E4439 V5

GOVERNMENT OF MIZORAM

PUBLIC WORKS DEPARTMENT

WIDENING TO 2-LANE, RE-ALIGNMENT AND GEOMETRIC IMPROVEMENT OF CHAMPHAI-ZOKHAWTHAR ROAD

(00.000 KM to 27.247 KM) WITHIN MIZORAM STATE ROADS PROJECT II

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

11th February 2014

STUP Consultants Pvt Ltd.

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CHAPTER -1 INTRODUCTION

1.1 Background: Mizoram State Road Project II

The "seven sisters" of North eastern India are landlocked states and lag significantly behind the rest of India in terms of income and human development indicators. The State of Mizoram, bordering Bangladesh and Myanmar, is among the poorest states in India. Recognizing the need to share prosperity and promote growth in lagging states, the Government of India in its 2012 budget speech, committed to significant investments in infrastructure development and trade promotion for lagging states, including the landlocked states of the Northeast. In this context, The Government of India has requested World Bank for financing rehabilitation, widening and strengthening of State Highways and District Roads which are managed by Public Works Department (PWD) in the State of Mizoram. The proposed improvements are expected to enhance the quality of service level. In line with this request, Mizoram State Roads Project – II (MSRP II) is proposed. The proposed roads under MSRP II are shown in **Figure 1.1.**

