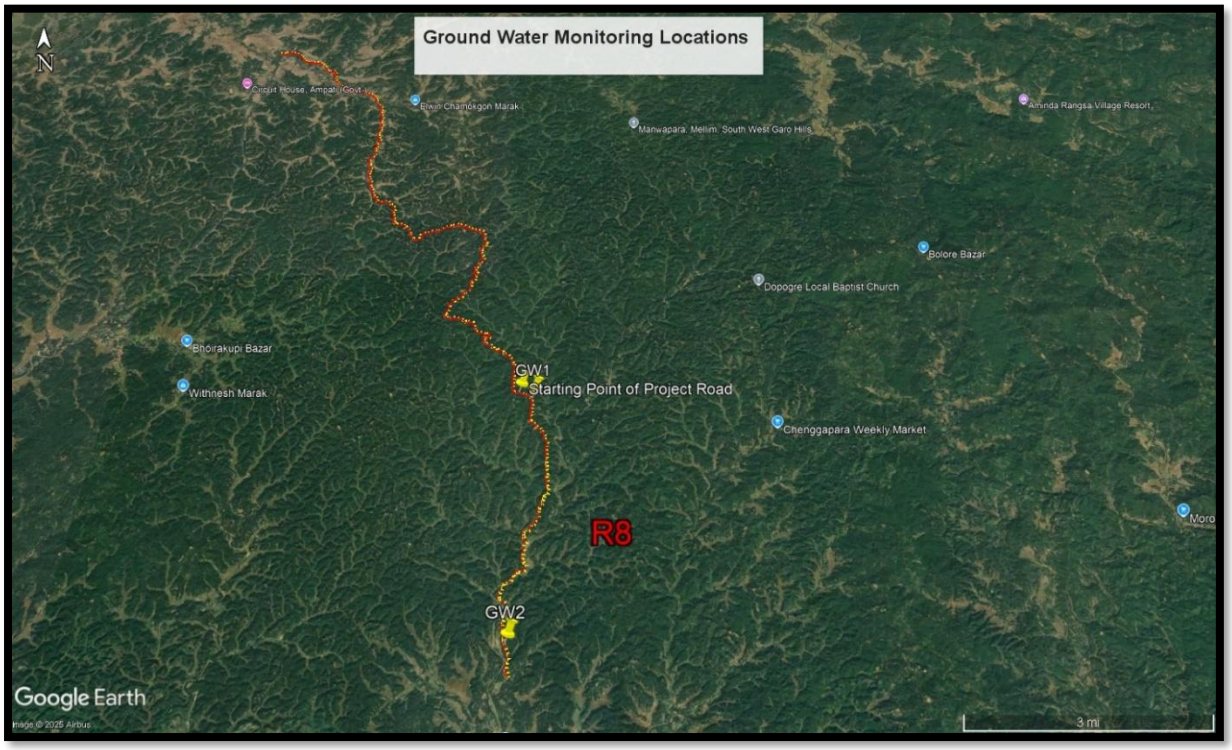



Figure 5.8: Ground Water monitoring locations

Groundwater at both locations (GW-1 and GW-2) shows good potability, with pH ranging from 7.30–7.33, TDS 238–241 mg/L, and total hardness around 121–123 mg/L, all well within IS 10500:2012 limits. Heavy metals like iron, chromium, arsenic, lead, cadmium, and mercury are below detectable or permissible levels, indicating no contamination risk. Overall, the groundwater quality is satisfactory and safely fit for drinking and domestic use.

Table 5.10: Ground Water monitoring results in the project area

| S. No. | Parameters | Unit | Limit (IS-10500:2012) | | GW-1 | GW-2 | Test method |
|---|---|---|---|---|---|---|---|
| | | | Desirable Limit | Permissible Limit | | | |
| 1 | Color | Hazen | 5 | 15 | <5 | <5 | IS: 3025(Pt-4) |
| 2 | Odour | - | Agreeable | Agreeable | Agreeable | Agreeable | IS: 3025(Pt-5) |
| 3 | Taste | - | Agreeable | Agreeable | Agreeable | Agreeable | IS: 3025(Pt-8) |
| 4 | Turbidity | NTU | 1 | 5 | <1 | <1 | IS 3025(Part-10) |
| 5 | pH | - | 6.5-8.5 | No Relaxation | 7.33 | 7.30 | IS: 3025(Pt-11) |
| 6 | Total Hardness (as $CaCO_3$) | mg/l | 200 | 600 | 123 | 121.7 | IS 3025(Part-21) |
| 7 | Iron (as Fe) | mg/l | 0.3 | No Relaxation | 0.20 | 0.21 | 3500-Fe- B, APHA 23nd Ed.2017 |
| 8 | Chlorides (as Cl) | mg/l | 250 | 1000 | 18.5 | 19.5 | IS 3025(Part-32) |
| 9 | Fluoride (as F) | mg/l | 1 | 1.5 | 0.35 | 0.40 | 4500-F-(D), APHA 23$^{st}$ Ed.2017 |
| 10 | TDS | mg/l | 500 | 2000 | 238.5 | 241.1 | IS 3025(Part-16) |

| S. No. | Parameters | Unit | Limit (IS-10500:2012) | | GW-1 | GW-2 | Test method |
|---|---|---|---|---|---|---|---|
| | | | Desirable Limit | Permissible Limit | | | |
| 11 | Calcium (as $Ca^{2+}$) | mg/l | 75 | 200 | 26.4 | 23.3 | IS 3025(Part-40) |
| 12 | Magnesium (as $Mg^{2+}$) | mg/l | 30 | 100 | 12.1 | 13.3 | 3500- Mg B, APHA 23nd Ed.2017 |
| 13 | Sulphate (as $SO_4$) | mg/l | 200 | 400 | 12.6 | 13.3 | IS 3025(Part-24) |
| 14 | Nitrate (as $NO_3$) | mg/l | 45 | No Relaxation | 12.2 | 11.1 | IS: 3025(Pt-34) |
| 15 | Total Chromium (as Cr) | mg/l | 0.05 | No Relaxation | <0.01 | <0.01 | 3110- B, APHA 23nd Ed.2017 |
| 16 | Alkalinity as $CaCO_3$ | mg/l | 200 | 600 | 139.3 | 131.6 | IS 3025(Part-23) |
| 17 | Aluminium (as Al) | mg/l | 0.03 | 0.2 | <0.01 | <0.01 | IS 3025(Part-55) |
| 18 | Total Arsenic (as As) | mg/l | 0.01 | No Relaxation | <0.01 | <0.01 | 3110- B, APHA 23nd Ed2017 |
| 19 | Copper (as Cu) | mg/l | 0.05 | 1.5 | <0.05 | <0.05 | 3110- B, APHA 23nd Ed2017 |
| 20 | Manganese (as Mn) | mg/l | 0.1 | 0.3 | <0.01 | <0.01 | 3110- B, APHA 23nd Ed2017 |
| 21 | Zinc (as Zn) | mg/l | 5 | 15 | 0.20 | 0.16 | 3110- B, APHA 23nd Ed2017 |
| 22 | Ammonia (as $NH_3$-N) | mg/l | 0.5 | No Relaxation | <0.1 | <0.1 | 4500-$NH_3$-B &C, APHA 23rd ED2017 |
| 23 | Anionic Detergents (as MBAS) | mg/l | 0.2 | 1 | <0.1 | <0.1 | Annexure K of IS-13428 |
| 24 | Boron (as B) | mg/l | 0.5 | 1 | <0.5(BDL) | <0.5(BDL) | IS: 3025(Pt-57) |
| 25 | Mineral Oil | mg/l | 0.5 | No Relaxation | <0.1 | <0.1 | IS 3025(Part-39) |
| 26 | Phenolic Compound (as $C_6H_5OH$) | mg/l | 0.001 | 0.002 | <0.001 | <0.001 | IS 3025(Part-44) |
| 27 | Cadmium (as Cd) | mg/l | 0.003 | No Relaxation | <0.002 | <0.002 | 3110- B, APHA 23nd Ed2017 |
| 28 | Cyanide (as CN) | mg/l | 0.05 | No Relaxation | <0.1 | <0.1 | 4500- CN-B, C & E, APHA 23nd Ed2017 |
| 29 | Lead | mg/l | 0.01 | No Relaxation | <0.01 | <0.01 | 3110- B, APHA 23nd Ed2017 |

| S. No. | Parameters | Unit | Limit (IS-10500:2012) | | GW-1 | GW-2 | Test method |
|---|---|---|---|---|---|---|---|
| | | | Desirable Limit | Permissible Limit | | | |
| 30 | Mercury (as Hg) | mg/l | 0.001 | No Relaxation | <0.001 | <0.001 | 3110- B, APHA 23nd Ed.2017 |
| 31 | Nickel (as Ni) | mg/l | 0.02 | No Relaxation | <0.02 | <0.001 | 3110- B, APHA 23nd Ed.2017 |
| 32 | Residual Free Chlorine | mg/l | 0.2 | 1.0 | <0.2 | <0.02 | 4500-Cl-B, APHA 23nd Ed2017 |
| 33 | Molybdenum (Mo) | mg/l | <0.05 | 0.07 | No Relaxation | <0.2 | 3110- B, APHA 23nd Ed.2017 |
| 34 | Polynuclear Aromatic Hydrocarbons | mg/l | <0.0001 | 0.0001 | No Relaxation | No Relaxation | APHA 6440,23nd Ed.2017 |
| 35 | Poly chlorinated biphenyl | mg/l | <0.0001 | 0.0005 | No Relaxation | No Relaxation | APHA 6430,23nd Ed.2017 |
| 36 | Total Coli form | MPN/ 100ml | Shall not be detectable in any 100 ml of sample | | | **Microbiological Parameters** | IS: 1622-1981 |
| 37. | E.Coli | E.Coli/ 100ml | Shall not be detectable in any 100 ml of sample | | | <1 | <1 |
| | | | | | | Absent | Absent |

## 5.5 AIR ENVIRONMENT

### 5.5.1 AIR QUALITY

The Project has the potential to impact air quality, and while these impacts can be managed through mitigation measures outlined in the ESMP and adherence to good international practices, there remains a possibility of significant residual impacts

Residential and other sensitive locations proximity to roads were the criteria used for selecting the sample locations. Parameters like Particulate Matter ($PM_{10}$), Particulate Matter ($PM_{2.5}$), Sulphur dioxide ($SO_2$), Nitrogen dioxide ($NO_2$) and Carbon Monoxide (CO) were monitored. Map showing monitoring locations are given in **Table 5.11** & **Figure 5.9.**

Table 5.11: Ambient Air Quality Monitoring Locations

| Sl. No. | Monitoring Location | Sample Code | Geographical Coordinate | |
|---|---|---|---|---|
| | | | Latitude | Longitude |
| 1 | Chopapara Village | AQ1 | 25°22'9.40"N | 90° 0'25.78"E |
| 2 | Mebitpara Village | AQ2 | 25°20'20.54"N | 90° 0'30.38"E |
| 3 | Mebitpara Village | AQ3 | 25°18'42.72"N | 90° 0'22.96"E |

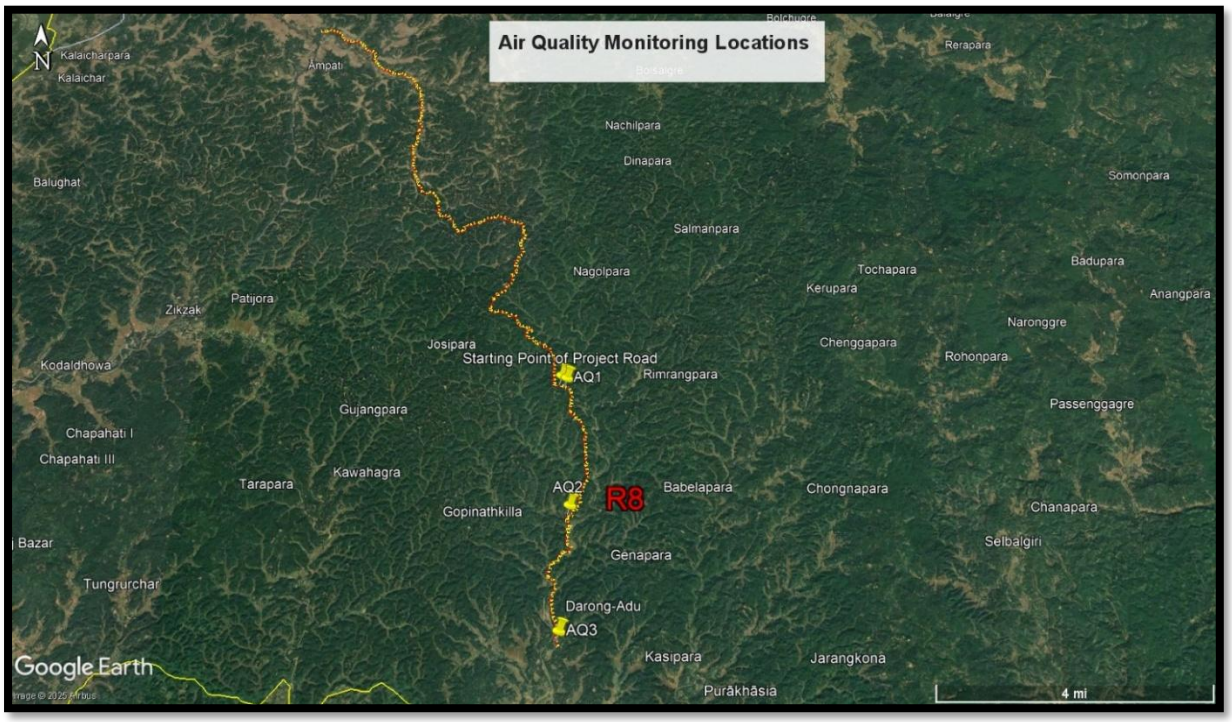



Figure 5.9: Air Quality monitoring locations

The monitored air quality data shows that overall pollution levels in the project area are within the National Ambient Air Quality Standards (NAAQS). PM10 concentrations range between 41.3–42.6 µg/m³ and PM2.5 between 16.9–18.4 µg/m³, both well below their respective limits, indicating low particulate pollution. Sulphur dioxide ($SO_2$) levels remain low, between 5.2–5.7 µg/m³, suggesting minimal sulfur-based emissions. Nitrogen dioxide ($NO_2$) values mostly lie in the lower range of 5.6–5.9 µg/m³, though one location recorded a comparatively higher value of 56.3 µg/m³, which is still within the permissible limit, may reflect localized emission sources such as vehicular movement or fuel combustion. Carbon monoxide (CO) concentrations, ranging from 0.190–0.210 mg/m³, also remain significantly lower than the prescribed limit, indicating negligible CO-related pollution in the area. Overall, the data suggests that ambient air quality in the monitored corridor is generally clean and does not pose environmental or public health concerns.

Table 5.12: Ambient Air Quality Monitoring Results within project influence area

| Sl. No. | Project Area | Location | Sample Code | Latitude (North) | Longitude (East) | $PM_{10}$ (µg/m³) | $PM_{2.5}$ (µg/m³) | Sulphur Dioxide (SO₂) (µg/m³) | Nitrogen Dioxide ($NO_2$) (µg/m³) | Carbon Monoxide (CO) (µg/m³) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AP road | Chopapara Village | AQ 1 | 25°22'9.40" N | 90° 0'25.78 "E | 41.3 | 16.9 | 4.2 | 4.9 | 0.190 |
| 2 | | Mebitpara Village | AQ 2 | 25°20'20.54 "N | 90° 0'30.38 "E | 41.4 | 18.2 | 4.9 | 5.6 | 0.210 |
| 3 | | Mebitpara Village | AQ 3 | 25°18'42.72 "N | 90° 0'22.96 "E | 42.6 | 18.4 | 4.4 | 5.3 | 0.200 |
| National Ambient Air Quality Standards, Central Pollution Control Board, 2009 | | | | | | 100 | 60 | 80 | 80 | 2000 |
| Test Methods | | | | | | IS:5182 (P-23): 2006 | SOP1/STRL/ Ambient Air/ Gravimetric method | IS:5182 (P-2): 2006 | IS:5182(P-6): 2006 | IS:5182(P-10):199, RA-2003 |

## 5.6 NOISE ENVIRONMENT

The principal sources of construction noise and vibration anticipated during the Project include:

- Delivery and movement of staff, materials, construction plant, and machinery;
- Site preparation works, including establishment of construction camps;
- Hill cutting and excavation activities;
- Removal of existing road pavement and structures; and
- Restoration and finishing works.

Most of these activities are expected to occur in proximity to the existing road alignment. Night-time construction is not generally proposed, except under special circumstances where continuity of work is essential (e.g., critical traffic management needs or safety considerations). This section describes the noise quality standards and the existing ambient noise levels, including the locations of the monitoring stations.

To compute the average Noise Level dB (A), noise level was monitored over a period of 24 hour by the authorized NABL laboratory. The noise monitoring has been conducted in October,2025 for determination of noise levels at 03 locations for (Figure 5.10) in the direct impact area as per Table 5.13 below.

Table 5.13: Ambient Noise Monitoring Locations

| S. No. | Location | Sample Code | Latitude (North) | Longitude (East) |
|---|---|---|---|---|
| 1 | Chopapara Village | NQ1 | 25°22'9.28"N | 90° 0'26.18"E |
| 2 | Mebitpara Village | NQ2 | 25°20'20.44"N | 90° 0'30.22"E |
| 3 | Mebitpara Village | NQ3 | 25°18'42.61"N | 90° 0'23.00"E |

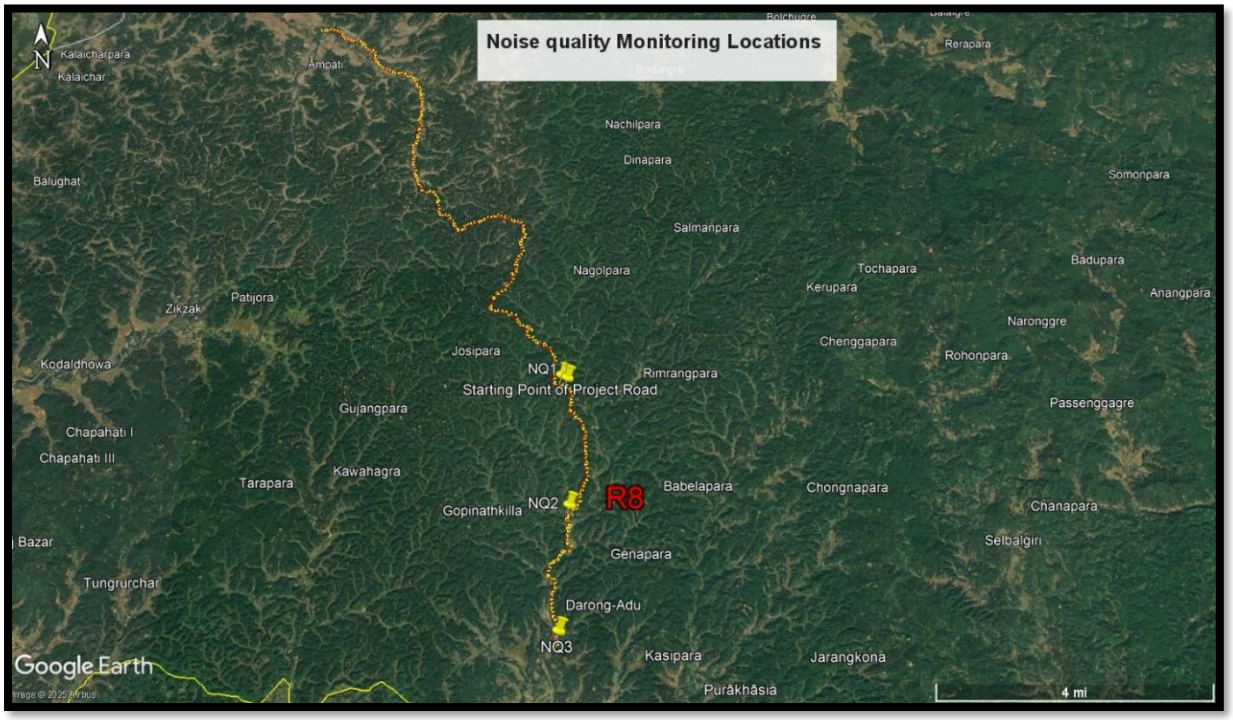



Figure 5.10: Noise quality monitoring locations

Average Ambient Noise Monitoring Results is given in **Table 5.14**.

**T**able **5.14**: Average Ambient Noise Monitoring Results in the sub-project area (AP Road)

| Sl. No. | Location | Sample Code | Type of area | Equivalent Noise Level, Leq (Day*) dB (A) | Equivalent Noise Level, Leq (Night**) dB (A) | CPCB Day Limit | CPCB Night Limit |
|---|---|---|---|---|---|---|---|
| 1 | Chopapara Village | NQ1 | Residential | 40 | 30 | 65 | 55 |
| 2 | Mebitpara Village | NQ2 | Residential | 45 | 33 | 55 | 45 |
| 3 | Mebitpara Village | NQ3 | Residential | 41 | 31 | 55 | 45 |

The noise monitoring results indicate that the ambient noise levels in all three monitored locations are well within the permissible limits prescribed for rural and residential areas. During daytime, the equivalent noise levels range between 40–45 dB(A), with the highest value observed at Mebitpara Village Market due to routine commercial and traffic activities. Night-time noise levels are comparatively lower, ranging between 30–33 dB(A), reflecting minimal human or vehicular activity during late hours. Overall, the observed day and night noise levels at Chopapara Village, Mebitpara Village Market, and Mebitpara Village fall within acceptable standards and do not pose any significant noise pollution concerns for local communities.

Noise barriers are not required along the Ampati road as the surrounding area is predominantly rural with low population density, resulting in minimal noise-sensitive receptors. The monitored ambient noise levels are well

within permissible limits during both day and night, indicating no significant noise impact that would justify installation of barriers.

## 5.7 BIOLOGICAL ENVIRONMENT

### 5.7.1 BIODIVERSITY IN SOUTH WEST GARO HILLS DISTRICT

The project influence area has been delineated with a buffer of up to 10 km from the periphery of the RoW to identify environmentally sensitive features such as protected areas, wildlife sanctuaries, national parks, wetlands, and wildlife corridors. 10 km Buffer area for project road is presented in **Figure 5.11**. Map showing distance from Eco sensitive Zones w.r.t Project Road is presented in **Figure 5.12.**

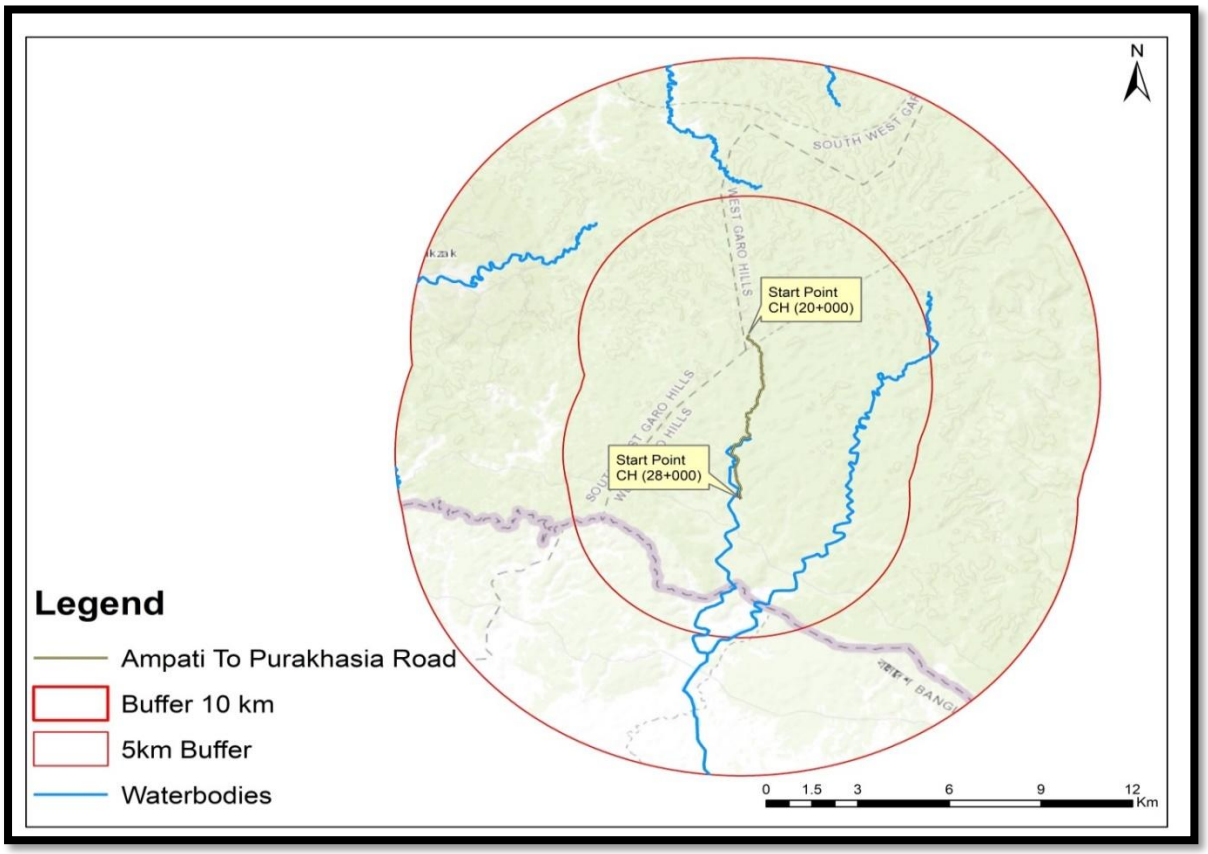



Figure 5.11: 10km Buffer area for project road

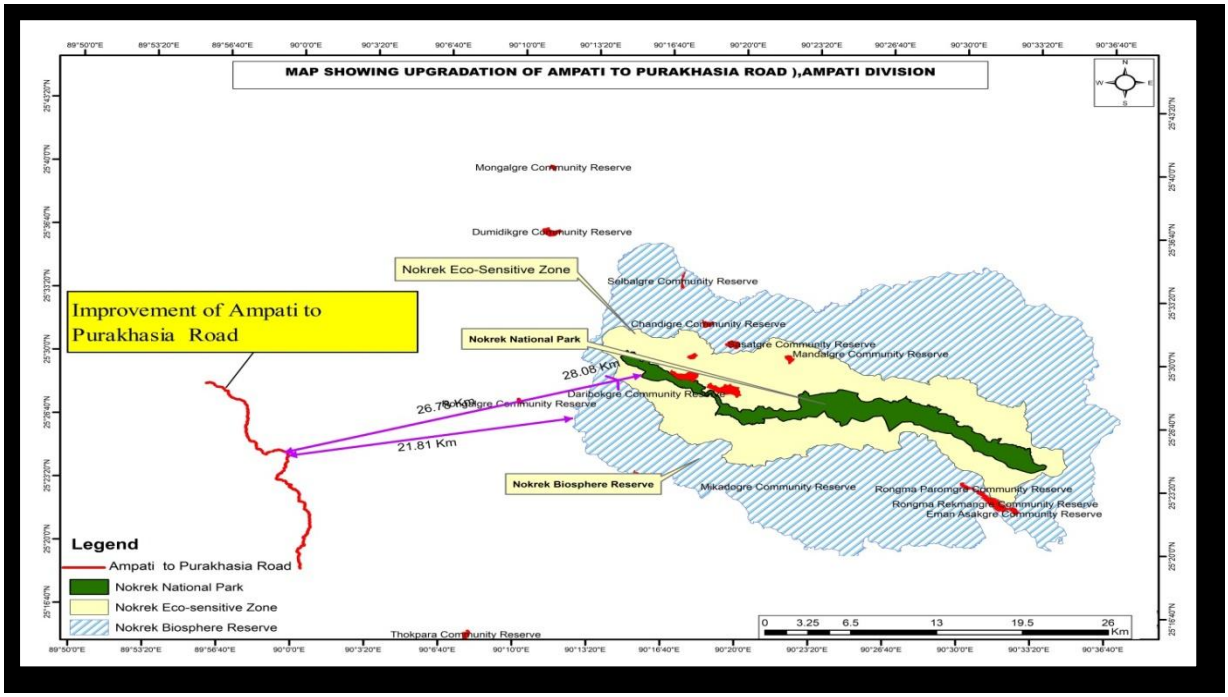



Figure 5.12: Map showing distance from Ecosensitive Zones w.r.t Project Road.

Along the roadside, common plantation trees include Jackfruit, Arecanut, and Mango tree. In some stretches, Banana, Bamboo, and Areca Nut palms are also planted by villagers. Shrubs commonly observed include Lantana, Eupatorium, Hibiscus, Clerodendrum, and various Bamboo plants. In moist patches, ferns and thickets of Ardisia and Strobilanthes are also common. Common herbs along the roadside include grasses Mint, Wild Ginger, Turmeric, Broom grass etc.

A primary biodiversity survey was conducted during the field visit in August 2025. The primary survey specifically recorded 21 tree species, 6 shrub species, 9 herb species, 3 fern species, and 7 grass species. In terms of fauna, the primary survey documented 9 bird species, 3 mammal species, 2 reptile species, 1 amphibian species, and 5 butterfly species.

The biodiversity survey from both Primary and secondary source documented a total of 108 floral species, comprising 62 tree species, 8 shrubs, 21 herbs, 10 ferns, and 7 grasses. Additionally, 18 species of aquatic biodiversity were recorded. Faunal diversity included 8 mammal species, 45 bird species, 6 reptile species, 2 amphibian species, 25 butterfly species, and 10 fish species.

The methodology adopted for biodiversity assessment is attached as **Annexure 5.1.**

Detailed list of flora, fauna, and aquatic biodiversity, along with their conservation status, is provided in **Annexure 5.2**.

During the field survey and consultations with local communities and forest department officials, no evidence of wild animal hunting was recorded within the Direct Impact area of the Project Road corridor. However, improved connectivity after construction may increase the risk of hunting and illegal wildlife trade.

In the South West Garo Hills of Meghalaya, traditional medicine remains central to primary healthcare among Garo communities, and alongside plants, animal by-products are also used for zoo therapeutic remedies. While detailed, district-wide inventories are still scarce, evidence from the Garo Hills and neighboring Northeast India indicates that a variety of wild species are targeted for medicinal use and bushmeat, with pangolins and primates among the species of concern. Robust, site-level documentation from South West Garo Hills is still limited, underscoring the need for focused surveys to map hunting hotspots and species affected within the district.

Given these findings, our study underscores the importance of conservation-driven infrastructure planning, ensuring that developmental activities in South West Garo Hills align with ecological sustainability and biodiversity protection. The following sections provide a detailed breakdown of the biodiversity recorded, emphasizing species conservation status and the ecological significance of different taxonomic groups.

### 5.7.2 BIODIVERSITY AND CRITICAL HABITAT IN SUB-PROJECT PIA

The biodiversity within 10 km radius of the AP Roads corridor (refer to Section 3.3 on PIA) were studied based on the secondary sources followed by primary data collection in the direct impact area and presented in **Figure 3.2** in Chapter 3.

**Project Influence Area (Within 10 km):**

Critical habitat screening was conducted based on the "Critical Habitat" criteria outlined by World Bank's ESF.

The biodiversity screening indicates that although several threatened species, including the Western Hoolock Gibbon (EN), Chinese Pangolin (CR), Bengal Slow Loris (EN), and critically endangered vultures, are known to occur in the broader Garo Hills landscape, their likelihood of significant impact from the project is low to moderate. Therefore, all listed species have been screened out, as the project is unlikely to cause adverse impacts on their populations or habitats. Details are provided in Table 5.15

Table 5.15: Critical Habitat analysis

| Scientific Name | IUCN Status | Restricted Range | Migratory / Congregatory | Habitat & Distribution | Likelihood in Project Area | Rationale | Screened In / Out |
|---|---|---|---|---|---|---|---|
| *Hoolock hoolock* (Western Hoolock Gibbon) | EN | Yes | Non-migrant | Evergreen forests of Garo Hills | Moderate | These are arboreal species and require contiguous forest cover for movement[6]. There are no contiguous forest cover along the road. Thus the habitat does not exist in the project areas | Out |
| *Manis pentadactyla* (Chinese Pangolin) | CR | Yes | Non-migrant | Forested slopes | Moderate | The pangolins live primarily in forested areas and in burrows. They are elusive and are thus not found near disturbed | Out |

[6] https://neprimateconservancy.org/western-hoolock-gibbon/

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | habits. Since all the improvements are limited within the exiting right of way their habitat is unlikely within the project direct impact. | |
| *Nycticebus bengalensis* (Bengal Slow Loris) | EN | No | Non-migrant | Dense forest edges | Low–Moderate | These are arboreal species and require contiguous forest cover for movement . There are no contiguous forest cover along the road. Thus the habitat does not exist in the project areas | Out |
| *Sarcogyps calvus* (Red-headed Vulture) | CR | No | Congregatory | Open forests & settlements | Low–Moderate | There are no bird hotspots in the study area . The nearest hotspot is Katuli Beel [7](18.20 km) . There are no nesting cliffs or other habitats in the project area. | Out |
| *Gyps bengalensis* (White-rumped Vulture) | CR | No | Congregatory | Forest edges and rural landscapes | Moderate | There are no bird hotspots in the study area . The nearest hotspot is Katuli Beel 18.20km) . There are no nesting cliffs or other | Out |

[7] https://ebird.org/hotspots

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | habitats in the project area. | |

**CR: Critically Endangered, EN : Endangered**

The details of the presence of critical habitat within PIA are summarized in **Table 5.16**.

Table 5.16: Biodiversity and critical habitat assessment-based on field survey and GIS analysis for the Direct Impact Area (10 km)

| Sl. No. | Habitat (includes natural or modified) | Observation | Remarks |
|---|---|---|---|
| I. | (a) Habitats protected by national and state legal regulations | | |
| | (i) PAs - Wildlife Sanctuary, National Park, conservation reserve or community reserve, Tiger reserve and corridor and Eco-sensitive zone (As notified under the Wildlife Protection Act, 1972) | Not present | - |
| | (ii) Reserve Forest (As notified under India Forest Act, 1927) | Not present | - |
| | (iii) Protected wetland of Meghalaya | Not Present | |
| II. | b) Habitat of significant importance to Critically Endangered or Endangered species | | |
| | (i) Species listed under Schedule I of the Wildlife (Protection) Act, 2022 | Not Sighted | |
| | (ii) Species listed under Schedule III of the Wildlife (Protection) Act, 2022 | Not Sighted | |
| | (ii) Species notified as "threatened species" by the Govt. of Meghalaya under the Meghalaya Biodiversity Rules 2010 | Not Sighted | |
| | (iii) Critically Endangered/Endangered species as listed by the IUCN Red List of Threatened species | Sighted | Teak species are observed during the field survey in 10 km study area. (Annexure 5.2) |
| III. | c) Habitats of significant importance to endemic or restricted-range species<br>d) Habitats that support globally or nationally significant concentrations of migratory or congregatory species<br>e) Highly threatened or unique ecosystems | | |
| | (i) Biosphere Reserve (Core Area) | Not present | |

| Sl. No. | Habitat (includes natural or modified) | Observation | Remarks |
|---|---|---|---|
| | (ii) Ramsar Site | Not present | |
| | (iii) Important fish & Key Biodiversity Area | Not, present | The Daru River (chainage 25+000) and adjoining water bodies in South West Garo Hills support a diverse freshwater fish community, including economically and ecologically important species such as carps *(Labeo rohita, Catla catla),* barbs *(Puntius sophore, Raiamas bola),* and native species like the Garo Stone Loach *(Aborichthys garoensis) and* Garo Spineless Eel *(Garo khajuriai).* These species inhabit a range of environments, from fast-flowing hill streams to rivers, ponds, and reservoirs, and are currently classified as Least Concern in terms of conservation status |
| | (iv) Habitat of Appendix I – Endangered migratory species as per the Convention on the Conservation of Migratory Species (CMS) | Not present | While secondary data from the Integrated Biodiversity Assessment Tool (IBAT) indicated the potential regional presence of five Schedule I species (Wildlife Protection Act, 2022), comprehensive primary field investigations were deployed to verify their status within the 10 km Area of Influence (AoI). Rigorous line transect surveys, quadrate sampling, and micro-habitat mapping confirmed that critical micro-habitats required to sustain these specific species are absent from the direct impact zone, and zero encounters were recorded during the active survey period." |
| | (v) Notified Elephant Reserve and Corridor | Not present | |
| | (vi) Natural habitats | Not Present | The habitats in the project area are modified for agricultural purposes, and the degraded forest is primarily dominated by bamboo species, Banana and Arecanut. |

### 5.7.3 SUMMARY OF BIODIVERSITY ASSESSMENT AND RISKS

Most of the flora and fauna present within the Direct Impact Area fall under the Least Concern category as per the IUCN Red List of Threatened Species (IUCN, 2024) and are not included in Schedule I or Schedule III of the Wildlife Protection Act, 2022.

The presence of 5 Schedule-I species identified through the Integrated Biodiversity Assessment Tool (IBAT) indicates the potential distribution range of these species within the broader landscape based on global biodiversity databases such as the International Union for Conservation of Nature (IUCN) and World Database on Protected Areas (WDPA). However, IBAT outputs represent modelled habitat suitability or regional occurrence data, not necessarily confirmed site-specific presence along the exact project corridor. During the field reconnaissance and ecological assessment conducted for the DPR/EIA study, no direct evidence such as sightings, tracks, nests, or habitat use of Schedule-I wildlife species was recorded within the immediate project influence area

A transit walk was carried out by the team of ESIA consultant along the entire project corridor during the Enumeration Block (EB) survey to verify on-ground conditions, identify environmental and social sensitivities, validate inventory data, and cross-check community-reported issues.

Field surveys, consultations with local communities, and studies by the Forest Department indicate the absence of critical habitats, endangered fauna, or hunting threats within the Direct Impact Area.

## 5.8 SOCIO ECONOMIC PROFILE

The baseline study assessed the socio-economic profile of households and families within the Project Influence Area that may be affected by the project. The assessment covered various parameters, including education levels, ethnicity, religion, sources of livelihood, and income levels of the affected families.

The proposed project site is located in the South West Garo Hills District of Meghalaya. Established in 2012 from the erstwhile West Garo Hills, the district covers an area of approximately 822 sq. km, with its administrative headquarters at Ampati. The district is bound by Assam and West Garo Hills District on the North, Bangladesh on the South, West Garo Hills District on the East, and Assam and Bangladesh on the West.

**Government and Administration:** South West Garo Hills is administered under the Government of Meghalaya and operates in accordance with the provisions of the Sixth Schedule of the Indian Constitution. This empowers the Garo Hills Autonomous District Council (GHADC) to manage matters related to land, forests, and customary practices, while law enforcement and other major state functions remain under the purview of the Meghalaya Government. The district is divided into four Community and Rural Development (C&RD) Blocks, including Betasing, Purakhasia, Rerapara and Zikzak. The administrative headquarters is located at Ampati, which also serves as the main center for governance and coordination of developmental activities.

### 5.8.1 SOCIO-ECONOMIC PROFILE OF THE PROJECT ROADS

The socio-economic details of the AP Road are discussed below. The methodology for data collection is detailed in section 1.3 of chapter 1.

### 5.8.2 DEMOGRAPHY

#### 5.8.2.1 POPULATION

The project corridor includes smaller rural settlements such as Chopapara (192), which have significantly lower populations. Gender distribution is generally balanced, although some areas—such as DarongAdu have more females than males. The population distribution of the sub-project affected villages is presented in **Table 5.17**.

Table 5.17: Population distribution of the sub-project affected villages

| Total Population | | | |
|---|---|---|---|
| **Village Name** | **Male** | **Female** | **Total** |
| Chopapara | 98 | 94 | 192 |
| Mebitpara | 136 | 122 | 258 |

**Source: Census 2011**

### 5.8.2.2 SEX RATIO

In sub project road, the sex ratio varies notably across villages Chopapara has a sex ratio of 959 females per 1,000 males. In contrast, Mebitpara reflects a lower sex ratio of 897, indicating a gender imbalance. Detailed sex ratio data for the project-affected villages and two towns are presented in **Table 5.18**.

Table 5.18: Sex ratio in the villages along the sub-project road

| Village Name | Sex Ratio |
|---|---|
| Chopapara | 959 |
| Mebitpara | 897 |

**Source: Census 2011**

### 5.8.2.3 SCHEDULED TRIBE POPULATION

The district is predominantly inhabited by the Scheduled Tribe (ST) population. A detailed distribution of the ST population along the project corridor is provided in **Table 5.19**.

Table 5.19: Population distribution of the sub-project affected villages

| ST Population | | | | |
|---|---|---|---|---|
| **Village Name** | **Male** | **Female** | **Total** | **Percentage** |
| Chopapara | 96 | 93 | 189 | 98.4 |
| Mebitpara | 135 | 121 | 256 | 99.2 |

**Source: Census 2011**

## 5.8.2.4 WORKFORCE POPULATION

The Garo communities residing along the AP road corridor are primarily engaged in agriculture and horticulture activities, including cultivation of paddy, maize, banana, and arecanut. In addition, some households are involved in livestock rearing, wage labour, and small-scale local trade for supplementary income. The occupational structure of the project corridor villages reflects a predominantly agrarian economy supplemented by wage labour and small-scale trade activities. To better understand the workforce composition, a detailed analysis of main and marginal workers across the study area villages is presented in Table 5.20. This table highlights not only the overall workforce distribution but also gender-wise participation, providing insights into the socio-economic dynamics of the corridor settlements.

The workforce distribution in the region highlights rural areas with strong female participation in Chopapara (94). The detailed workforce of the project affected villages is given in **Table 5.20**.

Table 5.20:Workforce Population in the AP Project Road corridor

| Area | Main Workers (No.) | | | Marginal Workers (No.) | | | Total Workforce (No.) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total | Percentage |
| Chopapara | 46 | 47 | 93 | 0 | 1 | 1 | 46 | 48 | 94 | 48.9 |
| Mebitpara | 48 | 25 | 73 | 8 | 15 | 23 | 56 | 40 | 96 | 37.2 |

Source: Census 2011

### 5.8.3 EDUCATION

The educational scenario in the project corridor reveals notable variations in literacy levels across rural areas. The detailed distribution of literate and illiterate populations in the sub-project affected villages is provided in **Tables 5.21**.

Table 5.21: Literate Population in the AP Project road corridor

| Literate Population | | | | |
|---|---|---|---|---|
| **Village Name** | **Male** | **Female** | **Total** | **Percentage** |
| Chopapara | 43 | 20 | 63 | 32.8 |
| Mebitpara | 98 | 71 | 169 | 65.5 |

**Source: Census 2011**

### 5.8.4 WAGES AND BENEFITS

Public consultations with local communities revealed that wages in the project area are lower than in urban centers, and workers often do not receive benefits such as healthcare, pensions, or paid leave. According to the Department of Rural Development (2023–24), the notified wage rate for unskilled labor in these corridors is Rs. 541, as per the latest Meghalaya notification effective from 1 April 2025 (dated 21st July 2025). While the lower cost of living partially offsets these lower wages, achieving financial stability remains a challenge for many workers

### 5.8.5 SEASONAL EMPLOYMENT

Initial consultations with communities along the AP road in South West Garo Hills indicated that agriculture and allied activities remain the primary sources of livelihood, including shifting cultivation, horticulture and livestock rearing. Community members reported that employment opportunities are largely seasonal, linked mainly to agricultural cycles and occasional local wage labour. During lean agricultural periods, households often experience underemployment and income fluctuations, prompting some individuals to seek temporary work in nearby towns or other districts. Improved road connectivity under the project is expected to enhance access to markets, services, and alternative livelihood opportunities for these settlements.

### 5.8.6 POVERTY

In this sub project road, poverty rates are higher in rural areas compared to urban centers. Households in remote villages, where road connectivity is still developing, largely depend on subsistence farming. Limited access to markets, credit, and financial services further constrains their economic opportunities, contributing to the higher prevalence of poverty in these areas.

### 5.8.7 SOCIAL VULNERABILITIES

#### 5.8.7.1 MIGRATION

Consultations with villagers indicate that residents prefer to remain within their local areas, primarily engaging in agriculture and commercial activities within their villages. Community members noted that while some individuals occasionally seek temporary or seasonal employment outside the village, long-term migration is limited, and livelihoods continue to be largely locally anchored.

#### 5.8.7.2 CRIME

In Sub project road, most disputes in the villages are resolved locally through traditional mechanisms, with the Nokma (village headman) playing a central role in dispute resolution. Only cases that cannot be settled at the community level or require legal intervention are escalated to and officially recorded by the police.

### 5.8.7.3 GENDER BASED VIOLENCE

According to records from the Gambegre Block, no general Gender-Based Violence (GBV) cases have been reported in Sub Project Road, indicating a relatively safe environment for women. Additionally, cases under the Protection of Children from Sexual Offences (POCSO) Act have been registered over the years. Consultations in Sub Project Road revealed that no such cases were reported in the current year.

## 5.9 SOCIO-ECONOMIC PROFILE OF PROJECT AFFECTED HOUSEHOLDS

Socio-economic data of project-affected households were collected through census and socio-economic surveys, systematically tabulated and analyzed to assess the extent of adverse impacts on structures, and livelihoods. A structured, pretested questionnaire was used as the primary tool for conducting these surveys. The survey has been conducted in September 2025.

### 5.9.1 DEMOGRAPHY

The total number of project-affected households is 5. The Table 5.22 below summarizes the gender distribution of the head of the Household.

Table 5.22: Gender Distribution of PAHs

| Gender | Sub Project Road AP | Percentage |
|---|---|---|
| Male | 5 | 100 |
| Female | 0 | 0 |
| **Total** | **5** | 100 |

### 5.9.1.1 GENDER DISTRIBUTION OF PROJECT-AFFECTED PERSONS

Out of a total of 20 Project Affected Persons (PAPs), 12 are male 60%) and 8 are female (40%), indicating an almost equal distribution between male and female beneficiaries. Details are given in Table 5.23.

Table 5.23: Gender Distribution of Project-Affected Persons (PAPs)

| Gender | Project Affected Persons | Percentage |
|---|---|---|
| Male | 12 | 60 |
| Female | 8 | 40 |
| **Total** | **20** | **100** |

### 5.9.1.2 ETHNICITY

The detailed distribution of ethnic groups in corridor wise is given in **Table 5.24** below. In Sub Project Road, a total of 5 individuals belong to Garo Community.

Table 5.24: Community Wise Distribution of PAHs

| Communities | Sub Project Road AP | Percentage |
|---|---|---|
| Garo | 5 | 100 |
| **Total** | **5** | **100** |

***Source: EIS primary survey – 2025***

### 5.9.2 IMPACT TO VULNERABLE HOUSEHOLDS

Vulnerable group of households included women-headed households, below-poverty-line, physically disabled, and elderly population (60+ years). **Table 5.25** below describes the distribution pattern of vulnerable group in the study area.

Table 5.25: Distribution of Vulnerable Group

| Vulnerable Category | PAHs |
|---|---|

| | |
|---|---|
| Aged persons above 60 years | 2 |
| Below Poverty Line | 0 |
| Woman Headed Household | 0 |
| Physically Challenged | 0 |

***Source: EIS primary survey – 2025***

## 5.9.3 ECONOMIC PROFILE

### 5.9.3.1 PRIVATE BUSINESS/ ENTREPRENEURSHIP DOMINANCE

Among the 5 Project Affected Households (PAHs), the majorities (4) are engaged in private business, while 1 depend on agriculture. Details are provided in **Table 5.26.**

Table 5.26: Occupation pattern of PAHs in sub-project area

| Sl. No. | Occupation | PAHs |
|---|---|---|
| 1 | Agriculture | 1 |
| 2 | Private Business | 4 |
| 3 | Service (Govt./Pvt.) | 0 |
| **Total** | | **5** |

***Source: EIS primary survey – 2025***

### 5.9.3.2 INCOME

In Sub Project Road, 05 households fall in the annual income range below ₹25,000. Details are provided in Table 5.27.

Table 5.27: Monthly Income Range of PAHs

| Sl. No. | Annual Income Range of HH | Sub Project Road | |
|---|---|---|---|
| | | No. of PAHs | Percentage |
| 1 | less than 25000 | 5 | 100 |
| 2 | 25000- 50000 | 0 | 0 |
| 3 | 50000-100000 | 0 | 0 |
| 4 | More than 100000 | 0 | 0 |
| **Total** | | **5** | **100** |

***Source: EIS primary survey – 2025***

## 5.9.4 EDUCATION

In Sub Project Road, the surveyed population consists of 20 individuals, comprising 12 males and 8 females, with no children recorded under 6 years of age. High school education (Classes 5 to 10) forms the largest demographic block with 9 individuals, showing a high male concentration of 7 boys compared to 2 girls. Primary education (Classes 1 to 4) and illiteracy share identical distributions, with each category accounting for 4 individuals split equally between genders with 2 males and 2 females each. Academic progression drops sharply in the upper tiers, where only 2 individuals (1 male, 1 female) have reached the higher secondary level, and just 1 female has attained a graduate degree or higher, representing the sole advanced qualification in the groupDetails are provided in Table 5.28.

Table 5.28: Education Level of PAPs

| Sl. No | Education | Sub Project Road | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| 1 | **Children below 6 years** | 0 | 0 | 0 |
| 2 | Primary (Class 1 to 4) | 2 | 2 | 4 |
| 3 | High School (Class 5-10) | 7 | 2 | 9 |
| 4 | Higher Secondary (Class 11-12) | 1 | 1 | 2 |
| 5 | Graduate and above | 0 | 1 | 1 |
| 6 | Illiterate | 2 | 2 | 4 |
| | **Total** | **12** | **8** | **20** |

***Source: EIS primary survey – 2025***

## 5.9.5 HEALTH STATUS

The predominant waterborne diseases in the study area include diarrhea, typhoid, Malaria and cholera, which pose significant health risks, particularly in regions with limited access to clean water and healthcare services as per public consultation with KII (Key Informant Interview) (Table 7.1). Poor sanitation and contaminated water sources further contribute to illnesses such as hepatitis A and typhoid fever. In addition, communicable diseases like dengue fever and respiratory infections continue to be prevalent concerns in the area (Table 7.1).

As per community consultation, AP settlements have made significant progress in sanitation. However, some households still lack access to well-constructed toilets with proper sewage disposal systems. The absence of public toilets and washrooms remains a critical issue, especially for individuals working in open or shared spaces.

Darengre PHC in Gambegre Block PHC serves as the primary healthcare facility, within the Project Influence Area (PIA).

## 5.9.6 IMPACT TO STRUCTURES

The project corridor wise details of the impacted structures are given in below **Table 5.29**. Chainage wise details are provided in **Annexure 5.3**. A total of 5 structures located within the existing Right of Way (ROW) are partially affected along the project corridor.

A total of 5 Project Affected Households (PAHs) are impacted under this category, all belonging to the encroacher group. The impacts are partial in nature, involving commercial structures (GI Shade) affecting 2 PAHs, and residential structures (Bamboo boundary fence of House) affecting 3 PAHs. Overall, the impacts are minor and limited to structural components without full displacement.

These structures extend into the available ROW are classified as encroachments. Accordingly, all such affected persons are categorized as encroachers in accordance with the RPF. The impacts are limited to secondary structures and do not result in physical displacement.

A 30-day notice period will be provided to all Project Affected Persons (PAPs) whose structures fall within the project ROW, allowing them sufficient time to salvage materials and relocate. The format of the notice issued to affected households is given in RAP. List of structure is given in Annexure 5.3.

Table 5.29: Type of Impact on Project Affected Household

| Type of Impact | Description | PAH Category | No of PAHs | No of PAPs | % of impact |
|---|---|---|---|---|---|
| Commercial Structures (GI Shade of | Loss of structure | Encroachers | 2 | 8 | <10 |

| | | | | | |
|---|---|---|---|---|---|
| Shops) | (partial impact) | | | | |
| Residential structures (Bamboo boundary fence of House) | Loss of structure (partial impact) | Encroachers | 3 | 12 | <10 |
| Total | | | 5 | 20 | |

## 5.9.7 TREES WITHIN ROW

Approximately 14 trees are situated within the available Right of Way (RoW) on both sides of the road. To mitigate the ecological impact of tree felling, compensatory plantation (@1:10)/ as suggested by Forest Department should be carried out, in accordance with applicable environmental regulations and guidelines. These measures, along with their implementation strategies, are comprehensively detailed in the Environmental and Social Management Plan (ESMP).

## 5.9.8 COMMON PROPERTY RESOURCES

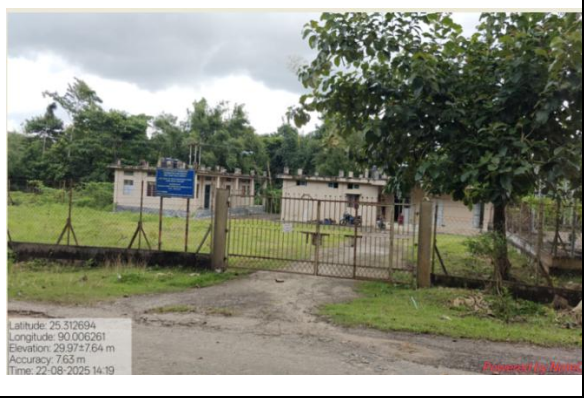
The Common Property Resources (CPR) assessment classifies structures into two categories: government facilities and community/public facilities. Government structures, comprising 05 minor structures such as compound walls (CWs) of government buildings, schools, and community halls, are situated away from the ROW. Since they are outside the direct influence zone, no adverse impacts are anticipated. A summary of CPRs is provided in **Table 5.30**.

**T**able 5.30: Common Property Resources located within 50 m of the ROW

| Sl. No. | Type of CPR Structures | Chainage | Distance from the PROW | DPR Mitigation |
|---|---|---|---|---|
| 1. | School | Ch. 20+200 | 7 m from center line LHS | Rumble strip for Marking Speed restriction sign board, Sign Board, School sign Board |
| 2. | Church | Ch 20+250 | 6 m from center line RHS | Rumble strip for Marking |
| 3. | Baptist Church | Ch 24+000 | 7 m from center line RHS | Rumble strip for Marking |
| 4. | Mebitpara School | Ch 24+100 | 6m from center line LHS | Rumble strip for Marking Speed restriction sign board Sign Board, School sign Board |
| 5. | Sub Station | Ch 26+800 | 8 m from center line LHS | - |

An illustrative view of the CPRs / Other important locations, along with their respective distances from the centerline, is presented in **Figure 5.13** below.

| Ch. No | LHS / RHS | Structure | Geo tagged photos |
|---|---|---|---|
| 20+200 | LHS | School |  |

| | | | |
|---|---|---|---|
| 20+250 | LHS | Church |  |
| 24+000 | RHS | Baptist Church |  |
| 24+100 | LHS | Mebitpara School |  |
| 27+100 | RHS | Grazing Field Baptist Church |  |
| 26+770 | LHS | Sub Station |  |

| | | | |
|---|---|---|---|
| | Present Road Condition | |  |

Figure 5.13: Illustrative view of the road features in Sub Project Road AP

## 5.10 HAZARD AND VULNERABILITY PROFILE

The Hazard and Vulnerability profile of the AP Road area and South West Garo Hills district includes landslide hazards, flash flood, earthquake, etc. The drought, group clash, fire incidents, etc. also occur in the district. The seasonal hazard analysis of South West Garo Hills Hills District[8] is given in **Table 5.31** below.

Table 5.31: Hazard analysis

| Type of Hazards | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Landslide | | | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ► | | |
| Earthquake | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ► |
| Flashflood | | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ► | | |
| Storm | | | ◄ | ---- | ---- | ► | | | | | | |
| Fire Accident | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ► |
| River Erosion | | | | ◄ | ---- | ---- | ---- | ---- | ► | | | |
| Industrial Hazard | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ► |
| Road Accident | ◄ | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ► |

### 5.10.1 EARTHQUAKE ZONES

The project road stretches fall under Zone – V, which is at Very High risk and intensity is IX. Seismic Zone details of South West Garo Hills is presented in **Table 5.32**.

Table 5.32: Seismic Zone details of North Garo Hills

| District | Seismic Zone | Notable Faults / Lineaments | Recent Earthquakes |
|---|---|---|---|
| South West Garo Hills | Zone V (highest risk). | Local faults/lineaments identified in district studies — notably **Yamuna** and **Dapsi** faults (mapped in CGWB district geological report). These are part of the regional structural fabric | Small-magnitude tremors are occasionally recorded in/near the district (typically M≈2–4). National Centre for Seismology / regional catalogs list scattered low-magnitude events in the Garo Hills region; commercial earthquake |

[8] District Disaster Management Plan for Meghalaya, 2024

| | | | |
|---|---|---|---|
| | | related to the Dauki–Kopili–Shillong Plateau fault systems. Source: (CGWB: 2018-1019) | trackers also show occasional recent quakes near South West Garo Hills. No major (M≥6) local events reported in the recent instrumental record for the district. Souce: (riseq.seismo.gov.in) |

## 5.10.2 Climate Resilient Features

The Ampati–Purakhasia Road project integrates climate resilience through early-stage vulnerability assessment, leading to enhanced design parameters such as increased discharge capacity for culverts and drainage structures based on future climate projections. Improved drainage systems, upgraded culverts, and proper roadside drains ensure all-weather connectivity and reduced flood risks. Slope stabilization is achieved through a mix of bio-engineering and structural measures to control erosion and landslides. Additionally, durable pavement materials, nature-based solutions, and integrated safety features enhance long-term sustainability and resilience of the road corridor. Climate Resilient design improvement details are given in Table 5.33.

Table 5.33**:** Climate Resilient Features

| Climate Resilient Feature | Climate-Resilient Design – Improvement of Adugre to Purakhasia Road (APR) |
|---|---|
| 1. Climate Vulnerability Assessment During Design | Roads and bridges undergo systematic climate vulnerability assessments at the design stage to identify hotspots prone to extreme rainfall, flooding, erosion, waterlogging, landslides, and submergence. Based on SSP 5–8.5 projections (IITM Pune), the design discharge has been increased by 25.2% for culverts and 14.5% for cross-drainage structures. The assessment has informed alignment selection, drainage design, and slope protection measures. Considering future climate risks and stream scouring pathways, slope protection has been provided where streams run parallel to the road. Upstream and downstream protection works for culverts have been incorporated as per IRC SP:13 to prevent scouring. |
| 2. Enhanced Drainage & Flood Management | At critical locations, undersized culverts have been upgraded by converting 11 small culverts into larger structures. Additionally, 12 pipe culverts and 4 box culverts have been provided to enhance hydraulic capacity and prevent flooding. Cross-drainage structures include aprons, cut-off walls, pitching, retaining walls, and stream protection works to ensure stability. Properly graded roadside drains have been designed and connected with culverts to prevent waterlogging and ensure all-weather road connectivity under intense monsoon conditions. |
| 3. Slope Stabilization & Erosion Control | Bio-engineering measures such as plantation of broom grass, use of geotextiles, erosion control mats, hydroseeding, and DT mesh with U-pins (500 mm length, 8 mm dia @ 1 m c/c) have been adopted for slope stabilization. Structural measures include gabion walls up to 3 m height and bio-engineering for higher slopes. These interventions reduce landslide risks and soil erosion in hilly terrain. |
| 4. Nature-Based & Green Solutions | The project incorporates nature-based solutions such as roadside avenue plantation using local species to enhance slope stability, reduce environmental impacts, and support carbon sequestration along the corridor. |
| 5. All-Weather Surface Materials | Use of Cement Treated Base/Sub-Base (CTB/CTSB) layers to improve structural strength, load distribution, and resistance to moisture damage, erosion, and rutting. Paved shoulders are provided to prevent water ingress, reduce edge failure, and enhance durability under high rainfall and weak subgrade conditions. |
| 6. Design with Safety & Maintenance Objectives | Climate-resilient designs are integrated with road safety measures including improved road geometry, signage, crash barriers, and delineation, along with provisions for long-term maintenance and sustainability. |

# 6. ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

## 6.1 INTRODUCTION

The project is expected to generate both positive and adverse environmental and social impacts along this Sub Project Road. This chapter analyzes the potential impacts arising from the implementation of project activities. The impacts differ in type, nature, magnitude, extent, timing, duration, certainty, and reversibility.

The assessment takes into account the nature of the project, the scope of activities, and the potential magnitude of impacts across different environmental and social components, namely:

- **Physical Environment:** air quality, water resources, noise levels, and soil
- **Biological Environment:** flora and fauna
- **Socio-economic Components:** property removal, land acquisition, ASI-protected sites, and influx of labor

## 6.2 IMPACTS IDENTIFICATION AND EVALUATION

The potential impacts were identified in three main steps:

1. Identification of project activities/aspects causing impacts;
2. Establishing affected environmental and social components (valued receptors). These were determined to include vegetation, water bodies, soil, land stability, water quality and quantity, ambient air quality, employment and livelihoods, vulnerable groups, infrastructure, public safety and occupational health and safety;
3. Determining potential environmental and social impacts in an impact Identification Matrix

Based on the understanding of the project information as outlined in chapter 3 and baseline environmental conditions detailed in chapter 5, the anticipated impacts of the MLCIP project are identified and discussed in the subsequent sections. The potential environmental and social impacts (both adverse and positive) of the MLCIP project activities during the Design, Construction and Operational Phases were identified and evaluated through the Leopold Matrix, where the interactions between relevant project activities and the natural/physical environmental components and the social components were considered to determine whether or not the interaction may create potential impacts.

## 6.3 6.3 LEOPOLD MATRIX

### (MAGNITUDE/IMPORTANCE CLASSIFICATION)

The Leopold Matrix is a comprehensive checklist designed for the identification, evaluation, assessment and analysis of environmental impacts on the development project following the interaction matrix analysis approach by Leopold. The Leopold Matrix developed for the road upgradation project is provided as **Table 6.1**. The checklist interaction matrix for environmental impact assessment was obtained by placing identified existing environmental components in the columns and the proposed project activities in the rows of the matrix. The process is summarized as follow:

### 6.3.1 IMPACT EVALUATION MATRIX

In order to assess the impacts of the proposed project, the impacts analysis across the project phases was done as follows.

1. Pre-Construction Phase
2. Construction Phase

3. Operational Phase

The description of the project activities and magnitude of the impacts for the various environments and social components for this project are presented in the below table. These impacts further have been categorized as per the World Bank's Environmental and Social Standards (ESSs) applicable to the project.

Table 6.1: Impact Evaluation Matrix

| Project Activity | Air Quality | Noise | Water Resources | Soil Stability | Flora & Fauna | Public Health | Community Safety | Cultural Heritage | Hazardous Material Risk | Drainage | Road Safety |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Site Clearance (Tree Felling, Vegetation removal, utility relocation) | MN | MN | N | MN | MN | LN | LN | LN | N | N | LN |
| Labour Camp Siting & Mobilization | MN | MN | MN | N | Low | MN | MN | N | MN | LN | N |
| Site identification for construction plants, quarrying, material storage | HN | HN | HN | MN | HN | HN | HN | MN | HN | HN | HN |
| Earthworks (Excavation, Filling) | MN | HN | MN | HN | MN | MN | LN | LN | MN | MN | MN |
| Grading, Levelling and Surface laying | HN | HN | MN | MP (Improved Stability) | MN | MN | LN | LN | MN | MN | MN |
| Drainage & Culvert Installation | N | LN | MP (Improved Drainage) | MP (Improved Stability) | LP | LP | LP | N | N | MP | LP |
| Slope Stabilization & Bioengineering | N | N | LN | MP (Improved Slope Stability) | MP | LP | LP | N | N | MP | LP |
| Construction Water Usage | LN | N | MN | LN | LN | LN | LN | N | N | LN | LN |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Operation of Construction Plants | HN | HN | HN | N | MN | MN | MN | N | HN | MN | MN |
| Waste Generation and Disposal | MN | N | MN | MN | MN | HN | MN | N | HN | HN | MN |
| Fuel and Hazardous Material Handling | MN | N | MN | N | LN | HN | MN | N | HN | N | N |
| Construction Traffic & Machinery | HN | HN | LN | LN | LN | MN | MN | N | MN | N | HN |
| Health & Safety Training and OHS Implementation | HP | HP | HP | N | N | HP | MP | N | MP | N | MP |
| Decommissioning of Construction Sites, Plants, Labour Camps | MN | MN | MN | MN | LN | MN | LN | N | MN | LN | LN |
| **Operational Phase** | | | | | | | | | | | |
| Operational Traffic Flow | LN | LN | LN | LN | LN | MP (Improved Access to Health Services) | MP(Improved Connectivity) | LN | LN | MP (Improved Drainage) | MP (Improved Road Safety) |
| Transportation of Hazardous Materials | MN | LN | LN | LN | MN | HN | HN | MN | HN | MN | HN |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Compensatory Plantation | HP | N | MP | MP | HP | MP | MP | LP | N | MP | HP |
| Monitoring & Community Engagement | - | — | — | — | — | MP | MP | N | N | N | LP |

HN – High Negative Impact, MN – Moderate Negative Impact, LN – Low Negative Impact, N – Neutral Impact, LP – Low Positive Impact,MP – Moderate Positive Impact, HP – High Positive Impact

**Interpretation of Impact Assessment Matrix**

The **Table 6.1** presents the environmental and social significance ratings of various project activities during the pre-construction, construction, and operational phases of the AP Road sub-project.

**Pre-Construction Phase**

Activities such as site clearance, tree felling, and utility relocation are assessed as having moderate to minor (MN–LN) environmental and social impacts due to localized vegetation removal and possible disturbance to cultural or community assets. Labour camp siting and mobilization exhibit moderate risks, primarily associated with worker welfare and sanitation. Identification of sites is for construction plants, quarrying, and material storage (represents a high-risk (HN) activity, as it can significantly affect land stability, noise, dust, and habitat quality if not properly managed.

**Construction Phase**

The earthworks, grading, and surface laying have moderate to high impacts (MN–HN) due to soil disturbance, erosion, dust generation, and safety concerns, although they also produce positive impacts (MP) through improved slope stability and road quality. Drainage and culvert installation and slope stabilization with bioengineering (are considered moderately positive (MP) activities, improving overall stability and flood resilience of the corridor. Construction water usage, waste generation, and fuel handling have low to moderate impacts, mainly localized and temporary in nature. Health and safety measures and OHS implementation result in high positive impacts (HP) by improving worker welfare and reducing accident risks. Decommissioning of construction sites and labour camps carries minor to moderate residual impacts, which can be mitigated through site restoration and waste clearance.

**Operational Phase**

During operation, the road will yield several positive outcomes, including improved connectivity, access to health and education services, better drainage, and enhanced road safety. Compensatory plantation contributes high positive (HP) environmental benefits, supporting biodiversity restoration and slope stabilization. Finally, monitoring and community engagement ensure long-term sustainability and social inclusion, producing moderate to low positive impacts through participatory oversight and grievance redress.

## 6.4 ENVIRONMENTAL IMPACTS

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the project. The analysis predicts the nature and significance of the expected impacts. The following sections provide a detailed analysis of the project's environmental and social impacts across its various phases in detail. Corresponding mitigation measures have been incorporated into the sub-project ESMP and sub-project RAP, IPDP, including project- level plans (LMP, Work Site safety Plan (OHS plan), SEP, and SEA/SH Prevention and Response Plan). Based on this indicative ESMP, contractor will prepare contractor's environment and social management plan (C-ESMP) and get it approved by MPWD before starting the pre-construction work.

### 6.4.1 IMPACTS DURING PRE-CONSTRUCTION PHASE

This Ampati to Purakhasia (AP) Road sub project envisages upgrading the existing single-lane carriageway to an intermediate lane configuration to enhance the capacity and extend the service life it. All construction activities are proposed within the existing Right of Way (RoW).

Pre-construction activities will primarily include:

- Site clearance and reconstruction/improvement of approach roads for movement of plant and machinery,
- Establishment of contractor's camp, material storage, and construction yard, and
- Planning for material sourcing and finalization of work methodology. The contractor shall as part of the material procurement identifies the quarry from which the sourcing would take place. Along with the process of approval of the material they would submit the copy of the EC, CTO to the CSC/PMU. If these documents are identified to be correct then the CSC/PMU would provide an approval of the quarry as part of the material approval. During construction, material can only be procured from these approved quarries. The royalty payment challan for the material procured would be submitted to the CSC/PMU along with the bills by the contractors.

The impact on the different environmental components is discussed in detail in the following sections.

#### Ecological and Environmental Impacts

During the pre-construction phase, potential impacts are anticipated from site clearance, vegetation removal, tree felling, material sourcing, labour camp establishment, and utility relocation. The AP corridor passes mostly through agricultural areas and community land, River. Some of the associated activities e.g establishment of the construction camp, storage of material, staging of equipment have potential to disturb the sensitive ecology. During field visit, no bird nest has been observed on road side trees. A total of 14 trees will be felled along the corridor, leading to localized loss of vegetation and minor habitat disturbance

**Mitigation Measures:**

- Avoid locating construction camps, material storage areas, machinery staging areas, and disposal sites near streams, productive community land, floodplains, or within/adjacent to natural habitats. The siting of all such facilities shall be subject to prior review and approval by the Construction Supervision Consultant (CSC). In addition, prior informed consent of the concerned community members and village heads shall be obtained before finalizing these locations. One disposal site location has been jointly identified in consultation with the community members, the Public Works Department (PWD), and the Independent Consultants, ensuring that site selection is socially acceptable and environmentally appropriate.

- The Environmental specialist of CSC shall undertake the visit of the probable sites (at the prospecting stage of the site) and shall provide his opinion on the suitability and also protection measures (within 7 days of such request being made by Contractor) which need to be taken to ensure suitability.
- Restrict vegetation clearing to the minimum area required for works.
- The trees can only be felled with the permission of the Forest Department, Government of Meghalaya. Compensatory plantation at a ratio of 1:10, (or as mandated by the Forest Department shall be carried out. Native species tolerant to local climatic and pollution conditions shall be planted.
- The scheduling of the plantation should be carried out so that plantation activities are undertaken before the monsoon season. The location of the plants shall be geo-referenced and reported to PIU on geo-referenced platform provided by the PMU,
- Greenbelt shall be developed at the camp as directed by the MSPCB.
- Maintain a buffer of at least 100 m from natural drainage channels or water bodies.
- Implement soil erosion control measures (silt fencing, sediment traps, and slope turfing).
- Prohibit hunting, fishing, or collection of forest produce by workers.
- Awareness and sensitization of laborers on local wildlife and biodiversity conservation.
- Schedule noisy operations (rock breaking, heavy equipment use) away from bird nesting seasons (March–July).
- Site-specific Environmental and Social Management Plans (ESMP) shall be developed by the contractor in consultation with the Environment Officer of PMU if any of the location of the construction activities have sensitive ecology to minimize biodiversity loss.
- An environmental monitor should be present on-site during tree felling activities to supervise the process and respond promptly to any wildlife that may be injured, killed, or require relocation due to disturbance, including birds and cavity-nesting animals.

## Occupational Health and Safety (OHS)

The road construction activity involves operation of equipment, vehicle and machinery which poses OHS challenges. The construction activities also involve the use of hot bitumen, and working with hazardous material i.e. molten bitumen spray. In addition, the construction activity would take place when the traffic is operational on the road. This poses an additional challenge for the workers. To ensure safe working conditions, the Contractor needs to carry out a detailed Hazard Identification and Risk Assessment (HIRA) for each task. A preliminary Hazard Identification and Risk Assessment have been carried out (Annexure 6.3) and some mitigation measures suggested and included in the Labour Management Plan for the project. The work methodology will define activity sequencing and associated occupational and community health and safety (OHS/CHS) risks. It will be reviewed by the PIU- PWD under the oversight of ESMU prior to approval of Work Methodology.

## Mitigation Measures:

- Develop and implement a site-specific OHS Plan conforming to World Bank Environmental, Health and Safety (EHS) Guidelines.
- The OHS Plan shall be submitted along with the Method statement. The PIU–PWD & CSC shall review the OHS Plan and provide their comments within 15 working days. Once these comments have been addressed and the OHS Plan approved the Method Statement shall be approved. The Method statement shall not be approved by CSC unless the OHS Plan has been approved.
- Arrange for PPE (helmets, safety shoes, high-visibility vests, gloves) to all workers.
- Develop tie-up with hospitals for the regular health check-up and Health Emergency and Accidents.
- Ensure proper sanitation, adequate potable water (minimum 5 liters per person per day), and waste disposal facilities in camps.
- All lifting equipment should have the appropriate certification and construction equipment should meet the emission requirement specified in MoRTH emission standards specified in GSR 144.
- Engage trained personnel for operating machinery and working at height or confined spaces.

**Community Health and Safety**

The project is not expected to result in significant adverse impacts on ecosystem services.

Construction works along existing habitations and roadside markets can pose safety risks to pedestrians and road users. The improvement works will largely be confined within the existing Right of Way (ROW). No diversion of forest land or large-scale removal of vegetation is involved. However, minor and temporary impacts may occur during construction, such as localized disturbance to roadside vegetation, increased sediment runoff affecting nearby surface water, and temporary obstruction of natural drainage during earthworks.

**Mitigation Measures:**

- Prepare and implement a work site specific Traffic Management Plan to regulate vehicle movement, material haulage, and diversions. The Traffic Management Plan shall indicate the locations for diversions, work zones, transition zones. It shall define the safety precautions and the signages etc, in conformance to IRC SP 55: 2014. The Traffic Management Plan shall also be submitted along with the Method Statement and shall state the process for implementation and notification for inspection of the traffic safety measures.
- Make arrangement for New Jersey barriers/ Water filled barrier, MS steel barricades (2 m high), signage, and warning lamps at work sites.
- Prepare a Community Health and Safety Plan (CHS Plan) ensuring public segregation from work zones. The Generic CHS Plan will be submitted along with the Work Statement and should be considered an integral part of the Work Methodology and Work Plan. The Work Plan should not be approved without an approved CHS Plan. The site-specific management plan should present the additional measures which have to be to be implemented. Every RFI should be accompanied with a site specific OHS, CHS and Traffic Safety Plan, which should define the site-specific measures which were implemented. Without these plans being implemented the works should not be approved.
- The material transport route through existing network of roads should be planned and approved by the local transport authorities. Possible risk areas need to be identified along with sensitive receptors and their time of sensitivity. The Traffic Management Plan shall be developed accordingly
- Schedule high-risk activities during off-peak hours to minimize traffic congestion.
- Develop posters for Community Awareness. Conduct community awareness campaigns before any temporary road closure or service disruption.

The OHS Plan, CHS Plan, and Traffic Safety Plan must be reviewed and approved by CSC/MPWD before initiation of construction. To mitigate these ecosystem service risks, appropriate measures have been incorporated in the design and Environmental and Social Management Plan (ESMP). These include provision of adequate cross-drainage structures and roadside drains to maintain natural water flow, slope stabilization and protection works (gabion walls, retaining walls) in vulnerable stretches, controlled construction practices to prevent sediment runoff, and restoration of disturbed areas through turfing and plantation. These measures will ensure that the quality of freshwater, soil stability etc. roadside vegetation, There will be some impact due to tree felling which is anticipated to be long term but would not irreversible because the plantation will be undertaken by the project.

**Construction Camp and Site Selection**

The locations of the construction camp have adverse impacts while its design and layout would influence the impacts during the operations stage. The establishment of labour camps and construction support facilities may exert localized pressure on water availability, sanitation systems, and waste management infrastructure. Appropriate provisions for safe drinking water, adequate sanitation, drainage arrangements, and solid waste disposal must be made to prevent health and hygiene issues. To avoid these unwanted impacts the following mitigations are proposed.

**Mitigation Measures**

- Contractor's camps, stockpile, and equipment yards will be located at least 500 m from settlements and 100 m from water bodies or forest areas.
- Camps should follow **IFC/World Bank Labour Accommodation Guidelines** and local environmental norms.
- The measures suggested in the BOCW rules shall also be included in the plan and implemented.
- The layout of camps will be reviewed and cleared by the Environment Officer, CSC prior to establishment.

**Disposal of Construction Debris and Waste**

Limited C&D waste (excavated material, asphalt fragments, scrap metal) will be generated. However, haphazard disposal of such debris can lead to both environmental and social issues.

**Mitigation Measures:**

- Segregate reusable and non-reusable debris.
- Reuse topsoil for slope stabilization and landscaping.
- Dispose of debris only at approved low-lying barren areas located at least 1 km downwind of settlements and away from drainage lines.
- The waste shall be disposed in pre designated location Jointly identified by the PWD/Community. Details of Spoil disposal site is given in Table 3.13.
- Avoid dumping in water bodies, wetlands, or near agricultural fields.
- Regularly monitor disposal sites to prevent contamination and visual pollution.

**Shifting of Utilities**

Significant utility shifting is required prior to the commencement of construction works. A total of 44 electric poles, 1 transformer, and 32 electric line crossings are identified along the AP road corridor for shifting. Of these, 15 poles are on the LHS and 29 on the RHS. A total of 9 OFC pillars are identified for shifting along the AP road corridor, comprising 3 on the LHS and 6 on the RHS.

**Mitigation Measures:**

- Coordinate with line departments (MePDCL, PHE, Telecom) for planned relocation prior to construction.
- Provide prior notice to local communities about any temporary service disruption.
- Restrict utility shifting to daytime hours to avoid safety risks at night.
- The scheduling of the construction works will be shared with the line department (MePDCL, PHE and Telecom Departments) for ensuring uninterrupted services during construction.
- Provision of utility ducts for crossing underground pipelines has been incorporated into the design to ensure safe and organized routing of essential services, minimize future excavation, and facilitate maintenance without disrupting road infrastructure

**Plant, Machinery, and Vehicle Selection**

Early-stage stakeholder engagement and to prevent pollution from the different activities during the construction phase preparation of a Contractor's Environmental and Social Management Plan (C-ESMP) will be essential. The following are envisaged:

- The C-ESMP shall apply the mitigation hierarchy prioritizing avoidance, then minimization, and finally offsetting and restoration through design improvements, slope stabilization, compensatory plantation, and safety training. Implementation of these measures during the pre-construction stage will ensure environmentally responsible preparation and minimize potential social disruptions before commencement of construction works. The CESMP will be submitted along with the Method Statement. The PMU and CSC will review it as stated above and shall provide its observations. Once these observations are addressed the CESMP will approve. The Method Statement will not be approved without the approval of the CESMP. Hence the Contractor cannot undertake any works on site till the time the C-ESMP, OHS Plan, Traffic Management Plan, CHS Plans are approved.

- All construction equipment and vehicles shall comply with MoRTH emission standards (GSR 144[9]) and have valid Pollution Under Control (PUC) certificates. The contractor shall maintain equipment in good working condition to minimize noise and air pollution.
- Conduct air quality monitoring according to the EMP. This will be carried out before the works and will be considered as a reference baseline.

**Sourcing of Construction Materials**

The sourcing of materials such as aggregates, sand, and stone may cause adverse impacts on land, air, and water quality if not properly managed. Sourcing material from and not operating them as per the specification can lead to unwanted impacts on the environment.

**Mitigation Measures:**

- The contractor shall as part of the material procurement identifies the quarry from which the sourcing would take place. Along with the process of approval of the material they would submit the copy of the EC, CTO to the ESMU. If these documents are identified to be correct then the ESMU would provide an approval of the quarry as part of the material approval.
- In the case of any change / alteration of the quarry area the same process shall be applied.
- During construction, material can only be procured from these quarries. The royalty payment challans for the material procured would be submitted to the PMU along with the bills by the contractors.
- If contractor procures any material (such as ready-mix concrete, asphalt/macadam, aggregates etc.), from third party agencies, contractor shall ensure that such agencies have all necessary clearances/permissions as required under the law; these include CTE/CTO from MSPCB, environmental clearance, etc.; contractor shall collect the copy of these certificates and submit to PMU; PIU will approve the source only after all the certificates are submitted. `

**Water Requirement**

Construction water will be required for concrete mixing, dust suppression, and domestic use. Over extraction of natural resources can lead of unwarranted impacts. To prevent this following mitigations are proposed.

**Mitigation Measures:**

- Obtain permission for groundwater abstraction from the State Water Resources Department or Surface water from Irrigation Department appropriate Agency.
- Prefer use of surface water from local streams or treated water from nearby sources.
- Avoid extraction from community wells.
- Maintain drainage around storage and batching areas to prevent stagnation.

[9] https://morth.nic.in/sites/default/files/notifications_document/GSR%20598%20%28E%29%20dated%2030%20September%202020%20Seperate%20emission%20norms%20for%20agriculture%20tractors%20and%20CEV.pdf

- In the case that water is sourced by tankers the Contractor shall submit the permission of the borewell before the sourcing of water.
- Maintain record of the water extracted or sources by tankers

#### 6.4.1.1 IMPACTS DURING CONSTRUCTION PHASE

Major Activities during the construction phase involves earthworks, grading, drainage works, cutting of slopes, slope protection, disposal of cut material, and culvert construction, laying of bitumen, and transportation of material. , These activities are expected to cause significant short-term adverse impacts on air quality, noise, water resources, and soil stability. Occupational health and safety (OHS) risks including accidents, exposure to dust and noise and handling of heavy machinery, require robust safety protocols.

Most of the adverse environmental impacts are related to construction works which are inevitable but are manageable through good engineering and construction practices which have mostly been well defined and standardized. The negative environmental effects can be taken care of at an early stage through proper construction planning, sensitization of workforce and supervision and oversight by the works supervisor.

The associated activities of road construction works would involve operation of plant, movement of machinery laying of bituminous mixtures, handling of hazardous materials like bitumen, diesel, etc., dumping of unusable debris materials, transportation of materials from production site to construction site, and other constructional activities and associated works like mobilization of construction equipment, setting up of construction plants, setting up of workforce camps, quarrying, material storage etc. These activities have certain impacts of various magnitudes on different components of the environment.

The anticipated impacts due to all these activities have been described below:

### 6.4.2 IMPACTS ON PHYSIOGRAPHY

The sub-project area comprises an existing road traversing plain and hilly terrain. Land use along the road stretches includes agricultural areas and areca nut plantation. The same alignment will generally be followed for upgrading the road from existing intermediate lanes to an intermediate configuration with paved shoulders and geometric corrections at selected locations. The existing ground profile will be maintained, with minor profile adjustments at certain locations. Rehabilitation and upgradation will generally be restricted to the existing right-of-way (ROW) in settlement areas.

The ESIA observations indicate several additional erosion-prone locations along the corridor requiring targeted interventions. At Ch. 20+500, initial signs of riverbank erosion and soil instability suggest the need for preventive protection measures such as slope stabilization and riprap. The stretch Ch. 21+200 to 21+300 (LHS) shows continuous bank erosion, requiring comprehensive bank protection through pitching, gabions, and bio-engineering measures. At Ch. 23+850, localized erosion near a minor bridge abutment highlights the need for structural protection such as toe walls, aprons, and scour protection works. Similarly, at Ch. 25+000 (LHS), riverbank erosion necessitates riverbank stabilization measures including riprap, retaining structures, and vegetative reinforcement to prevent further degradation.

In terms of speed reduction and road safety measures, geometric improvements have been undertaken at critical locations, including curve improvements at Ch. 24+375 and 26+450 (RHS) to enhance visibility and reduce accident risks. Furthermore, junction improvement with traffic islands at Ch. 27+600 has been incorporated to regulate traffic movement and improve safety. Overall, the DPR integrates both structural erosion control and traffic calming measures at identified chainages to ensure road stability and user safety.

As per the earthwork estimation for the project corridor, the total fill quantity is 2341 $m^3$, and the cut quantity is 23041 $m^3$. After balancing cut and fill requirements, there remains a surplus of approximately 20700 $m^3$ of excavated material. This excess earthwork shall be disposed of or utilized by the contractor only at designated and pre-approved disposal sites identified by the Meghalaya Public Works Department (MPWD), in accordance

with environmental management and safety norms. Summary of breast wall is given in Table 3.4. This approach ensures effective earthwork management while minimizing environmental impacts and maintaining slope stability and disposal of excavated material along the project corridor.

**Mitigation Measures**

The project has identified the 01 disposal site. Additional 0.35 ha land is required for Spoil disposal. Details are given in Table 3.13.

To prevent environmental impacts from the disposal sites, the following needs to be kept in mind during disposal:

- Clear the debris from construction sites. Unusable Debris' are to be carried by trucks/dumpers to the identified dumping yards. Covers should be placed on the trucks during the transportation of material. Usable construction and demolition waste/ debris should be stored separately outside the RoW at a designated place for usage.
- The locations of dumping sites should be selected with following considerations.
- Unproductive/wastelands shall be selected for dumping sites.
- These should be away from residential areas and located at least 1km downwind side of these locations,
- These sites shall be finalized such that they do not lie within any designed forest or other eco-sensitive areas, do not affect natural drainage courses and no endangered/rare flora is impacted by such disposal.
- The lowlands, natural depressions which are natural sinks will not be used for dumping as these are natural sinks.
- Drainage channels should not be used for dumping
- Local Authorities should be consulted about the location of debris disposal sites before finalizing the locations.
- Dumping sites should not contaminate water sources.
- Dumping sites should have adequate capacity for the amount of debris generated. Design of dumping site is given in Annexure 6.1 Dump site Stabilization plan.

#### 6.4.2.1 IMPACTS ON GEOLOGY

The construction of AP Road will require different materials such as earth, aggregate, boulders, and sand that occur naturally and whose formation process is slow and takes years. Minimizing the construction footprint on natural resources is a fundamental design principle for pavement and structures.

With an estimated surplus of approximately 20700 $m^3$ of excavated material after balancing cut and fill, the DPR emphasizes reuse of suitable cut and excavated earth for embankment formation, slope dressing, and construction of protection works such as toe walls, gabion retaining walls, and river training structures at critical erosion-prone locations, particularly near chainage 20+500, 23+850 and 25+00. In addition, stone and granular materials recovered from dismantling of existing pavement and drainage structures will be recycled and reused for sub-base layers, shoulder construction, and filter media where technically feasible, thereby reducing dependence on new quarry material. These practices not only conserve natural resources but also minimize environmental impacts from material extraction, transportation, and waste disposal. Only unsuitable or non-recyclable materials will be disposed of at MPWD-designated disposal sites in accordance with environmental management guidelines. To prevent unwarranted impacts the following measures are proposed:

**Mitigation Measures**

- The aggregate, sand and other construction material shall be supplied form quarries approved by the ESMU (indicated in the pre-Construction stage)
- The challans for the royalty paid against the material used shall be included in the IUFR / Bills submitted for payments.

### 6.4.2.2 IMPACT ON SOIL

Contamination of soil during the construction stage may happen primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping near water bodies.

Topsoil loss may occur in land parcels used for short-term purposes (e.g. Construction camps) as well as in areas permanently impacted due to road rehabilitation, unless measures for preservation are adopted. Project activity involves tree cutting and vegetation removal from the RoW followed by construction and strengthening of the present carriageway.

Since the project involves upgrading an existing road alignment rather than developing a Greenfield corridor, substantial removal of topsoil is not anticipated. However, localized topsoil disturbance may occur during shoulder widening, drainage improvement, and embankment raising activities. To mitigate this, the ESIA prescribes specific topsoil management measures to be implemented during construction. The alignment passes through areas which have sandy loam with varying amounts of clay, typically exhibiting low to medium plasticity. These soils are light textured and are thus prone to erosion by winds and during rain and consequent slides can occur due to hilly slopes of the area. Additionally, the movement and operation of vehicles, construction equipment, and material transport during project execution may cause soil compaction, temporary storage sites, and parking zones if not properly managed. Soil compaction reduces permeability and soil fertility, affecting natural drainage and vegetation growth.

### 6.4.2.3 QUARRIES

Construction materials required for the project road will be transported from Quarries. Details of Quarries site is given in Table 3.12 of Chapter 3.

Opening of a new pit creates the following impact:

- The excavation of earth in an unregulated manner may lead to unstable slopes, erosion, loss of fertility, inundation of water, breeding areas for mosquitos and an unhygienic environment. Fertile topsoil may be wasted if not preserved for backfilling.
- The transportation of earth quarry areas in open/uncovered trucks can increase the dust levels and overloaded transportation material may cause spillage of material on road causing dust, high emission, vehicle wear and tear, road surface damage due to overloading.
- Haul roads may develop surface damage due to plying of trucks and if left unattended may cause problems to other pedestrians and commuters on the road.

. The earthwork details in the project area are listed in **Table 6.2** below.

Table 6.2: Earthwork details in the project area

| Road | Fill ($m^3$) | Cut ($m^3$) |
|---|---|---|
| AP Road | 2341 | 23041 |

As per the earthwork estimation for the project corridor, the total fill quantity is 2341 $m^3$, and the cut quantity is 23041 $m^3$. After balancing cut and fill requirements, there remains a surplus of approximately 20700 $m^3$ of excavated material.

In addition, waste from hot-mix as wells as from the regular operations of the machinery e.g. layers and bitumen sprayers during the surfacing of the roads. The concrete wastes from the batching plant and transit mixer wash would also be generated.

The labour camps would be setup for construction which would generate municipal solid waste and hazardous waste (waste oil from the maintenance and operation of 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 or adjoining properties it may result in loss of productivity of land and can also impact the ecology.

**Mitigation Measures**

**PREVENTING COMPACTION OF SOIL**

- To minimize this impact, all construction activities and machinery movement will be strictly confined within the designated Right of Way (RoW) and approved working areas.
- Parking and servicing of vehicles and equipment will be allowed only in designated hard-surfaced zones,

**Spoil Disposal**

- Spoil disposal sites shall be located on stable, non-erodible terrain away from water bodies and agricultural land.
- Dumping will be done in compacted layers (≤1 m thick) with retaining walls, drainage channels, and slopes maintained within the natural angle of repose (30°–35°).
- Each site will be protected with toe walls, sediment traps, and vegetative cover for stabilization.
- The contractor shall operate only at approved locations under supervision and maintain the site until full rehabilitation is achieved.
- The site should incorporate proper retaining structures, such as toe walls and catch drains, to prevent sliding and erosion.
- Adequate drainage must be provided through surface and subsurface channels to control runoff.
- Spoil should be deposited in layers, compacted, and stabilized using vegetation or geo-textiles to minimize dust and erosion.
- Access roads should be provided to ensure safe transport of muck, and the site should be fenced and clearly demarcated.
- Environmental safeguards, including periodic monitoring and rehabilitation plans, must be integrated into the design to ensure long-term stability and ecological compliance.

**Waste Disposal**

- 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 wastes are presented in Annexure 6.2 The same guidance (storage of Hazardous Waste) may be used for storage of hazardous materials (oil, lubricants)

The typical design of each muck disposal site is incorporated into the DPR. Dumpsite Stabilization Plan is attached as **Annexure 6.1.**

### 6.4.2.4 AMBIENT AIR QUALITY

Construction stage impacts will have adverse impacts on the workers as well as the settlements adjacent to the road, especially those in the downwind direction. There are two types of pollution, i.e. dust pollution and pollution from harmful gases.

**Impacts from Generation of dust**

- Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense;
- Transportation of raw materials from quarries sites
- Stone crushing, handling, and storage of aggregates at on-site asphalt mixing plants are integral to the AP Road Corridor project. These activities generate significant dust and noise.
- Site leveling and vegetation clearing, including the removal of trees and topsoil, are being carried out along the alignment to prepare for subgrade laying. These operations are critical but environmentally impactful, especially near forested or community areas.
- Concrete batching plants and asphalt mix plants are being set up along the corridor to support continuous construction. These facilities involve the mixing of aggregates with bitumen, releasing particulate matter, hydrocarbons, and heat, which may affect local air quality and nearby settlements
- Construction of structures and allied activities

**Impacts from Generation of polluting gases including $SO_2$, $NO_x$ and CO**

- Large construction equipment, trucks and asphalt producing and paving equipment
- The movement of heavy machinery, oil tankers etc.
- Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

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

Table 6.3: Mitigation Measures for Ambient Air Quality

| Impact Source | Mitigation Measures |
|---|---|
| **Transportation and tipping of cut material; site levelling and excavation** | Regular water sprinkling (at least 3 times in a dry season) on haul roads, excavation areas, and disposal sites to suppress dust. Limit vehicle speeds to 25 km/h on unpaved roads.<br>A log book of the sprinkling has to be maintained. The Contractor should take into consideration the requirement of water for sprinkling which undertaking the planning of works. |
| **Transportation of raw materials from quarries** | Cover all vehicles carrying loose materials with tarpaulin; avoid overloading and ensure proper loading/unloading to prevent spillage. |
| **Stone crushing, batching, and asphalt plants** | Locate plants at least 500 m from settlements and sensitive receptors; install dust extraction, bag filters, and stack emission controls. Regularly maintain equipment to minimize emissions. |

| Impact Source | Mitigation Measures |
|---|---|
| | The emissions have to be monitored as per the monitoring plan specified in the ESIA Report. A log of the maintenance should also be maintained by the Contractor. |
| **Site clearing, vegetation removal, and handling of topsoil** | Restrict vegetation clearance to the required RoW; immediately stabilize exposed soil using mulching, water spraying, or temporary turfing. |
| **Concrete and asphalt mixing operations** | Use pre-mixed bitumen and maintain mixing temperature within permissible limits to reduce hydrocarbon release. Avoid fuel adulteration. |
| **Operation of heavy machinery and transport vehicles** | Maintain all equipment and vehicles regularly; prohibit use of old or poorly maintained machinery; use low-sulphur fuel. |
| **Generation of gaseous pollutants (SOx, NOx, CO)** | Ensure all machinery meets CPCB emission norms/ MoRTH emission standards (GSR 144); prohibit idling of vehicles; schedule material transport to avoid congestion. |
| **Worker and community exposure to dust and fumes** | Provide PPE (dust masks, goggles) to workers; display warning and awareness signs; avoid high-emission activities near schools or dense settlements. |
| **Monitoring and compliance** | Conduct periodic ambient air quality monitoring ($PM_{10}$, $PM_{2.5}$, SOx, NOx, CO) at identified locations and ensure compliance with CPCB National Ambient Air Quality Standards. The Monitoring plan presented in the ESIA Report shall be adhered to. |

#### 6.4.2.5 NOISE

During construction, particularly in residential and commercial areas, ambient noise levels may temporarily exceed statutory limits within about 50 m of active work zones due to operation of heavy machinery, material transport, and equipment use. The main noise sources will include excavators, graders, vibratory rollers, and transport vehicles, which typically generate levels above 70 dB(A). Vibration from rollers may also affect nearby structures depending on soil type, structural age, and construction quality.

These impacts will be intermittent, short-term, and localized, as all construction activities will not occur simultaneously along the corridor. Sensitive receptors such as schools, hospitals, and religious places located near the project road may experience temporary disturbance during high-noise activities. However, impacts will attenuate with distance and can be effectively mitigated through equipment maintenance, scheduling of high-noise works during daytime and strict adherence to CPCB noise standards.

The scale of construction required for upgrading the AP Road is moderate and confined mostly within the available Right of Way (RoW). The primary sources of noise emissions include construction equipment, material transport vehicles, stone crushers, and asphalt plants. These activities are temporary, localized, and limited to the construction period. Noise levels are expected to rise intermittently during operations such as excavation, compaction, and pavement laying, especially near settlements and sensitive receptors like schools and health centers. However, with proper scheduling of high-noise activities during daytime, maintenance of equipment, and adherence to CPCB noise standards, the impacts will remain within acceptable limits. Consequently, the

overall scale of works and the expected marginal increase in post-construction traffic are not anticipated to result in any significant or lasting adverse impacts on ambient air quality or noise levels.

Ambient noise level may increase temporarily in the close vicinity of various construction activities, maintenance workshops, and vehicles and earthmoving equipment. These construction machineries are expected to generate noise levels in the range of 80 – 95 dB(A) at about 1m from the source; while the actual ambient noise level experienced at surrounding receptors will depend on distance, terrain, and intervening structures.

Mitigation Measures

- Staging of construction equipment and unnecessary idling of machinery within noise-sensitive areas shall be avoided wherever possible.
- All plants and equipment used in construction (including third-party units) must conform to MoEF&CC/CPCB noise standards.
- All vehicles and equipment used in construction shall be fitted with effective exhaust silencers.
- Servicing of all construction vehicles and machinery shall be done regularly; during routine servicing, the effectiveness of exhaust silencers shall be checked and replaced if defective.
- Construction activities shall be restricted to daytime hours (6 AM–10 PM). Night-time work may be carried out only in emergencies, following all prescribed mitigation measures for night operations.
- Unnecessary honking at construction sites shall be strictly prohibited.
- Temporary barricading shall be installed around active construction zones, especially near settlements, schools, or hospitals, to minimize noise propagation.
- Noise monitoring shall be carried out at construction sites as per the approved monitoring schedule, and results shall be submitted to the Project Management Consultant (PMC) and Project Management Unit (PMU) for review and compliance verification.

**DG Set Noise Control Standards**

To minimize noise from generator operations during construction, the following measures shall be implemented:

- The contractor must use silent DG sets as prescribed by the Central Pollution Control Board (CPCB).
- Each DG set shall be provided with a proper exhaust muffler to further reduce noise emissions.
- The DG set shall be properly sited to minimize its noise impact beyond the premises, ensuring compliance with ambient noise standards at the nearest receptor.
- A routine and preventive maintenance schedule shall be prepared and followed in consultation with the DG set manufacturer to ensure that noise levels do not deteriorate with use.

At the outset, it should be noted that unavailability of exact information on the construction methodology, hours of work, no. of equipment and their ratings / fuel consumption, construction schedule, etc. are the limiting factors while estimate the construction noise for this subject project;

### 6.4.2.6 SURFACE WATER QUALITY AND SILTATION

For the upgradation of the AP Road, potential impacts on surface water arising from the construction of bridges and cross-drainage structures have been carefully assessed and incorporated into the design stage. The project corridor runs parallel to the Daru River around Chainage 25+000, where fishing activities are practiced, making this stretch environmentally sensitive.

During construction, activities such as earthworks, material storage, operation of construction camps, and dewatering of excavations may temporarily affect surface water quality. Runoff from exposed soil, stockpiles, and construction zones may carry suspended solids, oils, and debris into nearby streams and drainage channels,

leading to increased turbidity and siltation. In addition, improper handling of construction wastewater, machinery washing, or accidental spills of fuels and lubricants could result in localized water pollution.

Construction works near the Daru River, including bridge construction, river training, and slope protection, may temporarily increase sediment load and turbidity, potentially affecting aquatic habitats and local fishing practices. However, these impacts are expected to be short-term, localized, and limited to the active construction phase.

To mitigate these risks, the design incorporates adequately sized cross-drainage structures, stream protection measures, and apron/cut-off walls to maintain natural drainage patterns and prevent scouring. With the implementation of appropriate construction management practices, no significant or long-term adverse impacts on surface water flow, quality, or hydrological connectivity are anticipated along the AP Road corridor.

Labour camps and site facilities will generate domestic wastewater and sewage, which, if discharged untreated, may degrade nearby water bodies.

**Mitigation measures**

**Labour Camp and Construction Yard**

- To prevent this, sewage treatment through septic tanks and soak pits or mobile bio-toilets shall be provided at all camps.
- Construction runoff shall be managed through temporary drainage channels, sediment traps, and silt fencing, ensuring that no untreated discharge enters natural watercourses.
- Runoff from the camp shall be passed through an oil-water separator. All peripheral drains shall be linked to the oil water separator
- The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into river or any other nearby water bodies by passing wastewater to sedimentation tank to be considered as part of the EM plan and Contractor's responsibility.
- Stagnation of water should not be allowed at any place near the campsite as a precaution against vector-borne disease.
- The wash water from the concrete mixer/ batching plant/ miller should only be disposed at a pit developed in construction camp

**Water Pollution from Fuel and Lubricants**

- Spill Prevention and Control: Store fuel and lubricants in bunded areas (110% capacity of the largest container) with proper spill kits (sand, absorbents). Immediately clean up any spills or leaks.
- Impervious Flooring: Provide impermeable flooring (e.g., compacted clay or concrete base with HDPE lining) in storage areas for materials such as bitumen, fuel, cement, and chemicals to prevent seepage into soil and groundwater.
- Transfer of fuel by decantation is prohibited, Fuel Pump (manual or electric) should be used
- Storm water Management: Construct peripheral drains around storage yards to collect and divert runoff to sedimentation pits before discharge. Prevent mixing of clean storm water with contaminated runoff.
- Regular Inspection: Conduct routine checks for leakages, cracks, or improper containment in fuel and chemical storage zones. construction sites. Oil-water separator with adequate residence time to be provided before the outfall of these.

- Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a way that spillage of fuels and lubricants does not contaminate the ground. Only fuel pumps will be used for the transfer of fuel during refueling.

**Pollution from construction activities**

- The runoff from the construction material storage yard must be channelized through peripheral drains connected to sedimentation tanks (holding tanks excavated in the ground) of adequate capacity

### 6.4.2.7 IMPACTS ON NATURAL DRAINAGE AND WATERSHED MANAGEMENT (FLOODING)

Along the rivers and streams crossed by the road, bank protection measures are required to prevent accelerated sedimentation, which can disrupt drainage patterns and negatively impact riverine habitats. The road alignment generally follows the existing topography, except at the locations of cross-drainage structures. Within the project stretch of 7.770 Km, there is 1 major bridge and 6 minor bridges exist. A total of 24 pipe culverts are proposed for reconstruction and rehabilitation.

If the existing culverts are not adequately strengthened during road widening and rehabilitation, they may fail structurally, leading to disruptions in water flow, increased flood risk, potential damage to the road, and safety hazards for road users and nearby communities.

**Mitigation Measures:**

- The contractor will ensure that no construction materials/debris shall disposed off or block the flow of water of any water course and cross drainage channels.
- The stockpiled material must be prevented from erosion and deposition in the drainage channel from sites where these are stocked for construction.
- The runoff from the construction material storage yard must be channelized through peripheral drains connected to sedimentation tanks (holding tanks excavated in the ground) of adequate capacity
- All sedimentation tanks and peripheral drains must be cleaned before the monsoon.

### 6.4.2.8 GROUND WATER QUALITY

The road construction projects are water intensive and demand a large volume of water during the entire project's construction period however in this project the works are rehabilitation in nature, the quantum of water require will be minimal. However surface water AP project road stretch will require 15.233 KLD. Although the actual water requirement may vary depending on the contractor's construction methodology and equipment usage. As discussed with the DPR team, the primary source of water for construction will be the Daru River. The availability of surface water is sufficient. Hence demand for the construction is proposed to be met from the surface water sources. The demand for construction is proposed to be met from surface water sources. The project area is not classified as critical, semi-critical or overexploited by CGWB. It is "safe" area for ground water abstraction.

There is no pressure on ground water resources as most of the water requirement will be fulfilled by surface water.

**Mitigation Measure**

- Peripheral drains and temporary drainage channels will be provided at the construction site to safely divert stormwater runoff and prevent water accumulation.
- Silt traps/sedimentation pits and soak pits will be constructed to capture sediments and allow runoff

water to infiltrate, supporting groundwater recharge and preventing contamination.

- Construction water will 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 install a meter at the point of extractor and keep a log of the water extracted
- All the measures suggested in the permission for Borewell shall be adhered to
- In case the water is sourced form third parties the Contractor shall only source it form sources cleared by PMU. In such cases also eh shall maintain a log of the water procured.
- 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;
    - Install water metres with main supply pipes/water tanks/bore well to assess quantity of consumed water

### 6.4.2.9 CONSTRUCTION AND DEMOLITION WASTE

Construction and demolition (C&D) waste from major demolitions is not expected along the proposed AP alignment because no Pucca structures will be removed. Only temporary structures with masonry or light walls (e.g., temporary kiosks, sheds, boundary walls) will be dismantled where absolutely necessary to establish the right-of-way. Even these limited removals, if not handled correctly, can obstruct natural drainage, cause siltation of nearby waterbodies, generate dust, and create temporary traffic inconveniences or health nuisances. To avoid such impacts, all temporary-structure debris will be managed through a contractor-led waste handling plan that emphasizes source segregation, timely removal, reuse/recycling where feasible, controlled transport, and disposal at authorized sites.

**Key mitigation measures**

- **Avoidance & minimization:** limit removals to only those temporary walls/structures that are unavoidable for construction; explore minor realignments or temporary protection works to retain structures where possible.
- **Segregation on site:** separate inert masonry/brick, concrete, metal, wood and mixed waste at designated temporary collection points to maximize reuse/recycling.
- **Reuse & recycling:** priorities reuse of intact masonry/brick and concrete as backfill or for temporary access tracks; recover metal and timber for reuse.
- **Designated storage & timely removal:** store debris in covered areas away from drains and surface water; remove to authorized disposal/recycling facilities within agreed short timeframes to prevent runoff and scavenging.
- **Dust control:** dampen stockpiles and vehicle loads, cover trucks during transport, and restrict demolition/dismantling operations during high-wind conditions.
- **Drainage protection:** install silt traps/sediment control (e.g., sandbags, temporary settling pits) at nearby drains and around stockpiles to prevent siltation of water bodies.
- **Traffic & public safety:** schedule dismantling works off-peak where possible, use flaggers and signage, and maintain clear pedestrian/vehicular passage around work areas.
- **Permits & authorised disposal:** ensure waste is transported only to licensed C&D disposal or recycling facilities and that manifests/receipts are retained.

- **Contractor responsibilities & training:** the contractor shall prepare the C&D waste handling plan, train workers on segregation and pollution prevention, and maintain daily records of waste quantities and destinations.
- **Monitoring & reporting:** include C&D waste management in construction supervision checklists; undertake fortnightly inspections and submit waste disposal receipts as part of monthly compliance reports.

### 6.4.2.10 MUNICIPAL SOLID WASTE

AP road corridor will generate approximately 10 to 12 kg of municipal solid waste per day during the construction stage; this is estimated based on approximately 50 working people in the project site. This waste if not disposed of properly, may lead to littering in the immediate vicinity of the camp sites and contamination of ground water as well as air pollution due to unauthorized burning.

#### Mitigation measures

- Disposal of sanitary wastes and excreta shall be into septic tanks. If bio-toilets will be used the excreta could be converted to manure.
- The camp shall implement a two-bin system and the workers made aware about the segregation of waste
- Poster and leaflets will be done to make the camp residents aware of the segregation and process of segregation
- Kitchen wastewater shall be disposed into soak pits/kitchen sump located preferably at least 15 m from any water body. Sump capacity should be at least 1.3 times the maximum volume of wastewater discharged per day. The bottom of the pit should be filled with coarse gravel and the sides shored up with board, etc. to prevent erosion and collapse of the pit. New soak pits shall be made ready as soon as the earlier one is filled.
- Solid wastes generated in the kitchen shall be reused if recyclable or disposed of in landfill sites.
- Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed of hygienically as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of Project Authority.
- The camping area should be periodically sprayed with Bleaching powder and other disinfectants.

### 6.4.2.11 HAZARDOUS WASTE

Approximately 40 cum of scarified bituminous material will be generated from the project road during pavement rehabilitation. Improper disposal may cause localized soil and water contamination due to leaching of hydrocarbons; therefore, its reuse and handling shall follow MoRTH (5th Revision) guidelines.

As per MoRTH Clause 517 and Clause 305.2.2.2, the scarified bituminous material shall be recycled and reused in Granular Sub-Base (GSB), Wet Mix Macadam (WMM) layers, or for pavement shoulders, after appropriate screening and blending to achieve the required gradation. The reclaimed mix can also be incorporated in hot or cold recycling processes depending on site conditions and equipment availability.

Any quantity of scarified bitumen found unsuitable for reuse shall be disposed of at designated locations approved by the Engineer-in-Charge, with proper base lining and containment to prevent leachate migration and protect soil and water quality. This approach promotes resource recovery, cost efficiency, and environmental compliance in line with MoRTH and CPCB sustainability principles.

Corridor wise scarifying existing bituminous surface in the project area is listed in **Table 6.4** below.

Table 6.4: Amount of expected Scarified Bituminous material

| Sl. No. | Description | Unit | Quantity |
|---|---|---|---|
| | | | AP Road |
| 1. | Scarifying existing bituminous waste | cum | 40 |

A small quantity of hazardous substances (such as diesel, petroleum products, and other chemicals) will be used or stored during the project. If not stored properly, these substances may cause leakage or spillage, leading to soil and water contamination. During the construction phase, used batteries are also likely to be generated, which must be disposed of in compliance with the Battery Waste Management Rules, 2022. Improper disposal of lead-based batteries can result in leakage of lead, causing soil and water pollution.

**Mitigation Measures**:

- The Contract shall obtain Authorization for Generation, Storage and Handling of Hazardous Waste from MSPCB.
- The Hazardous Waste shall be stored as per the provisions specified in the rules (Segregated and access Controlled space, Covered, Impervious floor, bounded for 110% capacity)
- The Contractor shall maintain records of the generation, storage and disposal as per the provisions using the forms specified in the Hazardous Waste rules.
- The Waste shall be disposed of through the Authorized recyclers or Aggregators and the records maintained in Form V of the Hazardous Waste Rules.

### 6.4.2.12 NATURAL DISASTER

Based on the satellite image processing study on landslides and hazard assessment conducted under the Meghalaya State Action Plan on Climate Change (SAPCC) (2022), several hazard-prone and vulnerable zones have been identified across the state of Meghalaya. The review of the available hazard mapping indicates that the proposed sub-project corridor does not fall within the high-risk landslide or hazard-prone zones identified under the SAPCC assessment.

Detailed field reconnaissance and site verification was undertaken along the project alignment to assess potential geotechnical and hydrological risks. During the inspection, no direct evidence of flooding or prolonged waterlogging was observed along the project road. However, certain stretches of the alignment run in close proximity to river channels and streams, making these locations susceptible to localized bank erosion and soil instability, particularly during periods of high discharge and seasonal runoff.

The following locations were observed to have localized soil erosion and riverbank instability:

- Chainage 19+300: Signs of riverbank erosion and soil instability were visually observed near the river edge.
- Chainage 19+150 to 19+700 (LHS): Continuous bank erosion along the left-hand side riverbank was visually observed.
- Chainage 22+850: Localized soil erosion was observed near the abutment location of a minor bridge, indicating the need for appropriate structural protection.
- Chainage 24+000 (LHS): Riverbank erosion was observed along the left bank of the river.

Given these conditions, appropriate riverbank stabilization and erosion control measures are recommended to mitigate potential risks to roadway embankments and hydraulic structures. The recommended measures include revetment works, gabion retaining structures with wire crates, geotextile filter layers and other suitable river

training and bank protection techniques. These measures will help control erosion, prevent bank scouring, and ensure long-term stability of the road embankment and bridge structures.

The Detailed Project Report (DPR) has already incorporated protection walls and riverbank stabilization works at critical locations along the project corridor, as summarized below.

Table 6.5: Protection Walls Included in DPR

| Sr. No. | Location of Wall | Chainage | Total Length (m) | Road Side |
|---|---|---|---|---|
| 1 | At Minor Bridge (MNB) | 22+807 | 60 | BHS |
| 2 | At Minor Bridge (MNB) | 23+153 | 60 | BHS |
| 3 | At Minor Bridge (MNB) | 24+682 | 200 | BHS |
| 4 | At Minor Bridge (MNB) | 25+262 | 60 | RHS |
| 5 | At Minor Bridge (MNB) | 26+323 | 60 | BHS |

Table 6.6: Protection Works for Streams Running Parallel to the Road

| Sl. No | Chainage From | Chainage To | Length (m) | Width (m) | Depth (m) | Quantity ($m^3$) | Side |
|---|---|---|---|---|---|---|---|
| 1 | 23+585 | 23+935 | 350 | 12 | 0.5 | 2100 | LHS |
| 2 | 24+270 | 24+460 | 190 | 14 | 0.5 | 1330 | LHS |
| 3 | 25+000 | 25+040 | 40 | 14 | 0.5 | 280 | LHS |
| 4 | 25+235 | 25+325 | 90 | 11 | 0.5 | 495 | LHS |
| **5** | 25+510 | 25+550 | **40** | **11** | **0.5** | **220** | RHS |
| **6** | 26+350 | 26+540 | **190** | **18** | **0.5** | **1710** | RHS |

These riverbank protection and stabilization measures will effectively mitigate erosion risks, enhance slope and embankment stability, and safeguard road infrastructure from potential hydrological and geomorphological impacts along the corridor

### 6.4.2.13 DISRUPTION OF COMMUNITY SERVICES

During road construction, local infrastructure such as water supply lines, irrigation channels, drainage systems, and access roads may be affected. These facilities are essential for domestic water use, agricultural activities,

and community mobility. Improper or incomplete restoration of these services can lead to adverse impacts on local livelihoods and may also affect the integrity and progress of the road works.

### 6.4.2.14 IMPACTS ON OCCUPATIONAL HEALTH & SAFETY

During the construction phase of the road project, workers are continuously exposed to various occupational and environmental hazards. These include prolonged exposure to dust and gaseous emissions from equipment, vehicles, and material handling. In addition, there are significant safety risks associated with activities such as hill-side cutting, benching, excavation, embankment formation, operation of heavy machinery, and protection work along eroded riverbanks. Specific risks also arise from working near waterlogged or submerged sections, culvert and bridge construction, and sharp curves or junction improvements, where vehicular movement poses added danger. Electrocution, work at heights, slips, trips, and falls, as well as tree cutting and vegetation clearance, further contribute to potential safety concerns. Proper use of personal protective equipment (PPE), adherence to standard operating procedures (SOPs), traffic and work-zone safety management, and regular safety training will be critical to prevent accidents and ensure worker well-being throughout the construction period.

Mitigation Measure

- A Hazard Risk Identification and Assessment (HIRA) carried out by the Contractor during the Pre-construction for the activities which will be included in the road component of the Meghalaya Logistics and Connectivity Improvement Project. The Occupational Health and Safety Plan attached as Annexure 6.3 shall be implemented by the Contractor.
- The Contractor will provide adequate resources for its implementation.

### 6.4.2.15 DIVERSION OF TRAFFIC

Since the road upgradation works will be carried out on the existing alignment, there will be a direct interface with road traffic. Short-term impacts during construction will include traffic diversions wherever feasible and management challenges, potentially causing hindrance to the existing traffic flow. There is also a risk of accident hazards during this phase. Although such diversions do not directly impact the natural environment, poorly planned diversions can lead to adverse effects. Rapid restoration of diverted services can help minimize the severity of impacts resulting from the disruption of existing services.

### 6.4.2.16 WORK SITE SAFETY

During the construction activities the exiting road would be used by traffic. The risk of accident and collisions are very high because of the constricted width of the road, use of road by both construction vehicle and equipment and the local people for commuting. Thus, pedestrian, vehicles are susceptible to danger.

Labour camps and site operations pose community health and safety risks, including sanitation, water access, and increased traffic hazards. Labour influx may exacerbate these risks if not well managed.

The following mitigation measures are thus proposed:

**Mitigation Measures**

**Safety in Construction**

- RFI will be raised for all excavation, cutting and other works undertaken. The CSC will not approve any RFI for more than 500 m at one go or contiguous stretched. The RFI for excavation on both sides of the carriageway shall not be issued at any time. The subsequent RFI for the adjoining chainages should be issued only when the leveling and back filling is done

- Barricade the construction area using hard barricades (of 2 m height MS Steel Barricades/ New Jersey Barrier/ Water filled barriers) where the drop in level is more than 0.3 m.
- Initiate site clearance and excavation work only after barricading of the site is done.
- Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes, etc.,), to the barricaded area
- Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area
- Undertake the work section wise, a 500m section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones
- In case of settlement areas Steel / wooden Planks of sufficient capacity should be provided to cross over the trench.
- The Work zone safety signages shall be placed as per IRC: SP 55. All the safety measures stated in MoRTH Circular RW/NH-36098/25/2022-S&R (P&B)/pt. dated 16.03.2023 shall be applied.
- Construction material must be stored in the barricaded area. If temporary storage is required (for 1-2 days) outside the demarcated construction area, the same must be discussed with the community.
- Retroreflective tapes shall be fitted on all sides of equipment
- Reverse horns must be placed on all vehicles and equipment. In case of rotating equipment rotation alarm must also be fixed on the equipment.
- Preferably machinery should not be parked beside the carriageway. If machinery are parked on the roadside the area should be barricaded by water filled New Jersey barrier. Retroreflective tape must be fixed on the barrier for easy visibility. Solar LED blinkers shall be placed on the machinery for easy visibility.

**Labour Influx related**

- The project will prioritize the engagement of local workforce to the extent possible during the construction phase. Contractors will be encouraged to hire unskilled and semi-skilled labour from nearby villages along the project corridor. This approach will not only support local livelihood opportunities but also promote community participation in project activities. Skilled labour may be sourced externally if not available locally; however, preference will be given to local workers wherever feasible.
- Labour camp will be set up as per WB guidance (Annexure 6.4).
- The Project Board shall be installed at the beginning /start of the package. The Project Board should provide the critical information about the project including the grievance mechanism.
- The construction zone must be access controlled, and the workers must be provided valid identification cards to allow entry.
- The Contractor shall provide, explain, and obtain signed acknowledgement of the Worker Code of Conduct from all workers as part of the employment agreement. Time to time orientation programme on Code of conduct to be organized with the workers by the contractor.

## 6.4.2.17 ROAD SAFETY MEASURES

Road construction activities may affect road safety for commuters, pedestrians, students, women, and elderly persons using the corridor.

Although animal crossings have not been reported along the current project stretch, the possibility of wildlife or livestock movement during the construction phase cannot be ruled out; therefore, appropriate mitigation measures shall be incorporated into the Contractor's C-ESMP.

In addition, sensitive receptors such as schools (Ch. 20+200 and Ch 24+100) are located close to the Sub Project Road, will require enhanced traffic safety management measures during construction, including speed control, signage, safe pedestrian access, and coordination with school authorities.

**Mitigation Measures**

The road Safety measures suggested in IRC SP 55 need to be implemented.

- The following additional road safety measures have to be implemented include:
- Suitable safety measures in the form of safety barriers along valley side have been proposed throughout the mountainous terrain of the project stretch.
- For lane decision making, thermoplastic reflective road markings, traffic signage, has been proposed to ensure night visibility.
- Crash barriers have also been proposed along critical stretches of the project corridor to enhance road safety by preventing vehicles from leaving the carriageway and minimizing the severity of run-off road accidents.

## 6.4.2.18 ANTICIPATED IMPACTS ON BIOLOGICAL ENVIRONMENT

The Ampati to Purakhasia (AP) Road project is a road improvement activity confined to the existing alignment, with no widening or diversion through undisturbed habitats. Although several Endangered and Critically Endangered species occur regionally within the 10 km Study area, the project does not intersect or significantly influence any critical habitat as defined under World Bank ESS6 Paragraph 27–29. Hence, no species or habitat within the project's area of influence qualifies as Critical Habitat. All species are therefore screened out from Critical Habitat consideration.

No such species were observed during the field survey. A total of 05 species are listed under Schedule I of the Wildlife Protection Act, 2022. Although none of these species were recorded during the field surveys conducted in the 10 km study area, their presence has been indicated through secondary information sourced from the IBAT Tool. Details are provided in Table 5.15.

As per the design, the construction activities would also involve felling of 14 nos of trees. In addition, there would be clearing of the undergrowth and, bushes and shrubs. The unplanned removal would impact the impact on habitats of birds and animals unless the removal of vegetation in planned and limited. The following mitigation measures are required.

**Mitigation Measures for Biodiversity Management**

The proposed Ampati to Purakhasia Road (AP) Road improvement project passes through a modified landscape interspersed with secondary vegetation, agricultural fields, and small forest patches. Although no critical habitat is present, the area supports important biodiversity. To minimize ecological impacts during project implementation, the following mitigation and enhancement measures will be adopted.

**Mitigation Measures:**

- No tree felling should be carried out without permission of the Forest Department, GoM.
- Clearing and uprooting should be avoided beyond that which is directly required for construction activities.
- If any termite mound is found adjacent to the highway, precaution will be taken, the mound would not be disturbed, and the Bio-diversity specialist of the PIU/PMU would be intimated to ascertain the presence of Chinese pangolin and Indian Pangolin.
- Kerosene / LPG should be preferably used to avoid felling of the trees or provide community kitchen for the labour camps for cooking.
- Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation
- Compensatory plantation 1: 10 would be carried out by the Contractor. As indicated in the ESMF an app-based monitoring of the plantation would be carried out.
- All the workers will need to be oriented and monitored by the contractor so as not to cause any harm to the flora and fauna.
- Hunting and fuel wood collection will be strictly prohibited

**Impacts on Aquatic Ecology:**

During the construction phase, aquatic ecology may be affected by increased silt inflow into surface water bodies and the discharge of liquid wastes or untreated sewage from construction and labour camps.

**Mitigation Measures:**

- Disposal of construction material or debris into rivers or streams will be strictly prohibited.
- Regular monitoring of water quality will be conducted to ensure compliance with environmental standards
- The dewatering carried out from the excavated pits will not be discharged directly into the river. It will be transferred into a sedimentation tank of adequate size and residence time before discharge.
- A silt curtain will be provided across the river to prevent sediments from flowing downstream.
- Any works affecting aquatic habitat will be done during low flow (when water depth is less than 5 m) and when banks would be dry
- No Solid waste should be discharged into any waterbody
- Where any GI wire mesh gabions are used; all GI wire ends need to be folded inside.
- Ensure that no construction activities will be carried out during monsoon and the fish breeding season

The identified chainages highlight critical erosion-prone locations requiring structural and bio-engineering interventions. At Ch. 19+300, severe riverbank erosion due to scouring is addressed through toe walls, riprap pitching, launching aprons, and vegetative stabilization. Similarly, the stretch Ch. 19+150 to 19+700 (LHS) requires bank stabilization using gabion/stone pitching, slope regrading, geotextile layers, and bio-engineering measures.

At Ch. 22+850, erosion at the minor bridge abutment poses structural risks, for which toe walls, cutoff walls, riprap aprons, and slope strengthening measures are proposed. Further, at Ch. 24+000 (LHS), riverbank erosion impacting the embankment is mitigated through river training works such as spurs/groynes, retaining structures, riprap protection, and vegetative stabilization. Overall, a combination of structural protection and eco-friendly slope stabilization measures is planned to ensure long-term stability and erosion control.. Details are given below in Table 6.7.

Table 6.7: Drainage management and erosion control structures

| Chainage (km) | Issue / Environmental Impact | Type of Work Envisaged | Detailed Design Interventions / Description |
|---|---|---|---|

| | | | |
|---|---|---|---|
| (19+150 to 19+700) | Significant soil erosion near riverbank due to active scouring | Riverbank protection & erosion control | • Construction of RCC/stone masonry toe wall with adequate embedment below bed level<br>• Provision of riprap/stone pitching over geotextile to arrest scouring<br>• Installation of launching apron for riverbank stability<br>• Vegetative turfing/ grass plantation on upper slopes for long-term protection |
| 19+200 to 19+300 | Soil erosion along LHS riverbank indicating continued instability | Bank stabilization & slope protection | • Construction of gabion revetment or stone pitching along affected stretch<br>• Regrading of bank slope to stable profile with compaction<br>• Provision of geotextile filter layer to prevent soil loss<br>• Use of vegetative bio-engineering measures (grassing) |
| 22+850 | Soil erosion at abutment location of minor bridge, posing structural risk | Bridge abutment protection works | • Construction of RCC toe wall and cutoff wall at abutment<br>• Provision of riprap apron or gabion mattress for scour protection<br>• Backfill protection using filter media and geotextile<br>• Strengthening of abutment slope using stone pitching or gabion baskets |
| 24+000 | Soil erosion along LHS riverbank, loss of embankment material | River training & embankment protection | • Construction of river training structures such as spurs/groynes to deflect flow<br>• Provision of gabion/masonry retaining wall where embankment is threatened<br>• Placement of rock riprap over geotextile to prevent further erosion<br>• Vegetative stabilization on upper bank with bio-engineering methods |

### 6.4.2.19 IMPACTS ON ARCHAEOLOGICAL, HISTORICAL AND CULTURAL SITES

**There are no historical and cultural sites of importance observed in the project stretch.**

The other key potential impacts during the construction of the Project may be related to the risk of partial or total removal or destruction of unknown heritage assets (undiscovered archaeological sites) due to ground removal, which implies the need for setting mitigation approach.

During the construction works, as part of the Contractor's project CESMP, a "chance-find" procedure will be developed and implemented. The mitigation plan for the "chance find procedure" has been incorporated into the ESMP and is presented in Chapter 8 of this ESIA. Workers need to be trained in the use of this procedure. Cultural Heritage Monument Conservation Plan is attached as **Annexure 6.6.**

### 6.4.3 IMPACTS DURING OPERATIONAL PHASE

During the operation stage, the main environmental impacts are expected from increased traffic volume and speed, which may elevate safety risks, particularly in rural areas. However, no sudden or significant increase in traffic is anticipated, as the road already exists and is open to public use.

The project also offers opportunities to restore vegetation around the road corridor and worksite through a compensatory plantation program. This initiative will enhance the aesthetic quality of the area and contribute to soil stabilization and reclamation.

During the operation phase, moderate increases in air and noise pollution may occur due to higher vehicular movement. Nevertheless, the overall impacts are largely positive, with enhanced road safety, reduced travel time, and improved connectivity supporting local economic development. Landscaping, replantation, and slope bioengineering measures will improve local biodiversity, stabilize embankments, and enhance the corridor's visual aesthetics.

#### 6.4.3.1 Impacts on Water Quality and Resources

During the operation phase, the likelihood of water quality degradation is very low. Potential impacts on surface water may arise only from accidental spills. However, the probability of such incidents is minimal, as the road design incorporates safety enhancements, including curve improvements, road widening, and pedestrian facilities, which collectively reduce the risk of accidents.

#### 6.4.3.2 Impact on Air Quality

Vehicular emissions are the principal source of pollution during the operation stage. The AP project road being mostly located adjacent to open agricultural land and un-classed forest, adequate dispersion of gaseous pollutants is expected.

#### 6.4.3.3 Impact on Noise Quality

Impact due to increased noise level and vibration is anticipated due to increased vehicular movement upon improvement of existing road condition. Road side plantation will act as a noise barrier and is likely to reduce the noise quality during the operational phase and any further mitigation is beyond the control of the project authority.

#### 6.4.3.4 Accidents Involving Hazardous Materials

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

In case of spillage, the report to relevant departments will be made and instructions will be followed in taking up the contingency measures immediately as per the Emergency Management Plan of the contractor's OHS plan.

## 6.5 SOCIAL RISKS & IMPACTS

The construction of the road is expected to intersect various areas of significant social and economic value, which necessitates careful consideration and management. Key areas of concern include impacts on agricultural lands and residential communities. The route traverses along agricultural lands that are important for local food production, livelihoods and eco system services in general. Disruption to these areas could result in economic losses for farmers and reduced agricultural output. Mitigation measures, including design optimization, compensation, and community engagement, have been incorporated to minimize adverse effects and ensure that the project contributes positively to the socio-economic landscape. This has been outlined in the Resettlement Action Plan.

7.770 Km length of Sub Project Road will be improved within the available ROW (12m) and therefore will not require additional land. No additional Land is required for community infrastructure part of the FPIC agreement. As this facility will be constructed within the available ROW.

The proposed Sub project will also require 0.35 ha of land for spoil disposal. The required land for spoil disposal side will be used temporarily and will be returned to the land Owner after project completion and after having redeveloped in accordance to the community requirements. The Consultants along with the officials of the PWD and members of the village community including the Nokma jointly identified 1 locations for dumping of spoils.

A total of 5 encroaching structures will experience partial impacts due to the project. This includes 2 commercial structures (GI shade) and 3 residential structures (Bamboo boundary fence of House). The impacts are limited to minor structural losses, with no complete displacement anticipated.(Table 5.29).

A 30-day notice period will be provided to all Project Affected Persons (PAPs) whose structures fall within the project ROW, allowing them sufficient time to salvage materials and relocate along with other entitlements as per the Entitlement matrix provided in the RPF and RAP. The format of the notice issued to affected households is provided in the RAP. FPIC was carried out as the project will result in loss of assets and cause relocation of IP's.

FPIC was carried out as the project will result in loss of assets and cause relocation of IP's.

The road alignment requires no additional land, as most mitigation and improvement works are confined within the existing paved road. Key interventions along the alignment include:

- Along the project corridor, several community and institutional structures were observed in close proximity to the proposed alignment. At chainage 23+800, a Government School is located near the road, where appropriate speed reduction measures such as signage and a speed limit of 20 km/h are recommended to ensure student safety. Another educational facility, a Primary School, is located at chainage 25+850, where no direct impact from construction activities is anticipated.
- Religious structures were also identified along the stretch. A Church is situated at chainage 25+200, and another at chainage 27+100; both locations are at a safe distance from the construction zone and thus no impact is expected.
- Additionally, a JJM (Jal Jeevan Mission) facility was noted at chainage 25+300, which will remain unaffected by the proposed works.
- Overall, while schools, churches, and community infrastructure are present along the route, none are likely to be adversely affected, though speed regulation and safety signage near educational institutions are strongly recommended.

20 PAPs may experience temporary livelihood disruptions during the construction period, as access to their shops, farms, or workplaces may be temporarily diverted or closed for about 4–5 days during construction activities. However, these impacts are expected to be short-term and will be managed through advance notice, access management, and phased construction planning to minimize inconvenience.

The assessment of impacts along the project corridor indicates that the effects on land and structures are minor, localized, and do not involve complete asset loss or large-scale physical displacement. A total of 5 Project Affected Households (PAHs), comprising 20 Project Affected Persons (PAPs), will experience partial, minor impacts of less than 10% damage to their existing assets. This total includes 2 commercial encroaching structures affecting 8 PAPs, and 3 residential encroaching structures affecting 12 PAPs. Because all impacts remain below the 10% severity threshold, no physical displacement is anticipated. Overall, the findings suggest that the project will have limited and manageable socio-economic impacts, which can be effectively, mitigated through appropriate compensation and livelihood restoration measures.

To mitigate these social impacts, household surveys, meaningful stakeholder consultations and FPIC consultations were carried out to understand the concerns and needs of affected communities. The Free, Prior, and Informed Consent (FPIC) process was followed in a culturally appropriate manner to ensure meaningful engagement with Indigenous Peoples, securing their consent through transparent and participatory consultations [See IPDP for details]. Additionally, community engagement programs have been conducted to provide clear information about the project, address misconceptions, and explore opportunities for local benefits, such as job creation and infrastructure improvements. Contractors will be required to ensure that access to residences, shops, agricultural land, and public amenities is maintained throughout the construction period.

The Project recognizes the critical importance of addressing Sexual Exploitation, Abuse, and Harassment (SEA/SH) both within the workplace and in interactions between workers and the local community. To address these concerns, SEA/SH Prevention and Response Action Plan has been prepared for the project which will be implemented during the sub-project implementation.

Social impacts associated with the project have been assessed across the pre-construction, construction, and operation phases of the project lifecycle

### 6.5.1 PRE-CONSTRUCTION PHASE

**Nature of Impacts**

During the pre-construction phase, social impacts are primarily associated with impacts on structures, and livelihood disturbance arising from project preparation activities. The proposed AP road alignment requires no additional land and is expected to affect about 5 structures, most of which are located within the existing Right of Way (RoW). These impacts are largely partial in nature and include roadside kiosks, boundary walls, fencing, gates, and small commercial extensions. Such impacts may result in loss of assets and temporary livelihood disruption, particularly for small roadside vendors.
The project affects Indigenous Peoples (IPs) residing along the corridor, requiring culturally appropriate consultation and consent processes prior to implementation.

**Mitigation Measures**

Mitigation during the pre-construction phase focuses on planning and compensation measures. Household surveys, stakeholder consultations, and the Free, Prior, and Informed Consent (FPIC) process have been conducted to ensure meaningful participation of affected communities. Compensation for affected assets, livelihood assistance, and relocation support where required will be implemented through the Resettlement Action Plan (RAP). Community amenities identified through consultations with Indigenous Peoples have been incorporated into the Indigenous Peoples Development Plan (IPDP). Continued disclosure and consultation will

be undertaken through the Stakeholder Engagement Plan (SEP).

**Nature of Impacts**

The construction phase is expected to generate mostly temporary social impacts. Construction activities may restrict access to residences, agricultural land, shops, and public facilities along the project corridor. These disruptions may affect daily mobility and reduce customer access to roadside businesses for short periods. Construction activities may also increase pressure on local ecosystem resources due to the presence of workers in the project area. Vulnerable groups including elderly persons, women-headed households, and economically weaker households may face additional mobility and safety challenges during construction.
The project may require a limited number of workers from outside the project area, creating potential risks related to labour influx, worker–community interaction, communicable diseases, and SEA/SH risks. Occupational health and safety risks for workers are also anticipated during this phase.

**Mitigation Measures**

Construction-phase impacts will be managed through measures included in the Environmental and Social Management Plan (ESMP) and project level Labour Management Plan (LMP). Contractors will maintain alternative access routes, schedule works in phases, provide advance notice of construction activities, and install safety signage and temporary crossings to ensure continued access to residences, shops, and public facilities. Contractors will be required to source materials responsibly and avoid dependence on local forest resources. Special attention will be given to vulnerable groups by maintaining access to healthcare facilities, schools, and markets through temporary walkways and crossings where necessary. Further, contingencies will be made to ensure that any construction related damages to property are compensated by the contractors. Moreover, information on grievance mechanisms must be clearly displayed and function effectively to address any grievances from the community members and workers at the site. Labour-related risks will be managed through implementation of the Labour Management Plan (LMP), worker codes of conduct, labour camp management provisions, occupational health and safety measures, and worker grievance mechanisms. The SEA/SH Prevention and Response Action Plan will be implemented during construction to address risks related to worker–community interaction. Monitoring of these measures will be carried out as part of ESMP implementation.

### 6.5.2 OPERATION AND POST-CONSTRUCTION PHASE

**Nature of Impacts**

No significant adverse social impacts are anticipated during the operation phase. Instead, the improved road infrastructure is expected to generate positive social and economic outcomes for communities along the corridor. Improved connectivity will enhance access to markets, healthcare facilities, schools, and administrative services. Road safety improvements and better drainage infrastructure will improve mobility and travel reliability, particularly during the monsoon season.

**Enhancement and Monitoring Measures**

During the operation phase, the focus will be on sustaining project benefits and ensuring road safety. Community awareness programs on road safety and maintenance of road infrastructure will support long-term project sustainability. Improved connectivity is expected to contribute to local economic development, improved service access, and poverty reduction in the project area. Efforts should also be made to ensure non-discriminatory employment practices, particularly in the inclusion of women. Over the long term, the project is expected to contribute positively to poverty reduction and overall community development.

# 7. STAKEHOLDER CONSULTATION AND INFORMATION DISCLOSURE

This chapter provides an overview of the stakeholder consultations carried out as part of the Environmental and Social Impact Assessments (ESIA) for the proposed Meghalaya Logistics and Connectivity Improvement Project (MLCIP). These consultations were aimed at ensuring a participatory approach to identifying and addressing potential environmental and social impacts associated with the project.

Relevant stakeholders were mapped and can be categorized under three broad categories as shown in below **Table 7.1**.

Table 7.1: List of relevant stakeholders

| Category of stakeholder | Type of stakeholder |
|---|---|
| Project-Affected Parties | • Village community<br>• Shop owners<br>• Residential structure owners<br>• Road Users |
| Interested Parties | **A. Government agencies**<br>▪ Public Works Department (Roads), Meghalaya (PWD-R)<br>▪ Garo Hills Autonomous District Council (GHADC)<br>▪ Meghalaya Forests & Environment Department<br>▪ Meghalaya State Pollution Control Board (MSPCB)<br>▪ Meghalaya State Biodiversity Board (MSBB)<br>▪ Land Records & Revenue Department, Meghalaya<br>▪ Meghalaya State Disaster Management Authority (MSDMA)<br>▪ Meghalaya Energy Corporation Limited (MeECL) (for electricity & power supply)<br>▪ Public Health Engineering (PHE) Department (Water supply & sanitation)<br>▪ Agriculture Department, Meghalaya<br>▪ Irrigation Department, Meghalaya<br>▪ Transport Department, Meghalaya<br>▪ Urban Affairs Department, Meghalaya (instead of Town Committee)<br>▪ Health & Family Welfare Department, Meghalaya (including AIDS Control Society functions)<br>▪ Department of Arts & Culture, Meghalaya (instead of Directorate of Archaeology, Meghalaya)<br>▪ District Social Welfare Office (South West Garo Hills)<br>▪ District Legal Services Authority<br>▪ District Child Protection Unit<br>▪ Office of the Child Development Project Officer<br>▪ Nokma<br><br>**B. Civil society organizations: Local NGOs such as**<br>• **Civil Society A'chik Welfare Organisation-** Based in Ampati, this organization engages in community welfare activities, focusing on the upliftment of the A'chik (Garo) community.<br><br>• **The Social Humanoid-** Situated in Garobadha, this organization focuses on social welfare and community development projects.<br>▪ megscpwd.gov.in<br>▪<br>• **PA Sangma Foundation-** Named after the late Purno Agitok Sangma, this foundation is involved in various development activities, including education and healthcare |

| Category of stakeholder | Type of stakeholder |
|---|---|
| | initiatives.<br>• **GHE Global Human Expedition-** This organization collaborates with local communities to implement development projects aimed at improving the quality of life. Bethany Society – strong presence of Community based work in the entire Garo Hills Region.<br>• Church-based Organisations (Baptist / Catholic Missions) – significant role in education, health, and social services across villages<br><br>**C. Community based Organization**<br>▪ Bio-Diversity Management Committee |
| Vulnerable groups | ▪ Women Headed Household (WHH),<br>▪ PAPs falling under Below Poverty Line (BPL),<br>▪ Scheduled Tribe (ST) categories,<br>▪ Persons with disabilities |

During ESIA, consultations were conducted with representatives from all categories of stakeholders. The consultations conducted with government agencies, communities, & other organizations with representation from vulnerable groups were undertaken. Special attention was given to engaging with communities from sub-project locations that are likely to experience significant impacts, such as impact on residential and commercial structures etc.

Representatives from interested parties were consulted to incorporate their concerns and expertise to align the project with broader developmental objectives associated with economic and environmental goals. Key discussions during the consultations were focused on potential displacement, loss of livelihoods, environmental degradation, law & order issues in project area, irrigation related, structural issues such as Cross Drainage Structures, etc., and related mitigation measures, ensuring that the concerns and suggestions of all stakeholders were documented and considered in project planning. The consultations provided valuable insights into the priorities and concerns of affected local community, helping to shape mitigation measures for minimizing adverse impacts.

Through public participation in consultations, stakeholder's viewpoints and suggestions were captured as an input to the technical design, which were duly considered, and all the suggestions were incorporated in the project design to the extent feasible and /or warranted.

Additionally, **Annexure 7.1** provides a summary of consultations with project-affected parties from local communities and institutional stakeholders from government agencies.

The project has prepared a project level Stakeholder Engagement Plan (SEP) which details out the procedures of stakeholder engagement during the project cycle. The SEP outlines the process, methods and frequency of engagement with various stakeholders and will be accordingly implemented during the project period. Stakeholder Engagement Plan is attached as **Annexure 7.2.**

Disclosed Stakeholder Engagement Plan link on MPWD website is https://megpwd.gov.in/pdf/2026/ESMF/Stakeholder%20Engagement%20Plan%20MLCIP.pdf.

## 7.1 Public Consultation

Public consultations were a key component of the Environmental and Social Impact Assessment (ESIA) process. These consultations were conducted to ensure that the views, concerns, and suggestions of local communities and other stakeholders were effectively considered in project planning and decision-making. The process was guided by the principles of transparency, inclusiveness, and participation, in line with the requirements of the World Bank's Environmental and Social Standard 10 (ESS10) on Stakeholder Engagement and Information Disclosure. Consultations were organized at different stages of the project to inform stakeholders about the project objectives, potential environmental and social impacts, and proposed mitigation measures, while also providing an opportunity for them to share feedback and local insights. The outcomes of these consultations were incorporated into the project design and environmental and social management plans to enhance the project's sustainability and community acceptance.

### 7.1.1 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were carried out to ensure that the perspectives, concerns, and expectations of all relevant stakeholders particularly the project-affected persons, IPs, and vulnerable groups were effectively captured and integrated into project planning and decision-making. The details of consultations along the project road are presented in **Table 7.2**.

Table 7.2: Summary of consultations

| Stakeholders | Dates of Consultation | No of Participants | Summary of Key Feedback |
|---|---|---|---|
| PCCF, Shillong | 28 August 2025 | 4 nos | Ecological sensitivity Map in 10 km radius; HWC & safety; governance/dependence. |
| Local residents | 22 August 2025 Chopapara<br>Mebitpara<br>24 August 2025<br>Darong Adu | 21 Nos (Male – 20,Female – 1) At Chopapara<br>16 Nos (Male – 10,Female – 6) at Mebitpara<br>14 nos (Male-12, Female-5) At Darong Adu | Participants appreciated the project and recognized its positive community benefits, while raising concerns about non-functional streetlights. They also requested fair compensation and adequate support in case of any demolition-related impacts on properties or livelihoods. |
| Village Nokma | 17 September 2025 | 01 Nos | Waterborne diseases such as diarrhoea, typhoid, and cholera are prevalent due to unsafe drinking water and poor sanitation. The community stressed the need for improved water supply and health awareness. |
| Youth Groups | 25 September, 3 &9 October 2025 | 20 Nos | Local youth were sensitized on access to proper sanitation and basic facilities during project employment. Community members expressed willingness to provide land for boundary walls, a community hall-cum-bus shelter, and separate public toilets, and will submit formal written consent for these facilities. |
| Women FGD | 3 &9 October 2025 | 13 Nos | Limited local employment, lack of skill development opportunities, and absence of structured career guidance are driving migration in search of better prospects. While this serves as a coping mechanism, it often exposes individuals to significant social and economic risks. |
| Consultations held during FPIC for Priority Projects | | | |
| Community Members & Project Affected Households & Families | 25 September, 3 &9 October 2025, 12 th December | 4 Consultations 133 Nos (Male – 103 Female – 30) | **Major key Agreements:**<br>• Improvement of the existing road to Intermediate Lane with provision of safety measures, drainage, and protection works in habitation and market areas, subject to technical feasibility.<br>• Construction of passenger waiting sheds at specific village locations<br>• Construction of drains cum footpath near settlement areas etc.<br>• Construction of separate toilets for males and females |

### 7.1.2 FPIC PROCESS

As per the requirements of the World Bank's Environmental and Social Standard 7 (ESS7), Free, Prior, and Informed Consent (FPIC) is required where project activities affect lands and natural resources traditionally owned or used by Indigenous Peoples, result in their relocation, or have significant impacts on their cultural heritage. For the proposed AP sub-project road, FPIC was triggered under the first condition, as the intervention involves the use of natural resources traditionally used by Indigenous communities. Accordingly, a structured FPIC process was undertaken to ensure culturally appropriate engagement with Indigenous communities and their traditional institutions, including Nokma, village councils, and community representatives. Consultations were conducted in the local Garo language using accessible formats and covered key aspects of the project such as alignment, design, anticipated environmental and social impacts, and proposed mitigation measures, with particular attention to water sources, livelihoods, and community assets.

The FPIC process was carried out in a phased and participatory manner through multiple rounds of consultations, allowing adequate time for internal deliberations in accordance with customary decision-making systems. The process ensured inclusive participation of women, youth, and vulnerable groups, and was undertaken in good faith, free of coercion or external influence. The outcomes reflect broad community support for the AP sub-project, subject to agreed mitigation measures and design considerations, which have been incorporated into the project design. These measures, along with the detailed record of the FPIC process and continued engagement framework, are presented in the Indigenous Peoples Development Plan (IPDP) prepared specifically for the AP sub-project.

Documentation of the FPIC process, including signed minutes of meetings and attendance records endorsed by Community Leaders, is provided in the Indigenous Peoples Development Plan (IPDP) prepared for the AP sub-project.

.

# 8. ENVIRONMENTAL AND SOCIAL MANAGEMENT, MONITORING AND REPORTING PROGRAMME

## 8.1 GENERAL

Monitoring and reporting are critical components in the implementation of the project. Monitoring involves periodic checks to determine whether activities are being carried out in accordance with the proposed mitigation plans. It provides essential feedback to project management, helping ensure that project objectives are achieved on schedule. The reporting system ensures that environmental and social mitigation measures are implemented as planned. Together, monitoring and reporting support the proper implementation of the Environmental and Social Management Plan (ESMP).

The broad objectives of monitoring and reporting on E&S management are:

- To evaluate the performance of mitigation measures proposed in the ESMP and in other mitigation plans.
- To evaluate the adequacy of environmental and social assessment.
- To suggest improvements in ESMP and other mitigation plans based on the monitoring and to devise fresh monitoring based on the improved ESMP.
- To enhance environmental quality and social development through proper implementation of suggested mitigation measures.
- To meet the requirements of the existing environmental and social regulatory framework and community obligations.

## 8.2 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) has been prepared in accordance with the World Bank's Environmental and Social Framework (ESF) to ensure that the potential environmental and social impacts identified during the assessment are effectively managed during the design, construction, and operation phases of the project. The ESMP outlines specific mitigation, enhancement, and monitoring measures; defines institutional responsibilities; and provides a framework for capacity building and reporting. It serves as a practical tool to guide the implementation of mitigation measures, ensuring compliance with applicable national regulations and the World Bank's Environmental and Social Standards (ESSs), while promoting sustainable and inclusive project outcomes.

Table 8.1:Environment and Social Management Plan

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| **PRE-CONSTRUCTION** | | | | | | | |
| 1 | Consents/ Permits/ Approvals/ Compliances | Regulatory Compliance | Non-compliance to various Environmental/ social/ regulatory requirements pertaining to the proposed project could lead to legal Implications | ➢ Obtain all necessary statutory clearances (CTE, CTO, Labour License, Fire NOC, Tree Cutting Permission, Hazardous Waste Authorization etc.)<br>➢ Obtain necessary insurance and indemnities as specified in the Contract Agreement or a necessitated by law.<br>➢ The CSC will not allow any construction activity without these being completed<br>➢ Renew permits before expiry. | Contractor/ MPWD | CTE, CTO, Labour License, Fire NOC, Tree Cutting Permission Insurance and indemnities to be submitted and tracked | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ The conditions mentioned in the permit need to be maintained.<br>➢ Reports and Returns need to provided. | | | |
| 2 | Preparation of Works Methodology Contractor's ESMP (CESMP) | | Inadequate preparation and implementation of CESMP by Contractor can leave environmental and social issues unattended | ➢ The contractor needs to follow the project ESMP to formulate the CESMP aligned with its work methodology.<br>➢ The CESMP shall be submitted with the Work Plan and Method Statement.<br>➢ The CSC shall review it and provide one set of consolidate comments within 15 days and the plan shall be approved once these are compiled to by the Contractor. The Work Plan and Method Statement will be approved by MPWD only when the CESMP, Traffic Management Plan, OHS Plan is prepared and approved by the CSC . | Contractor | Approved CESMP including TMP, LMP and other relevant plans, and implemented; | MPWD/PMC/CSC |
| 3 | Identification of land for material | Land use and ecology | Discharges from Yards/ Camps to pollute the | ➢ Contractor needs to identify suitable land for storage yard/ construction camp/ labour camp | Contractor | Approved site location; Lease/NOC copies; | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | storage yard/ construction camp/ labour camp | | surroundings and lead to social tension. | ➢ The land shall not be closer to the water bodies, waterlogged areas or wetlands.<br>➢ The land will be handed back to the owner in the same condition as it was prior to the commencement of project activities, once the project is completed.<br>➢ Contractor to produce the lease agreements, NOC etc. for these lands.<br>➢ Avoid construction camps and material storage near streams or unclassed forest on community land, flood plain, encroachment into natural habitats.<br>➢ Restrict vegetation clearing to the minimum area required for works.<br>➢ Maintain a buffer of at least 100 m from natural drainage channels or water bodies.<br>➢ Implement soil erosion control measures (silt fencing, sediment traps, and slope turfing). | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ Prohibit hunting, fishing, or collection of forest produce by workers.<br>➢ Awareness and sensitization of labourers on local wildlife and birds.<br>➢ The guidance for the preparation, construction and operation of the labour camp shall comply with the World Bank Group10 Guidance on Labour Accommodation | | | |
| 4 | Supply of Construction Material | Physiography | Sourcing materials from unauthorized sources. | ➢ The Contractor will submit the EC, CTE, CTO of the aggregate and sand quarry to the PMU for the approval at the beginning of the project.<br>➢ Procurement of construction material only from approved quarries and sites and licensed/ authorized vendors/ manufacturers.<br>➢ Contractor to produce approvals and receipts of the payment of royalty for | Contractor | EC, Permits, challans, Material source approval copies; | MPWD/CSC |

[10] Workers' accommodation: processes and standards

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | all the material procured along with the bill / IUFR. | | | |
| 5 | Water | Groundwater and Surface Water | Abstraction and Pollution of surface and groundwater sources. | ➢ The Contractor will be responsible for arranging adequate supply of water for the entire construction period.<br>➢ In case of own borewell the Contractor shall obtain a permission of abstraction form CGWB/ SWID.<br>➢ He shall arranged for a meter to be fixed at the borewell and the log of the water extracted will be maintained.<br>➢ Measures suggested in the permission will also maintained<br>➢ The contractor will minimize the pollution and wastage of water during construction. The labour camp shall be provided with adequate number of toilets as specified in BCOW Act/ WBG Guidance on Labour accommodations. The toilets have to be provide with soak pits , septic tank | Contractor | Permission for Water source; Usage records; Wastewater management measures | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | or be linked to a mobile treatment unit. Bio-toilets can also be considered as an option<br>➢ The Construction Camp, Construction material storage yard will be provide with peripheral drain which shall be linked to a sedimentation tank.<br>➢ The vehicle repair area , oil storage area shall be impervious , the runoff form these areas shall be sent to a drain and the same is connected to an oil water separator of adequate capacity | | | |
| 6 | Appointment of Environment, Social and Safety Officers | | Inefficient and incompetent supervision by contractors may lead to negative impacts on environment, Social, health and safety. | ➢ The contractor will appoint qualified and experienced Environment. Social and Safety personnel to ensure implementation of CESMP and occupational health and safety issues at the camps and construction work sites.<br>➢ The Environmental Officer along with the other key members of the tram team shall be | Contractor | To be mobilized before construction; approved OHS plan | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | responsible for the preparation of the Plans and also obtaining the statutory permits | | | |
| 7 | Identification of OHS Hazard and Risk Categorization | Occupational Health & Safety | May cause physical harm, injury, illness, or death to workers. | ➢ Develop a site- specific Hazard Identification and Risk Assessment (HIRA) and develop mitigation measures . The Contractor shall prepare an OHS Plan containing the HIRA and submit it as part of the Work Plan and Methodology. The Work Plan shall be approved only when the OHS Plan is satisfactory.<br>➢ Arrange for PPE (helmets, safety shoes, high-visibility vests, gloves) to all workers.<br>➢ Develop tie up with local Hospital Hospital/ PHCs/ CHCs for Health Checkups of labours and also to handle to any accident cases.<br>➢ Ensure proper sanitation, adequate potable water (minimum 5 litres per person per day), and | Contractor | OHS hazard register; Inspection reports; | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | waste disposal facilities in camps.<br>➢ Consulting with workers to identify hazards that may not be obvious to employers or safety professionals.<br>➢ Reviewing safety data sheets (SDSs) to collect information about the hazards of chemicals and other substances used in the workplace.<br>➢ | | | |
| 8 | Other Construction Vehicles, Equipment and Machinery | Pollution Management | Vehicles and equipment not complying with regulations may lead to pollution of environment. | ➢ The contractor will maintain records of fitness and Pollution Under Control (PUC) certificates for all vehicles and generators used during the contract period.. These certification shall be renewed and always maintained. The certificate shall be submitted with the IUFR's (if necessary)<br>➢ All lifting should have the appropriate certification and construction equipment should meet the emission requirement | Contractor | Records of valid PUC / fitness; Inspection log | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | specified in MoRTH emission standards specified in GSR 144.<br>➢ Engage trained personnel for operating machinery and working at height or confined spaces.<br>➢ Crushers, hot-mix and batching plants shall be located at least 1000m (1km) away from residential/ settlements, forests, wildlife movement areas, and commercial establishments, preferably in the downwind direction.<br>➢ The crushers, batching plant and all other equipment shall meet the specifications which are likely to be mentioned by MSPCB in the consent. . | | | |
| 9 | Tree Cutting | Ecology | Loss of green cover and biodiversity | ➢ Maximum efforts shall be made to minimize the number of trees to be felled.<br>➢ The requirement or specifics to fell trees shall be notified to the Forest Department in advance. | Contractor | Records of trees cut and saved. | MPWD/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ Tree felling shall only be carried out when permission has been obtained from the Forest Department.<br>➢ Tree cutting and disposal shall be done as per the Forest Dept. | | | |
| 10 | Joint field verification | Community Engagement | The impacts may not have been identified in time. | ➢ The MPWD and the Contractor shall carry out joint field verification to ascertain the local complaints/suggestions and to confirm the need for additional protection measures or changes in design/scale/nature of protection measures including the efficacy of enhancement measures suggested in the ESMP.<br>➢ Contractor shall provide advance notice to communities and village councils prior to road closures, diversions, or major construction activities.<br>➢ The MPWD shall maintain proper documentation and justifications/reasons in all such cases. | Contractor | Verification reports; | MPWD |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| 11 | Identification of construction material transportation route | Community Health and Safety | Inconveniences and safety issues to the public due to the material transport vehicles. | ➢ The material transport route through existing network of roads should be planned and approved by the local transport authorities.<br>➢ ossible risk areas need to be identified along with sensitive receptors and their time of sensitivity. The Traffic Management Plan shall be developed accordingly.<br>➢ he local communities need to be consulted with prior information on any likely inconveniences. | Contractor | Approved route plan; Community consultation record | MPWD/CSC |
| 12 | Identification of Borrow Area | Damage to existing eco-system due to borrowing activities | Indiscriminate borrowing activities may damage the eco-system and lead to unproductive environment | Borrow area should be located at a minimum distance of 300m from the residential/ settlement area. Preferably, non-agricultural land and barren lands shall be used. Proper barricading should be provided and access to the borrow areas should be restricted to the unauthorized persons.<br>The Contractor will have to obtain the Environmental Clearance for borrow areas. | Contractor | Borrow area EC copy; Approved management and closure plan | MPWD /CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | The borrow area will be operated as per the MoEFCC guidelines11 issued by the concerned SEAC and SEIAA. | | | |
| 13 | Identification of sites for debris disposal or wastes generated from construction camps and site offices | Land and Water environment | Pollution due to indiscriminate dumping of wastes. Wastes entering water bodies and groundwater causing pollution | ➢ MPWD Division and the Contractor are responsible for identifying a suitable area in consultation with local administration to dispose of the wastes from labour camps, construction sites and site offices.<br>➢ The locations of dumping sites should be selected with following considerations i) Unproductive/wastelands preferred , ii) away from residential areas (at least 1km downwind side), iii) are not designed forest or other eco-sensitive areas, Iv) do not affect natural drainage courses , v) no endangered/rare flora is impacted vi) are not lowlands, natural depressions which are natural sinks | Contractor | Approved disposal site and its management plan; NOC, Agreement with landowner; Waste disposal records; | MPWD/CSC |

11 https://parivesh.nic.in/publicdocument/UPLOAD_OM_NOTIFICATION/IA_DOCS/1001_19032025024958.pdf

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ Drainage channels should not be used for dumping<br>➢ Local Authorities should be consulted about the location of debris disposal sites before finalizing the locations.<br>➢ The topsoil of 15cm shall be removed before any works are carried out Reuse topsoil for slope stabilization and landscaping.<br>➢ Dispose of debris only at approved low-lying barren areas located at least 1 km downwind of settlements and away from drainage channels.<br>➢ Avoid dumping in water bodies, wetlands, or near agricultural fields.<br>➢ Regularly monitor disposal sites to prevent contamination and visual pollution. | | | |
| 14 | Relocation of Utility and Common Property Resources (CPR) | Utility Service | Loss of services from utilities and common property resources for the public | ➢ When the utilities/ Common Property Resources need to be shifted, they will be shifted in consultation with the communities and | Contractor/ Divisional offices of MPWD | Records of Relocation completion. | MPWD/ PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | with least inconvenience to the public.<br>➢ If any displacement of Utility/CPRs is required, they will be relocated with prior approval of the concerned agencies. The relocation site identification will be in accordance with the choice of the community.<br>➢ Restrict utility shifting to daytime hours to avoid safety risks at night.<br>➢ The scheduling of the construction works will be shared with the line department (MePDCL, PHE and Telecom Departments) for ensuring uninterrupted services during construction.<br>➢ Provision of utility ducts for underground pipelines shall be incorporated into the design to ensure safe and organized routing of essential services, minimize future excavation, and facilitate maintenance without | | | |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | disrupting road infrastructure | | | |
| 15 | Planning for Worksite and Work Zone Safety | Community Health and Safety | Accidents and inconvenience to communities | ➢ Make arrangement for New Jersey barriers/ Water filled barrier, MS steel barricades (2 m high) ,signage, and warning lamps at work sites.<br>➢ Prepare a Generic Community Health and Safety Plan (CHS Plan) along with the Work Methodology and Work Plan. The Work Plan should not be approved without an approved CHS Plan.<br>➢ Schedule high-risk activities during off-peak hours to minimize traffic congestion.<br>➢ Develop posters for Community Awareness. Conduct community awareness campaigns before any temporary road closure or service disruption.<br>➢ Every RFI should be accompanied with a site specific OHS, CHS and Traffic Safety Plan, which | Contractor | Community Health Safety Plan | MPWD/PMU |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | should define the site-specific measures which were implemented. Without these plans being implemented the works should not be approved. | | | |
| **CONSTRUCTION** | | | | | | | |
| **1** | Crushers, Hot mix Plants & Batching Plants | Air Pollution | Impacts due to establishment and operation of plants and equipment | ➢ The Contractor shall submit a detailed layout plan for all such sites and seek prior approval before entering into a formal agreement with a landowner for setting-up such sites.<br>➢ Specifications of crushers, hot mix plants, and batching plants shall comply with the technical requirements of the contract and prior Consent / NOC for all such plants shall be obtained.<br>➢ No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority<br>➢ The emission has to be monitored as per the | Contractor | Approved layout plan; Valid NOCs/Consents; Dust suppression records; Air quality monitoring reports | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | monitoring plan specified in the ESIA Report.<br>➢ The plant has to be maintained as per the specification of the manufacturer. A log of the maintenance should also be maintained by the Contractor.. | | | |
| 2 | Operation of Borrow Areas | Topsoil and land | Impacts due to improper operation and closing of borrow areas | ➢ Borrow areas shall be selected as specified in the guidance in The Contractor should submit the EC, a copy of agreement with the landowner, borrow area management and closure plan before initiating any kind of borrowing activities.<br>➢ The Borrow are should comply with the conditions set in the EC/ SoP from MoEFCC.<br>➢ Topsoil up to a depth of 150 mm from all areas of cutting, filling, and temporary construction zones, shall be stripped and preserved as indicated in the MoEFCC SoP / MoRTH Orange | Contractor | EC and lease copies; Approved Borrow area restoration and Closure plan | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | Book: Specification for Road and Bridge Works;<br>➢ Topsoil will be stored separately in designated stockpiles with proper slope protection and sediment barriers to prevent erosion;<br>➢ Reuse stored topsoil for median greening, roadside plantation, and slope turfing after construction; and<br>➢ Prohibit disposal of topsoil at dumping sites. | | | |
| **3** | Operation of Quarries | Physiography and Geology | Impacts due to improper management, operation and closing of quarries | ➢ The Contractor shall only source material from quarries approved by PMU(indicated in the Pre-Construction stage)<br>➢ The challans for the royalty paid against the material used shall be included in the IUFR / Bills submitted for payments.<br>➢ In case of new quarry fo the project the Contractor | Contractor | Quarry permit, EC; Safety inspection report; Haul road maintenance record, dust suppression measure, geotagged photos | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | has to obtain EC and other relevant permits and licenses.<br>➢ Inca se of Blasting , A Blasting Management Plan shall be prepared in addition to the Blasting Permit,<br>➢ No quarry or associated plants can be set-up within 1000m from the residential/ settlement locations<br>➢ Contractor shall prepare a haul road network for quarry transport and ensure the suitability of such haul roads from the safety of residents, biodiversity and other environment points of views. | | | |
| **4** | Dismantling of Bridges/ Culverts/ Structures, Hill Cutting | Landuse and Land quality | Impacts due to improper dismantling and disposal | ➢ All necessary precautions shall be taken while working near cross-drainage channels, to prevent earthwork, stonework, construction materials from obstructing cross-drainage at rivers, streams, and drainage | Contractor | Debris disposal/reuse records; Approved Site restoration plan; Photographic documentation. | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | systems, or from causing flooding.<br>➢ Any material which has spilled into the river/ drainage channel or road shall be removed by end of day .<br>➢ In case of hill cutting if any debris cannot be removed by end of day the and shall be demarcated with, crash barrier and traffic safety beacons. However, such sites cannot be left for more than 2 days.<br>➢ Reusable materials (e.g., steel, stones, bricks) shall be segregated and stored properly for reuse or recycling.<br>➢ Non-recyclable debris and waste materials shall be transported to approved disposal sites identified and approved by the concerned authority.<br>➢ dampen stockpiles and vehicle loads, cover trucks during transport, and restrict demolition/dismantling | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | operations during high-wind conditions.<br>➢ Only sites which have been approved by the PMU/PMC/CSC shall be used for dumping.<br>➢ Temporary barriers or silt fences shall be provided to prevent debris from entering watercourses.<br>➢ Dumping will be done in compacted layers (≤1 m thick) with retaining walls, catch and chute drains, and slopes maintained within the natural angle of repose (30°–35°).<br>➢ Each site will be protected with toe walls of adequate height, sediment traps, and vegetative cover for stabilization.<br>➢ The contractor shall operate only at approved locations under supervision and maintain the site until | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | full rehabilitation is achieved.<br>➢ The site should incorporate proper retaining structures, such as toe walls and catch drains, to prevent sliding and erosion.<br>➢ Adequate drainage must be provided through surface and subsurface channels to control runoff. Temporary barriers or silt fences shall be provided to prevent debris from entering watercourses.<br>➢ Spoil should be deposited in layers, compacted, and stabilized using vegetation or geo-textiles to minimize dust and erosion.<br>➢ Access roads should be provided to ensure safe transport of Spoil, and the site should be fenced and clearly demarcated.<br>➢ Upon completion, the associated disposal sites | | | |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | shall be restored to their original condition or as directed by the Engineer | | | |
| **5** | Road scraping and dismantling | Bituminous waste disposal | Impacts due to hazardous wastes | ➢ The contractor shall maintain records of quantities generated, transported, and disposed of, along with details of the disposal site and approvals obtained.<br>➢ Bituminous waste shall be collected and stored temporarily in impermeable, lined containers or areas to prevent leaching or contamination of soil and groundwater.<br>➢ Scrapped Bituminous Material shall be reused in asphalt mix design/ subbase, strengthening of shoulders as directed by CSC. other lower order roads<br>➢ The disposal of bituminous wastes shall be carried out by the Contractor at secure landfill sites approved by the concerned government authorities. | Contractor | Records of Waste reused/disposed; Details of approved disposal site; Photographic documentation. | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ No bituminous waste shall be disposed of in water bodies, open lands, agricultural fields, or along the roadside<br>➢ Periodic inspections shall be carried out to ensure compliance with waste management guidelines. | | | |
| 6 | Storage of Fuel and Repair of vehicles | Soil pollution due to Oil and fuel spills from construction equipment and plants or storage of Hazardous waste. | . Contamination of Soil | ➢ Construction plants, workshops, and fuel storage areas shall be located at least 500 m away from any surface water body and environmentally sensitive locations.<br>➢ Oil interceptors shall be installed at construction camps, vehicle parking, and washing areas to trap oil and grease before wastewater is discharged.<br>➢ All fuel and lubricant storage tanks shall be placed on impermeable platforms or within bunded (contained) areas.<br>➢ The Storage area should be covered and have restricted access | Contractor | Spill log; Waste oil disposal records; Fuel storage inspection record. Photographic documentation. | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ The area should be bunded to contain 110% of the capacity of storage.<br>➢ The area should be provided with ABC type fire extinguishers as per the IS codes (IS 1641, IS 1642 and IS 1643, etc)<br>➢ Transfer of fuel by decantation is prohibited , Fuel Pump (manual or electric )should be used<br>➢ Regular maintenance and inspection of construction equipment and vehicles shall be carried out to prevent leakage of oil, fuel, or hydraulic fluids.<br>➢ Spill control kits (absorbent pads, sand, and containment booms) shall be available at all fuel storage and handling locations.<br>➢ Records of fuel usage, storage, and waste oil disposal shall be maintained and made available for inspection.<br>➢ Stormwater runoff from fuel and equipment storage areas shall be | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | directed through oil-water separators before discharge. | | | |
| 7 | Operation of Plant , Machinery and equipment | Generation of Hazardous Waste | Contamination of land and soil | ➢ Used oil and lubricants shall be collected, stored in labelled, leak-proof containers, and handed over only to authorized aggregators/recyclers for disposal in compliance with applicable hazardous waste regulations.<br>➢ Records of waste oil generation and disposal shall be maintained and made available for inspection.<br>➢ Returns shall be submitted to comply with the Hazardous Waste Permit. | Contractor | Hazardous waste permits, records and returns | PMC/CSC |
| 8 | Operation of Vehicles and earthwork during construction | Air Pollution - Dust Generation | Dust generation will cause air pollution and will have impacts on health and safety. | ➢ Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.<br>➢ Water should be sprinkled regularly (3 time a day) on the work sites.<br>➢ Plying of vehicle on unpaved surface should be prohibited.. | Contractor | Air quality monitoring reports; Dust suppression log; PPE compliance records | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ Speed limits shall be enforced for construction vehicles within and near project sites to reduce dust generation.<br>➢ Personal protective equipment (PPE) such as masks shall be provided to all workers exposed to dusty environments.<br>➢ Air quality monitoring shall be conducted periodically to ensure compliance with prescribed air quality standards.<br>➢ Community complaints related to dust shall be recorded, and addressed promptly.<br>➢ The Conractor should keep a records of cummity grievances due to dust , runoff separately and mitigations adopted. | | | |
| 9 | Operation of Vehicles, plant, and machinery | Emissions | The emissions from vehicles and construction equipment will pollute the air causing health and safety issues as | ➢ Fitness and PUC of the vehicles and equipment's need to be ensured.<br>➢ Maintain all equipment and vehicles regularly; prohibit use of old or poorly maintained | Contractor | Valid PUC certificates; Equipment maintenance log; Emission test results | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | well. | machinery; use low-sulphur fuel<br>➢ Dust extraction, collection and control systems shall be installed at batching plants, crushers, and material handling areas to minimize particulate emissions<br>➢ Ensure all machinery meets CPCB emission norms/ MoRTH emission standards (GSR 144); prohibit idling of vehicles; schedule material transport to avoid congestion. | | | |
| 10 | Operation of construction Camp and construction activities | Contamination of Surface / Ground Water | Discharges from construction activities and construction camps/ labour will lead to surface/groundwater pollution. | ➢ All the debris resulting from construction activities and labour camp shall be removed from the site and disposed at approved sites ( by CSC/ PMC/ PMU) away from water bodies, on a regular basis to prevent them from getting into surface runoff.<br>➢ The Contractor shall mantian the sanitation facility in good conditions. Covered and enclosed | Contractor | Water quality monitoring report; Waste disposal records; Camp inspection records. Photographic documentation. | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | facility shall be provided for washing and bathing.<br>➢ The sanitation facility and waste management facility to be shall be maintained in construction camp.<br>➢ Construction labours should be restricted from polluting the water sources or misusing the sources.<br>➢ Bentontie slurry is prohibited during piling work.<br>➢ Any slurry used in piling works should be in closed systems. It should not be allowed, to enter waterways. The residual slurry shall only be disposed of in lined pits , It should not be dumped near agriculture lands.<br>➢ | | | |
| 11 | Operation of construction Camp and construction activities | Contamination of Surface / Ground Water | Discharges from construction activities and construction camps/ labour will lead to surface/groundwater | ➢ All the debris resulting from construction activities and labour camp shall be removed from the site and disposed at approved sites ( by CSC/ PMC/ PMU) away from | Contractor | Water quality monitoring report; Waste disposal records; Camp inspection records. Photographic | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | pollution. | water bodies, on a regular basis to prevent them from getting into surface runoff.<br>➢ The Contractor shall maintain the sanitation facility in good conditions. Covered and enclosed facility shall be provided for washing and bathing.<br>➢ The sanitation facility and waste management facility to be shall be maintained in construction camp.<br>➢ Construction labours should be restricted from polluting the water sources or misusing the sources.<br>➢ Bentontie slurry is prohibited during piling work.<br>➢ Any slurry used in piling works should be in closed systems. It should not be allowed, to enter waterways. The residual slurry shall only be disposed of in lined pits , It should not be dumped near agriculture lands. | | documentation. | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ | | | |
| 12 | Operation of construction equipment, DG sets, and labour camps during construction | Deterioration of Air Quality | Emission | ➢ LPG shall be used as fuel for cooking of food at construction labour camp instead of fuel wood.<br>➢ DG sets should meet the specification mentioned by CPCB from time to time | Operation of construction equipment, DG sets, and labour camps during construction | Deterioration of Air Quality | Emission |
| 13 | Sourcing Water for project | Surface Water resources | Over extraction or exploitation of ground/surface water will lead to water scarcity. | ➢ Contractor to ensure optimum and judicious use of water;<br>➢ The Contractor shall install and keep the water meter running at the point of extraction, main consumption areas. A log of water abstraction and<br>➢ Discourage labour from wastage of water and applicable prior approvals shall be obtained from concerned authorities.<br>➢ Rainwater harvesting structures shall be installed at construction camps and plant sites to promote sustainable use of water.<br>➢ Awareness programs shall be conducted for laborers and staff on responsible | Contractor | Water consumption log; Permission for water source; Installation of Rainwater harvesting structure | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | water use and conservation practices.<br>➢ Records of daily water consumption shall be maintained as part of regular reporting. | | | |
| 14 | Coffer dam to make dry working space for bridge work | Water Environment and Aquatic Habitat | Change in the flow pattern and quality of water, effect on local habitat | ➢ Selecting the right location for the cofferdam to minimize its impact on the environment.<br>➢ Using environmentally friendly materials to construct the cofferdam eg. Biodegradable/ reusable materials can be used instead of concrete.<br>➢ Restoring the environment after construction. This may involve replanting vegetation and removing any debris. | Contractor | Worksite inspection record; Restoration completion record | MPWD/PMC/CSC |
| 15 | Operation of Vehicle, Plant and Machinery | Noise | Noise from construction vehicles, plant and equipment will lead to noise pollution and cause health and safety issues | ➢ Staging of construction equipment and unnecessary idling of machinery within noise-sensitive areas shall be avoided wherever possible.<br>➢ All plants and equipment used in construction (including third-party | Contractor | Noise level test report; PPE usage record; Complaint register; vehicles, plants and equipment maintenance records. | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | units) must conform to MoEF&CC/CPCB noise standards.<br>➢ All vehicles and equipment used in construction shall be fitted with effective exhaust silencers.<br>➢ Servicing of all construction vehicles and machinery shall be done regularly; during routine servicing, the effectiveness of exhaust silencers shall be checked and replaced if defective.<br>➢ Construction activities shall be restricted to daytime hours (6 AM–10 PM). Night-time work may be carried out only in emergencies, following all prescribed mitigation measures for night operations.<br>➢ Unnecessary honking at construction sites shall be strictly prohibited.<br>➢ Temporary barricading shall be installed around active construction zones, especially near | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | settlements, schools, or hospitals, to minimize noise propagation.<br>➢ Noise monitoring shall be carried out at construction sites as per the approved monitoring schedule, and results shall be submitted to the Project Management Consultant (PMC) and Project Management Unit (PMU) for review and compliance verification. | | | |
| 16 | Operation of DG Sets | Noise and Air | Noise | ➢ The contractor must use silent DG sets as prescribed by the Central Pollution Control Board (CPCB).<br>➢ Each DG set shall be provided with a proper exhaust muffler to further reduce noise emissions.<br>➢ The DG set shall be properly sited to minimize its noise impact beyond the premises, ensuring compliance with ambient noise standards at the nearest receptor.<br>➢ A routine and preventive maintenance schedule | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | shall be prepared and followed in consultation with the DG set manufacturer to ensure that noise levels do not deteriorate with use. | | | |
| 17 | Blasting of rocks (if required) | Blasting | Unmanaged blasting result in health and safety issues and accidents. | ➢ The Contractor will inform well in advance the PMU of the requirement for blasting.<br>➢ He will have to obtain all required Statutory permission as is required from all Government Authorities, public bodies and private parties;<br>➢ The Blasting Management Plan shall be prepared by the Contractor and reviewed by the CSC and approved by PMC/PMU.<br>➢ The Blasting permits shall be reviewed by the PMU. Blasting will be carried out only with permission of Engineer-in-charge.<br>➢ All the statutory laws and regulations, rules etc., pertaining to acquisition, transport, storage, handling, and use of | Contractor | Approved Blasting management Plan; Blasting permission; Incident log. Geotagged photos. | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | explosives will be strictly followed.<br>➢ The CSC shall maintain oversight of the implementation of the Blasting Management Plan. | | | |
| 18 | Tree Felling | Loss of trees and Plantation works | Cutting of trees can lead to loss of biodiversity. | ➢ No tree felling should be carried out without permission of the Forest Department, GoMM.<br>➢ Clearing and uprooting should be avoided beyond that which is directly required for construction activities.<br>➢ Kerosene / LPG should be preferably used to avoid felling of the trees or provide community kitchen for the labour camps for cooking.<br>➢ Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation<br>➢ Compensatory Afforestation 1: 10 would be carried out by the Contractor. As indicated in | Contractor | Tree felling register; Plantation record; | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | the ESMF an app based monitoring of the plantation would be carried out. | | | |
| 19 | Removal of Vegetation | Terrestrial Flora and Fauna | Construction activities and workers may cause harm to flora and fauna. | ➢ All the workers will need to be oriented and monitored by the contractor so as not to cause any harm to the flora and fauna.<br>➢ Hunting and fuel wood collection will be strictly prohibited | Contractor | Worker awareness attendance; Wildlife sighting log | MPWD/PMC/CSC |
| 20 | Discharges from Construction | Aquatic Fauna | Construction activities and workers may cause harm to fauna. | ➢ Disposal of construction material or debris into rivers or streams will be strictly prohibited.<br>➢ Regular monitoring of water quality will be conducted to ensure compliance with environmental standards<br>➢ Any works affecting aquatic habitat will be done during low flow (when water depth is less than 5 m) and when banks would be dry.<br>➢ Where any GI wire mesh gabions are used; all GI | Contractor | Work timing records; Site inspection checklist | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | wire ends need to be folded inside.<br>➢ Ensure that no construction activities will be carried out during monsoon and the fish breeding season. | | | |
| 21 | Construction Activities | Occupational Health and Safety | When Occupational Health and Safety are compromised the associated risks from accidents and incidents could affect health and safety of the workers and others on constriction/ project sites. Improper first aid facilities on the sites could affect health and safety of workers and others. | ➢ The Contractor would prepare OHS plan and other required plans as per the WBs guidelines.<br>➢ All the laborers to be engaged for construction works shall be screened for health and adequately treated before issue of work permits.<br>➢ Periodic health check-up of construction workers.<br>➢ Prevention of mosquito breeding need to be ensured at the project site and other ancillary areas<br>➢ The contractor's Environment and Safety personnels, shall ensure implementation of CESMP including Occupational health and safety issues at the camp, construction work sites | Contractor | Approved OHS plan; OHS training log; PPE checklist; Awareness programme and Health inspection reports | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ➢ All workers and staff should be provided with Personal Protective Equipment (PPE) appropriate to their job on-site and their use shall be ensured.<br>➢ All construction sites should be barricaded properly.<br>➢ Smoking should be prohibited near areas of fire or explosion risk.<br>➢ Sufficient supply of potable water should be ensured for all workers and employees on-site.<br>➢ Ensure a First Aid room at the camp and first aid kits is available in all work areas.<br>➢ Safe working techniques will be followed up and all the workers will be trained.<br>➢ An Emergency Response system in case of any incidence will be developed and implemented.<br>➢ The Contractor will conduct awareness | | | |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | programmes on EHS, HIV/AIDS and other sexually transmitted diseases for workers at least once in a quarter and the record of such training programme must be recorded.<br>➢ Conduct regular safety audits on safety measures adopted during construction. | | | |
| 22 | Community Health and Safety | Community Safety | The safety aspects like (i) safety of road users including pedestrians and cyclists<br>(ii) safety of cattle;<br>(iii) safety of local community<br>(iv) unsafe/ hazardous traffic conditions due to construction vehicle movement need to be considered during the construction stage. Children are most vulnerable to injury due to vehicular accidents. | ➢ Plants and equipment will be installed sufficiently away from the settlements.<br>➢ Proper caution signage, barricading, delineators, lightings etc. will be installed at construction zone and temporary diversions.<br>➢ Hard barricading will be provided at construction zone near habitation area and public roads, and the same will be maintained throughout the construction period.<br>➢ Proper traffic management will be | Contractor | Safety signage installed; Community complaint register; Traffic control records | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ensured near roads of the Construction zone.<br>➢ Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken.<br>➢ Speed restrictions shall be imposed on project vehicles to control speeding.<br>➢ Installation of temporary speed bumps to control speed near designated pedestrian crossing areas/school areas/ market places/ religious places/ human habitations.<br>➢ The general public/ residents shall not be allowed to any of the risk areas of the project, e.g., excavation sites, construction sites and areas where heavy equipment is in operation.<br>➢ In the consideration of risk at civil works, each labour should be covered under | | | |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | ECA 1923 insurance until completion of work. | | | |
| 23 | Emergency Response system<br>Health Management | Emergency Response system | Absence may result to increased incidents, injury, economic loss etc. | ➢ Develop and implement ERS<br>➢ Train personnel and Establish communication channels<br>➢ Systematic planning and training for emergencies. | Contractor | Approved ERP; Emergency drill and training report; Incident response record | MPWD/PMC/CSC |
| | | Health Management – Communicable Diseases | The water fringe areas provide suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water-borne diseases. | ➢ There would be possibility of the transmission of communicable diseases due to migration of labour population from other areas at the construction site.<br>➢ Agreement shall be made with nearby health center or hospital for emergency treatment.<br>➢ Special Measures for COVID 19 should be strictly followed at the camp and construction site. | Contractor | Health screening record; Awareness session log; Medical report; Agreement with nearby hospital | MPWD/PMC/CSC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| 24 | Health Management | Health Management – Communicable Diseases | The water fringe areas provide suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water-borne diseases. | ➢ There would be possibility of the transmission of communicable diseases due to migration of labour population from other areas at the construction site.<br>➢ Agreement shall be made with nearby health center or hospital for emergency treatment.<br>➢ Special Measures for COVID 19 should be strictly followed at the camp and construction site. | Contractor | Health screening record; Awareness session log; Medical report; Agreement with nearby hospital | MPWD/PMC/CSC |
| 25 | Risk of Natural Hazards | Risk of Natural Hazards | The project area is at risk from floods and Earthquakes. | ➢ Protection of Agriculture Land near roads/ bridges.<br>➢ The mitigation measures should be adopted as per norms of State Disaster Management Authority, Government of Meghalaya. | Contractor | Site assessment report; Record of Compliance with SDMA norms | MPWD/PMC/CSC |
| | | Risk of Force Majeure | These unforeseen risks can have both adverse environmental and social impacts | ➢ All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc.<br>➢ All necessary steps will be taken for prompt first aid treatment of all injuries | Contractor | Force majeure preparedness plan; Emergency contact list | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | likely to be sustained during the course of work.<br>➢ Contractor has to prepare a response plan before start of construction works | | | |
| 26 | Labour camp establishment and workforce sanitation management | Occupational Health and Hygiene | Impacts related to unhygienic surroundings | ➢ At every workplace, good and sufficient water supply shall be maintained to avoid waterborne diseases to ensure the health and hygiene of workers.<br>➢ Adequate drainage, mobile toilets shall be provided at workplace.<br>➢ Preventive Medical care shall be provided to workers.<br>➢ Proper Hygiene shall be maintained | Contractor | Sanitation inspection record; Hygiene logbook | MPWD/PMC/CSC |
| 27 | Traffic diversion, detour management, and movement of construction vehicles | Community Health, Safety, and Traffic Management | Unplanned and unmanaged traffic diversion and detours can result in public nuisance. | ➢ Before start of the construction, proper traffic management plan will be prepared and submitted to MPWD for approval. Secure assistance from local police for traffic control during the construction.<br>➢ Necessary signage and barricading will be | Contractor | Approved TMP; Signage/ barricade checklist; Traffic incident register; geotagged photos | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | provided for safety of road users.<br>➢ Contractor will ensure that no construction materials and debris are lying on the road. It will be collected and disposed of properly.<br>➢ Unnecessary parking and sound pollution to be strictly avoided near settlements and sensitive receptor such as schools, hospital and cultural centers.<br>➢ The contractor will ensure that the diversion/ detour is always maintained in running conditions, particularly during the monsoon to avoid disruption to traffic flow. | | | |
| 28 | Labour camp management and workforce conduct during construction | GBV-SEAH Risks | GBV-SEAH risks may arise due to labor influx | ➢ Ensure labor camps are away from settlement areas<br>➢ Ensure that every worker working in the project has been given an orientation on the Worker's Code of Conduct, especially on GBV and SEA/SH, and has | Contractor | Signed CoC register; GBV training log; GBV complaint record | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | signed the Code of Conduct.<br>➢ Conduct periodic awareness programs targeted at women laborers and women and children of communities residing close to the work sites for reporting incidents of GBV- SEAH<br>➢ Ensure complaints of GBV-SEAH are recorded and addressed with urgency. Ensure that name(s) of complainant(s) are kept in confidence and enable anonymous reporting of complaints.<br>➢ Activate GBV Grievance Redressal Committee immediately on receipt of any GBV- SEAH complaint. Take action on recommendation of the GBV Grievance Redressal Committee within 24 hours of submission of the report. | | | |
| 29 | Works carried out near the Archeological | Chance Finds | There is a possibility of Cultural relics, Chance finds at the | ➢ If any cultural remains of geologic or archaeological interest are found, Stop work immediately. | Contractor | Chance find report; Notification records | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | Properties or Monoliths, chance finds | | construction sites. Without proper plan these artefacts may be misused by contractor/ workers. | ➢ CSC and MPWD shall be immediately informed of such discovery and carry out the instructions for dealing with the same<br>➢ No construction related activity not limited to the following storage of material or debris, establishment of labour camp, staging of plant equipment or vehicle, parking of vehicle etc shall be carried out in the vicinity of the Elephant crossings<br>➢ | | | |
| 30 | Engagement of labour | Compliance to Labour Welfare Laws and reporting | Workplace accidents and injuries, unsafe working condition, loss of productivity etc. | ➢ Establish a policy and ensure the compliance within the organization, from the top to the lowest-level employee, understands the importance of complying with labour laws and reporting.<br>➢ Employees should be trained on their rights and responsibilities under labour laws.<br>➢ Employees should have a way to report violations of | Contractor | Labour law compliance record; Training attendance record | MPWD/PMC/CSC/ Labour Inspectors, Govt of Meghalaya |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | labour laws without fear of retaliation. This could be a hotline, an email address, or a suggestion box.<br>➢ Investigating and taking action on violations. This could include disciplinary action against the violator, or even legal action.<br>➢ Employees should be kept updated on the organization's compliance with labour laws. This could be done through regular training sessions, newsletters, or other communication channels.<br>➢ Contractor shall establish and maintain a Worker GRM consistent with the LMP. Worker grievances shall be recorded and resolved within defined timelines.<br>➢ Anonymous reporting shall be permitted and retaliation prohibited. Employment of child labour and forced labour is prohibited. Age- | | | |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | verification records shall be maintained. | | | |
| 31 | Engagement of Labour | Labour Influx | Strain on infrastructure, such as housing, healthcare, and education;<br>social tension, as new arrivals compete with locals for jobs and resources. | ➢ Proper plan for labour influx by investing in infrastructure and social services.<br>➢ Governments can regulate the flow of labour to ensure that it is orderly and sustainable.<br>➢ Local communities can engage with new arrivals to help them understand the local culture and customs.<br>➢ Maximum use of local labours<br>➢ Workers shall receive orientation on local customs and behavioural expectations. Workers shall not enter nearby settlements unnecessarily. Contractor shall coordinate with village authorities regarding labour camp establishment. | Contractor | Labour License and registration records; Local labour hiring records;<br>Orientation logs; | MPWD/PMC/CSC<br>Labour Inspectors, Govt of Meghalaya |
| 32 | Site-specific stakeholder engagement and | Community participation, transparency, and | Lack of information sharing, unresolved grievances, and | ➢ Establish and implement a structured system of regular consultation meetings at the site level | Contractor/ CSC/ PWD | Meetings conducted per month Attendance records | MPWD/ PMC |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | consultation | inclusion of affected persons, including Indigenous communities (FPIC compliance) | reduced community participation in project activities | in line with ESS10 and FPIC requirements under ESS7.<br>➢ Conduct meetings at least twice a month with PAPs, Nokmas /traditional leaders, women and youth groups, and local institutions.<br>➢ Share project information, discuss construction-related impacts, review implementation of mitigation measures, and address concerns through the GRM. The process will also be used to track adherence to agreed FPIC commitments and ensure culturally appropriate engagement throughout project implementation. | | with representation of Indigenous communities, women, and vulnerable groups Number of issues raised and resolved Availability of documented meeting records (MoMs) | |
| 33 | Grievance Redressal | GRM | Increased impunity, conflict and violence; Loss of trust and confidence | ➢ Establish a grievance redressal mechanism<br>➢ Ensure that the mechanism is impartial and independent<br>➢ Provide adequate support to people who use the mechanism<br>➢ Communicate effectively with people about the mechanism | Contractor | GRM register; Grievance resolution records | MPWD/PMC/CSC |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| 34 | Monitoring and Reporting Mechanism | Monitoring and Reporting (Monthly/ Quarterly) | Monitoring environmental attributes like (Air, Water, Noise & soil microbiology) and proper reporting are important for the successful ESMP implementation | ➢ The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per Monitoring Plan prepared.<br>➢ Regular submission of CESMP implementation monitoring report | Contractor | Monthly/quarterly ESMP compliance report; Monitoring data records | MPWD/PMC/CSC |
| **Operation Phase** | | | | | | | |
| 1 | Closure and restoration of temporary construction-related sites during project completion stage | Debris and Waste from Clearing/ Closure of Construction Site, Labor Camps, Disposal Sites. | Land and soil contamination due to improper waste disposal;<br>Aesthetic degradation;<br>Health risks to nearby communities | ➢ Contractor shall prepare and implement a Site Restoration Plan approved by the Engineer.<br>➢ On completion of works, all kuchha structures, debris, and wastes shall be cleared.<br>➢ Disposal pits and sanitation trenches shall be filled, compacted, and sealed.<br>➢ Topsoil removed during construction shall be re-spread to aid vegetation regrowth.<br>➢ Native grass or trees shall be planted to stabilize | Contractor | Site clearance restoration records and closure NOC; Geotagged photos | MPWD |

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| | | | | restored areas and improve aesthetics. | | | |
| 2 | Operation and maintenance of road slopes, embankments, and drainage systemsfor the | Soil Erosion due to Runoff over Steep Slopes and Embankments | Loss of fertile topsoil; Siltation of nearby water bodies; Slope instability or road damage | ➢ Regularly inspect slopes and embankments for erosion signs.<br>➢ Implement bioengineering measures like turfing, hydroseeding, and vegetation planting.<br>➢ Provide stone pitching, retaining walls, or gabions where needed.<br>➢ Maintain effective drainage systems to reduce concentrated runoff. | Contractor | Reports on Erosion inspection; implementation of mitigation measures; Drain maintenance log | MPWD |
| 3 | Operation and maintenance of road drainage systems and surface runoff management | Water Pollution from Road Runoff and Drainage into Water Bodies | Deterioration of surface and groundwater quality; Sediment and oil contamination in nearby streams or waterbodies | ➢ Conduct regular water quality monitoring during operation phase.<br>➢ If pollutants exceed prescribed limits, install silt traps, or sedimentation chambers.<br>➢ Ensure roadside drains are cleaned and desilted regularly.<br>➢ Conduct public awareness to discourage waste disposal into water bodies. | Contractor | Water quality monitoring results; Drain cleaning records | MPWD |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| 4 | Operation of road and vehicular movement along the project corridor | Air Quality Management | Deterioration of ambient air quality; Nuisance to roadside residents and vegetation; Reduced visibility | ➢ Establish and maintain roadside plantation to serve as dust barriers.<br>➢ Maintain smooth road surfaces to minimize dust generation.<br>➢ Install signage discouraging over-speeding, which increases dust levels. | Contractor | Air quality results; Plantation survival record | MPWD |
| 5 | Vehicular movement and emissions during road operation | Air Pollution and Public Health | Increased levels of NOx, $SO_2$, CO, and PM; Health impacts on local population; Deterioration of roadside vegetation | ➢ Conduct ambient air quality monitoring at sensitive locations.<br>➢ Maintain green buffers along the corridor.<br>➢ Organize awareness campaigns for drivers on emission reduction and vehicle maintenance. | Contractor | Air quality results; Plantation survival record ; Awareness records | MPWD |
| 6 | Increased traffic movement during road operation | Noise Environment and Community Health | Noise nuisance to residents; Disturbance to schools, hospitals, and wildlife | ➢ Conduct periodic noise level monitoring.<br>➢ Provide noise barriers, dense plantation near sensitive receptors.<br>➢ Enforce “No Horn” zones near schools and hospitals.<br>➢ Maintain road surface to minimize noise due to uneven pavement. | Contractor | Noise monitoring results; Maintenance records | MPWD |



Official Use Only

| Sl. No. | Activity | Environmental/Social Aspects | Impacts | Mitigation/ Management Measures | Implementation | Indicator | Supervision/ Monitoring |
|---|---|---|---|---|---|---|---|
| 7 | Traffic operation and movement of vehicles along the project road | Road Safety and Accident Risks | Traffic congestion; Increased likelihood of road accidents; Risk to pedestrians and local communities | ➢ Install and maintain proper signage, reflectors, and road markings.<br>➢ Ensure adequate lighting at intersections and pedestrian zones.<br>➢ Provide speed control measures and pedestrian crossings in settlement areas.<br>➢ Conduct community road safety awareness programs. | Contractor | Accident record; Safety audit report; Awareness records | MPWD |
| 8 | Roadside maintenance, drain cleaning, and repair activities during operation phase | Waste Management and Pollution Control | Soil and water contamination from indiscriminate disposal; Visual pollution and clogging of drains | ➢ Collect and dispose of maintenance waste at designated locations.<br>➢ Prohibit dumping into drainage channels or low-lying areas.<br>➢ Reuse or recycle suitable materials (e.g., asphalt, concrete, metal). | Contractor | Waste logbook; Disposal records | MPWD |



Official Use Only

## 8.3 PERFORMANCE INDICATORS

Environmental and social components identified in affecting the environment and social conditions at critical locations have been suggested as performance indicators (PIs). For example, near the construction site, a thick layer of dust over the nearby vegetation/leaf is an indication that the dust control measures are not effective. The performance indicators shall be evaluated under three heads as;

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution.
- Environmental and social management indicators to determine compliance with the suggested environmental and social management measures. Social monitoring indicators will be indicated as part of the Resettlement Action plan (RAP)/Indigenous People Development Plan (IPDP).
- Operational performance indicators have also been devised to determine efficacy and utility of the proposed mitigation measures.

The performance indicators and monitoring plans prepared for the road stretch are given in **Annexure 8.1**. Details of the performance indicative parameters for each of the component will have to be identified and reported during all stages of the implementation.

## 8.4 MONITORING PLAN FOR ENVIRONMENTAL CONDITIONS

Environmental monitoring involves regular checking of the environmental management issues detailed in the ESMP and to ascertain whether the mitigation measures are achieving their objectives, according to the ESMP, with the progress of the works. It provides the necessary feedback for Project management to keep the programme on schedule.

For each environmental condition, the Monitoring Plan specifies the parameters to be monitored, the locations of monitoring sites, and the frequency and duration of monitoring. It also outlines the applicable standards, as well as the responsibilities for implementation and supervision. The Monitoring Plan, along with details of monitoring locations for environmental condition indicators during the construction and operation stages of the project, is presented in **Table 8.2**.

The monitoring will be carried out by Contractor through the NABL accredited agency and will be supervised by the Environment Specialists of the CSC/PMC and E&S cell MPWD.

## 8.5 MONITORING PLAN FOR SOCIAL CONDITIONS

The social monitoring plan is designed to track and evaluate the effectiveness of social safeguard measures implemented under the Environmental and Social Impact Assessment (ESIA). It ensures compliance with national and international social safeguard frameworks, including the Resettlement Action Plan (RAP) and the Indigenous Peoples Development Plan (IPDP). The monitoring plan for social condition indicators of the sub-project during the construction stage is presented in **Table 8.2**.

Table 8.2: Environmental Monitoring Plan for Environmental condition indicators (Air, Water, Noise and Soil)

| Environmental Attribute | Timing | Parameter | Standards | Frequency | Duration | Location | Total no. of Samples during construction and operation stage. | Implementation |
|---|---|---|---|---|---|---|---|---|
| Air | Construction | CO, NOx, PM10, PM2.5 and SO2 | CPCB Guidelines (NAAQMS/ Volume- I/2013-14) | 2 locations for 3 Seasons* for 2 consecutive years | 24 hours sampling | 1 locations (Construction Plant Sites, settlements and Work Zones) | 12 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| | Operation | | | 1 locations for 3 Seasons for 1 Year | | At 1 location during operation stage where monitoring had been done during construction stage | 3 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| Water | Construction | As per Drinking Water Standards | Indian standards for inland surface waters (IS:2296,1982) and for drinking water (IS:10500-2012) | (Surface water at 2 locations for 3 Seasons for 2 consecutive years. ground water at 2 location for 3 seasons for 2 consecutive years | As per Grab Sampling guidelines | Drinking water samples from the labour camps and from hand pumps. Surface water from the water courses near the work site and River. | 24 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| | Operation | | | Surface water 1 locations for 3 Seasons for 1 years. Water (Ground water) at 1 location for 3 Seasons for 1 years. | | At 2 locations during operation stage where monitoring had been done during construction stage | 6 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |

| Environmental Attribute | Timing | Parameter | Standards | Frequency | Duration | Location | Total no. of Samples during construction and operation stage. | Implementation |
|---|---|---|---|---|---|---|---|---|
| Noise | Construction | Noise Levels on dB (A) scale | Noise rules 2000 by CPCB | 2 locations for 3 Seasons for 2 consecutive years. | Leq in dB(A) of daytime and night-time | Near the working zones, sensitive receptors and construction plant sites. | 12 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| | Operation | | | 1 locations for 3 Seasons for 1year. | | At 01 locations during operation stage where monitoring had been done during construction stage | 3 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| Soil | Construction | Monitoring of Pb, SAR and Oil and Grease | (IS): 2720 for 'Method of Test for Soils' | 1 locations for 3 Seasons for 2 consecutive years. | Grab Sampling | Soil at1 location 3 times a year for 24 Months At 2 locations | 6 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |
| | Operation | | | 1 locations for 3 Seasons for 1Year | | During operation stage where monitoring had been done during construction stage | 3 | Contractor through NABL accredited Laboratory and supervised by Construction Supervision Consultant |

*Except Monsoon

Social Monitoring will be done during Construction stage of the proposed Project as per the details provided in Table 8.3.

Table 8.3: Social Monitoring Plan

| Indicator Category | Responsibility | Performance Indicators | Data Collection Method | Frequency |
|---|---|---|---|---|
| Resettlement & Livelihood Restoration | RP Implementation consultant/ MPWD | % of affected households receiving compensation & assistance | Household surveys, payment records | Quarterly |
| Labour & Working Conditions | Contractor/ CSC/ MPWD | Compliance with fair wages, working hours, safety | Labour camp inspections, interviews | Monthly |
| | | % of local workforce employed in project | Contractor reports | Quarterly |
| Social Inclusion & Gender | RP Implementation consultant/ Contractor/ MPWD | % of women engaged in livelihood activities | Beneficiary tracking | Quarterly |
| Stakeholder Engagement & Grievance Redressal | RP Implementation consultant/ Contractor/ MPWD | No. of community consultations held | Consultation records | Bi-annually |
| | | % of grievances resolved within set timeline | GRM logs | Quarterly |
| Indigenous Peoples & Cultural Heritage | RP Implementation consultant/ Contractor/ MPWD | Documentation of FPIC & community agreements | Meeting records, video/audio evidence | Ongoing |
| | | No. of cultural sites protected/enhanced | Site inspections, community feedback | Annually |

## 8.6 REPORTING SYSTEM

Effective monitoring and supervision would require regular reporting of the implementation of the E&S Management measures by the contractor. The E&S Non-conformance / non-performance needs to be flagged and followed up on regularly so that performance improves. Repeated non-conformance / non-performance needs to be brought to the notice of decision makers for contractual action and management decision. These aspects will be monitored and reported through the Concurrent Monitoring and Reporting.

The more strategic aspects of E&S Performance Monitoring, Gap Analysis, and documentation of good and bad practices, which would guide the management to have a review and provide direction, will be done through the Periodic Monitoring. The Mid-Term and End-Term audits will be carried out through specialised Third-Party Agencies to be hired under the project. The findings and recommendations of these studies, along with the analysis of the concurrent monitoring, will be used by the Officers of the E&S Cell to brief the Management during the review. Details are given in section 9.1 of Chapter 9 of ESMF

## 8.7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN BUDGET

An amount of Rs. 59,62,800, have been marked for ESMP budget. The detailed budgets for the same have been presented in Table 8.4

Table 8.4: ESMP Budget

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| **A.** | **Monitoring Measures** | | | | | | |
| 1 | Air quality monitoring | Construction | No. | 12 | 9,000 | 1,08,000 | Civil works contract |
| | | Operation | No. | 3 | 9,000 | 27,000 | Civil works contract |
| 2 | Noise levels monitoring | Construction | No. | 12 | 7,000 | 84,000 | Civil works contract |
| | | Operation | No. | 3 | 7,000 | 21,000 | Civil works contract |
| 3 | Soil quality monitoring | Construction | No. | 6 | 3,000 | 18,000 | Civil works contract |
| | | Operation | No. | 3 | 3,000 | 9,000 | Civil works contract |
| 4 | Ground and Surface Water | Construction | No. | 24 | 6,000 | 1,44,000 | Civil works contract |
| | | Operation | No. | 6 | 6,000 | 36,000 | Civil works contract |
| | **Subtotal (A)** | | | | | **4,47,000** | |
| **B.** | **Capacity Building** | | | | | | |
| 1 | EMSP implementation (1 days) | On Award of Contract | lump sum | | | Included in project safeguards capacity building | PIU Cost |

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| 2 | Plans and Protocols Orientation (1 day) | At Beginning of Construction | lump sum | | | Included | PIU Cost |
| 3 | Experiences and best practices sharing | Once every Year for 2nd yr, 3rd yr , 4th yr , 5th yr | lump sum | | | Included | PIU Cost |
| 4 | Contractors Orientation to Workers on ESMP implementation and refresher program | Once every year or as directed by the PIU | Lump sum | | | Included | Civil works contract |
| 5 | Water Sprinkling Measures for Dust Suppression | Construction | Trips | No of trips to be decided by the Contractor (work areas and haul roads to be sprinkled as two times every day or as directed by the Engineer) | - | 0 | Civil works contract |
| 6 | Silt Fence along Water Bodies | Construction | Rm | 90 | 331 | --- | Civil works contract |
| | **Subtotal (B)** | | | | | **---** | **Civil works contract** |
| **C.** | **Construction Contractor ESMP Implementation** | | | | | | |
| 1 | Providing, fixing, maintaining, shifting & refixing, barricading of minimum 2.0 mtr height at stipulated active site | Construction | to be provided at each of the active | To be decided by the contractor as per his schedule of works | - | -- | Civil works contract |

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| | of the same project site, made with angle iron frame of 50x50x5mm and GI sheet of 0.63mm thick including primer painted initially, painting, lettering & border with reflective paint at the time of every shifting, traffic diversion arrangement, safety guard, suitable lightning arrangement during night, complete in all respect till completion of the project as per technical specification and direction of Engineer-In-charge and same shall be possessed by the contractor after completion of the Project | | sites by the Contractor (i.e. till the completion for the works) | | | | |
| 2 | Supplying and fixing of cautionary and or information signs boards including the cost of posts, fixtures, fixing, foundation, fitting and fixing. Sheeting will be made of encapsulated lens type of retro-reflective type and message / borders will be screen printed complete as per screen specification in IRC SP 55: 2001. To be made available at all time at the work sites as required and directed by the engineer | Construction | Numbers | To be decided by the contractor as per his schedule of works (every worksite to have cautionary boards as described by the Engineer) | - | -- | Civil works contract |

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| 3 | Supplying and fixing of flashing beacon warning lights including the cost of posts, fixtures, fixing, foundation, fitting and fixing, cost of material, labour, loading, unloading, lead, lift, shifting, transportation etc. and as per specification in IRC SP 55: 2001 | Construction | Numbers | To be decided by the contractor as per his schedule of works ( every worksite to have flashing beacons to warn the approaching train as directed by the Engineer) | - | 0 | Civil works contract |
| 4 | Provision and maintenance of Bio toilets with 1 male and 1 female units including cost of material, labour, loading, unloading, lead, lift, transportation, shifting etc. And shall be made available at worksite at the direction of the PIU. The facility shall complete with water arrangement, privacy, lighting arrangement. The WC and /urinals should be made of stainless Steel and the partitions should be made of aluminums framework with FRP panels. The bio-digester tank should be approved by Defence Research & Development Organization (DRDO) or any other competent agency. The whole toilet | Construction | -- | --- | --- | ---- | Civil works contract |

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| | shall be mounted on MS framework with skids; Overhead water tank shall be made of HDPE with proper arrangement of ball cock and mosquito proof cover. These should also be provided with two dustbins for wet and dry waste. The bio-digester toilets shall be mounted on skids and shall not require any creation of permanent structure so that they can be shifted from one worksite to another | | | | | | |
| 5 | Provision of Helmets (IS CODE 2925 : 1984) , Safety Shoes (IS CODE 5852 : 1996), Googles (•IS CODE 5983 : 1980), Reflective Jackets, mitten/ gloves (IS 2573) , safety nose masks to all personnel (including temporary labour) involved in the worksites | Construction | Lumpsum | --- | ---- | --- | Civil works contract |
| 6 | Provision of First Aid Kits for worksites | Construction | Nos | --- | --- | --- | Civil works contract |
| 7 | Provision and maintenance of waste collection bins in sets of 2 (blue and green) for collection of municipal solid waste generated at the worksite including cost of material , | Construction | Nos | Each worksite to be provided with 2 bin system | --- | ------ | Civil works contract |

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| | labour, loading, unloading, lead, lift, shifting, transportation etc. | | | | | | |
| 8 | Environment, Health & Safety Engineer/Supervisor having Bachelors in Env Science / Management/ B.Tech (Env Engg.) Diploma in Central Labour Institute / Regional Labour Institute (Mandatory) | Construction | Nos | ---- | --- | --- | Civil works contract |
| 9 | Tree Plantation (Afforestation) (1:10 ratio) | Construction | Nr. | 140 | 2020 | 2,82,800 | Civil works contract |
| 11 | Worker Code of Conduct orientation, labour awareness sessions, and OHS refresher training | Construction | Lumpsum | - | | Included in the Contract | Civil works contract |
| | **Sub Total (C)** | | | | | ------ | **Civil works contract** |
| **D** | **Social Safeguards Implementation (Framework Instruments)** | | | | | | |
| 1 | Stakeholder engagement, consultations, disclosure, and GRM implementation (SEP) | Construction & Operation | - | - | | 5,00,000 | As per SEP |
| 2 | Indigenous people development plan (IPDP) | Construction & Operation | - | - | | 46,33,000 | As per IPDP of the Sub Project |
| 3 | Resettlement action Plan (RAP) | Construction | - | - | | 1,00,000 | As per RAP of the Sub project |



Official Use Only

| Sl.No | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| 4 | Safeguards capacity building and training (ESMF) | Construction | - | - | - | As per ESMF | Project |
| 5 | Labour Management Plan Budget | Construction | | | | As Per LMP | Project |
| | **Sub Total ( D )** | | | | | **52,33,000** | |
| **E** | **PIU ESMP Implementation cost** | | | | | | |
| | Environmental Expert at PIU | Construction and Operation | Salary | 0 | - | 0 | PIU Cost |
| | Social cum Tribal Development Expert at PIU | Construction and Operation | Salary | 0 | - | 0 | PIU Cost |
| | Labour / OHS Expert at PIU | Construction and Operation | Salary | 0 | - | 0 | PIU Cost |
| | Gender Expert at PIU | Construction and Operation | Salary | 0 | - | 0 | PIU Cost |
| | Biodivesity Expert at PIU | Construction and Operation | Salary | 0 | - | 0 | PIU Cost |
| | ESMP Supervision Cost | Construction and Operation | per month | 0 | - | 0 | PIU Cost |
| | Equipment | Construction and Operation | (Noise Meter 1 nos, Cameras 1 nos) | lumpsum | | 0 | PIU Cost |
| | **Sub Total ( E )** | | | | | **0** | |
| | **Grand Total (A+B+C+D+E)** | | | | | **59,62,800** | |

Official Use Only

## 8.8 INSTITUTIONAL FRAMEWORK OF THE PROJECT

The Meghalaya Infrastructure Development and Finance Corporation (MIDFC) acts as the nodal agency for planning, financing, and coordinating major infrastructure projects, with the PMU providing overall strategic and policy oversight. The Project Implementation Unit (PIU) under PWD executes road and connectivity works, ensuring technical quality, environmental and social safeguards, and coordination with local institutions. An E&S Cell within PIU manage safeguards, including tribal land rights, biodiversity, and community engagement, supported by specialized experts. Project Management Consultants (PMC) provides technical, managerial, and E&S support, while Construction Supervision Consultants (CSC) ensure on-site compliance with quality, safety, and safeguard standards. Divisions of PWD supervise field-level execution, facilitate grievance redressal, and monitor ESMP implementation. This structure aligns with Meghalaya's institutional framework and Sixth Schedule provisions to integrate sustainability and positive social-environmental outcomes. Details are provided in chapter 7 of ESMF.

# 9. GRIEVANCE REDRESSAL MECHANISM

## 9.1 INTRODUCTION

An effective grievance redressal mechanism fosters good governance, accountability, and transparency in addressing project-related environmental and social concerns. An integrated system, featuring Grievance Redressal Cells (GRCs), will be established at the MIDFC Project Management Unit (PMU), supported by designated officers and dedicated procedures. Grievances may be lodged in person, in writing, via email, or by telephone, with overall coordination managed by the PMU's Social and Environmental Expert. The mechanism will become operational from the commencement of RAP and construction activities, adopting a two-tier structure at the site and state (PMU) levels, and incorporating regular platforms and meetings to facilitate timely and amicable resolution.

The project follows a two-tiered Grievance Redress Mechanism (GRM). Tier I operate at the project/site level, chaired by the Village Head with PWD, CSC, and contractor representatives, aiming to resolve grievances within 15 days. Tier II functions at the State/PMU level, chaired by the Secretary of Planning, addressing unresolved or escalated grievances within 15 days. Complaints can be submitted via toll-free helplines, WhatsApp, email, in-person at DPIU/PMU offices, project sites, grievance boxes, or social media. All complaints are logged, categorized, acknowledged within 2 days, investigated, and actions taken by the respective GRCs. Feedback is collected post-resolution, and reparations, if applicable, are documented. Training on grievance handling, stakeholder engagement, and gender sensitivity is conducted every six months. Complainants can escalate to Tier II or pursue legal remedies at any stage. A confidential and survivor-centred grievance channel for Sexual Exploitation, Abuse, and Harassment (SEA/SH) complaints will be established as part of the GRM, ensuring safe reporting, referral to appropriate support services, and handling by trained personnel in accordance with the SEA/SH Prevention and Response Action Plan. Details are provided in Chapter 7 of ESMF.

# 10. CONCLUSION AND RECOMMENDATIONS

## 10.1 CONCLUSION

An Environmental and Social Impact Assessment Study was conducted to assess the potential environmental and social impacts of the project. Primary information about the project influence area was gathered using an Environmental and Social Screening Checklist to evaluate the extent of environmental and social impacts resulting from project interventions. Environmental and social baseline data were collected from secondary sources to depict the existing conditions of the project area accurately. This information serves as a foundation for assessing potential environmental and social impacts, as well as enhancing the accuracy of impact predictions. Additionally, public consultations and FPIC were held with stakeholders to incorporate their inputs and concerns. The key findings of the ESIA are summarized as follows:

- Proposed project will ease the traffic flow and create safe and smooth mobility to motor vehicles as well as pedestrians. The proposed road improvement can reduce travel time from the farthest section of the road to the nearby market from one hour to just 30 minutes. The project is imperative for encouraging more trade and commercial activity (including public transport) in the district of South West Garo Hills.
- The environmental and the social impact assessment have been conducted in accordance with ESMF and National & State regulations. All the potential impacts were identified in relation to pre-construction, construction, and operation phases.
- The proposed project alignment does not pass through any Wildlife Sanctuary/National Park/Biosphere Reserve/Tiger Reserve.
- No ASI Protected monuments found within 0.5 km from the project site.
- 14 nos. of trees are located within the existing Right of Way (RoW) along both sides of the road. To mitigate the ecological impact of tree felling, compensatory plantation at 1:10 ratio for each tree cut should be undertaken in line with applicable environmental regulations and guidelines.
- The Sub project Road does not require additional land, only 0.35 ha land is required for spoil management. The Sub Project road will partially impact five Project Affected Households (PAHs) whose structures encroach upon the available Right of Way.". These impacts will be addressed through compensation and assistance measures outlined in the Resettlement Action Plan (RAP).
- The project road is expected to have some environmental and social impacts due to construction activities along the corridor, its proximity to culturally important sites such as community center, church, school, etc. and potential effects on Project-Affected Persons (PAPs) arising from access-related issues.
- Stakeholder Consultations were conducted to assess the perception of the people about the proposed project. The outcome of the consultations suggested that people are in general with the project because it will improve the present road conditions and connectivity. However, they also raised the requirement for the road safety measures; road furniture's (including streetlights, signage's, speed breaker etc.) and proper compensation for the loss of their assets.
- Occupational health and safety measures for both workers and the local community shall be ensured through the preparation and implementation of a comprehensive Labour Management Plan (LMP), in compliance with the World Bank's Environmental and Social Standard ESS2 on Labor and Working Conditions
- The mitigations will be further assured by a program of environmental and social monitoring conducted

during construction and operation to ensure that all measures are implemented, and to determine whether the environmental and social conditions has stipulated or protected. This will include observations on- and off- site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported by the contractor to the MPWD.

- The ESMP shall be included in the bidding document along with appropriate contractual clauses for safeguarding the environment and social impacts during the project construction and operation (maintenance period).
- An overall project level and also construction stage level Grievance Redress Mechanism (GRM) will be formed to receive, feedback, suggestions and complaints, if any, from affected parties and addressing them during the construction stage and operation stage.
- The prepared ESMP will assist the Contractor and MPWD in mitigating the Environmental and Social impacts and guide them in the environmentally sound execution of the proposed project.

A copy of the updated ESMP shall be always kept on-site during the construction period. As per the World Bank policy requirements, the prepared safeguard documents shall be disclosed in the World Bank website.

During the field survey, as well as consultations with the Detailed Project Report (DPR) team and the Public Works Department (PWD), several key issues were identified. For each observation, appropriate mitigation measures have been proposed to minimize adverse impacts and ensure smooth project implementation.

The ESIA observations have been fully integrated into the final design through targeted engineering and social compliance measures across twelve critical locations. Slope stabilization, stream protection, and river training works are strategically deployed to counter active soil instability and riverbank erosion at chainages 19+150 to 19+700, 19+700 to 19+740 (LHS), and from 23+960 to 24+150 (LHS). Conversely, the section at chainage 19+500 requires no structural intervention due to its stable, elevated hilltop topography.

Structural protection against scouring and approach embankment erosion is guaranteed through specific masonry works at key drainage junctions. These include the installation of floor aprons and quadrant pitching at culvert chainage 22+213, stream protection and embankment approach repairs at minor bridge chainage 22+843, and combined structural protection with approach repairs at minor bridge chainage 24+375.

Road safety and asset preservation are addressed through alignment modifications and junction improvements. Sight distances are enhanced and structural damage to an adjoining building is avoided via geometric curve improvement at chainage 26+450 (RHS), while traffic movement and pedestrian safety are streamlined through traffic islands integrated into the junction design plan at chainage 26+770 / 27+600.

Social requests gathered during consultations are addressed through community infrastructure enhancements. Public water access is improved by constructing a spring water collection tank at chainage 20+200 (LHS), and student safety at the Sarva Shiksha Abhiyan school is secured by building a dedicated boundary wall from chainage 22+740 to 22+810 (LHS).

## 10.2 RECOMMENDATIONS

- The Contractor shall prepare a site-specific contractor's Environmental and Social Management Plan called as C-ESMP based on final design and identifications of locations of construction camps, quarries etc. within one month from the date of entering into the contract.
- MPWD shall conduct regular stakeholder consultations including local residents, village councils, and public representatives, and maintain records of each consultation and meeting. These consultations are to be carried out during the pre-construction and construction phases to ensure stakeholder concerns are addressed and documented.

- MPWD shall organize training for the capacity development of concerned staff of ESMU/PMC and district level MPWD engineers on ESHS policies, regulations, implementation, monitoring and reporting about the ESMP implementation before construction activities.
- Contractors will engage qualified and experienced ES&HS Staff for ESMP implementation as well as to ensure imparting induction, work-specific and other required trainings to the workers;
- MPWD shall ensure implementation of the Resettlement Action Plan (RAP) and provide compensation and assistance to Project Affected Households (PAHs) in accordance with RAP provisions.
- Contractor/ MPWD to ensure the compliance of applicable laws at state/national level and relevant policies and best practices.
- The shifting of public utilities will be planned in coordinated in advance to maintain supply of electricity and telephone services to people without or minimum disruptions, with prior intimation through Media, newspaper and other mode of communication.
- MPWD to monitor the ESMP implementation, RAP implementation and redress of grievances on a regular basis
- The contractor to ensure safe access and mobility for vulnerable people such as elderly persons, children, and people with disabilities during the construction stage.
- The project shall implement the Labour Management Plan (LMP) and Occupational Health and Safety (OHS) Plan to ensure safe working conditions.
- The SEA/SH Prevention and Response Action Plan shall be implemented during construction, including worker training, code of conduct enforcement, and survivor-sensitive grievance handling.
- The Grievance Redress Mechanism (GRM) shall remain functional throughout construction and operation phases.