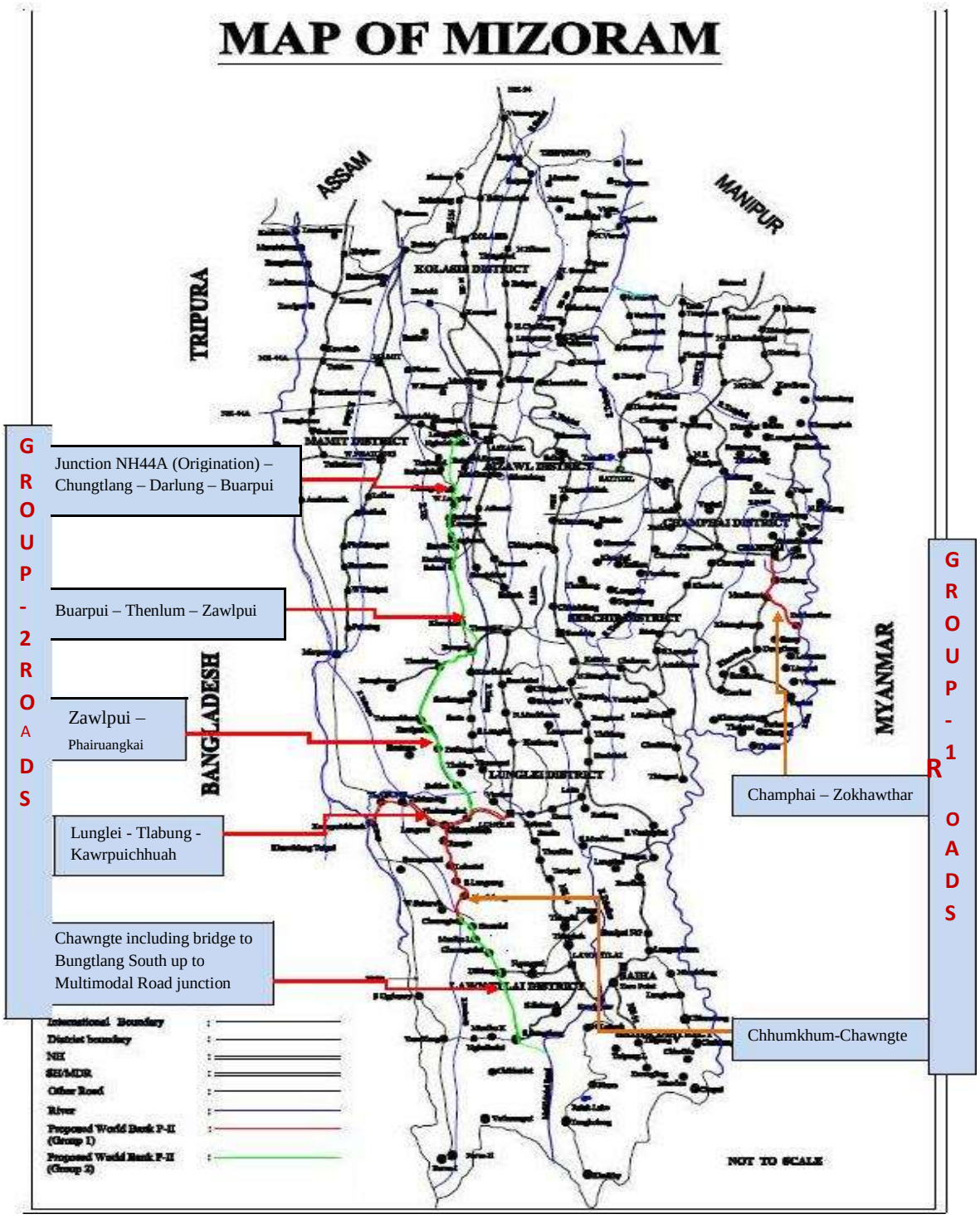


Figure 1-1 Map showing the proposed road under MSRP II

1.2 Project Objective, Location and Scope

The Mizoram State Roads Project II (MSRP-II) key objective is to improve existing road connectivity through rehabilitation, strengthening and widening efforts. Such an effort

would also lead to incidental benefits of improving the quality of existing connectivity to Bangladesh and Myanmar.

As part of the project preparation, about 69.03 km of existing road length, under Group 1 will be strengthened and upgraded, as they are already designed; and as part of project implementation, design additional 371.9 km of existing roads under Group 2 for upgradation. The proposed road corridors under Group 1 and 2 are given in the table 1.1 below and in **figure 1.1.**

Table 1.1 – Proposed Project Roads under MSRP II

Group -1		**District(s)**	**Length**
i.	Champhai – Zokhawthar	Champhai	27.5 km, (E-W road to Myanmar border)
ii	Chhumkhum-Chawngte	Lunglei	41.53 km, (part of original N-S road alignment)
Group – 2			
i.	Lunglei - Tlabung - Kawrpuichhuah	Lunglei	87.9 km, (E-W road to Bangladesh border)
ii.	Junction NH44A (Origination) – Chungtlang – Darlung – Buarpui	Mamit&Lunglei	83 km
iii.	Buarpui – Thenlum – Zawlpui	Lunglei	95 km
iv	Chawngte including bridge to BungtlangSouth up to Multimodal Road junction	Lawngtlai	76 km
v.	Zawlpui – Phairuangkai	Lunglei	30 km

The proposed road works involve widening and improvement of existing roads for which centre would be altered depending on the availability of Righ of Way (RoW). The Group-1 road alignments have been finalised, while Group-2 corridors are identified but

the feasibility of existing alignments for the proposed works would be assessed as part of project implementation activities.

1.3 Champhai –Zokhawthar Road (C-Z Road)

The existing 28.0 Km long *Champhai –Zokhawthar* Road (C-Z Road) is one of the roads proposed under the MSRP II. The Mizoram Public Works Department has decided to upgrade the *Champhai –Zokhawthar* road to 2-Lane National Highway Standard. The proposed alignment will branch off from *Khankawn* village i.e. Km 150.0 of *Seling to Champhai* Road and then running towards in the East to West direction. The designed length of the road is 27.247 km including spur road of 2.53 KM length. The *Champhai – Zokhawthar* Road passes through villages viz; *Khankawn, Zotlang, Ruantlang, Mualkawi, Melbuk & Zokhawthar*. A number of villages like

Ruantlang, New Hruaikawn, Tlangsam, etc are located nearby which are heavily depending on this road. This road is important lifeline for the people in the North-Eastern belt of Mizoram. At several locations, the road alignment passes through or near prime agricultural land, forest plantation**,** habitation etc. Map showing *Champhai – Zokhawthar* road is given in Fig 1-2.

1.3.1 The Objective of *Champhai –Zokhawthar* Road improvement

The Objective of *Champhai –Zokhawthar* Road improvement is to improve the

Champhai –Zokhawthar Road from single lane standard to 2-Lane National Highway Standard, re-alignment and geometric improvement to provide connectivity with the North Eastern belt of Mizoram. A number of villages like *Ruantlang, New Hruaikawn, Tlangsam etc.* are located in the area adjoining to this road. *Champhai*, the District Headquarter, is one of the most important commercial centers in Mizoram. It is also the seat of several State Government Department offices. Large quantities of fruits and vegetables are produced annually in the road surrounding areas. The existing road, in spite of the poor condition, remains an important lifeline for the people in the North Eastern belt of Mizoram. Improvement of the *Champhai – Zokhawthar* Road is expected to contribute in improving connectivity / accessibility and facilitate trade and development in the area.

Assessment of social impacts, mitigations, and management are covered in a separate report (under R&IPDP).

Figure 1.2 Topo-sheet showing existing and proposed *Champhai –Zokhawthar* Road

1.3.3 Requirement, basis and objective of Environmental Impact Assessment (EA)

Overall, MSRP II has been categorized as environmental category "A" as per World Bank Policy. For category "A" projects a detailed EA report need to be prepared along with an Environment Management Plan. Government of India (GOI), Ministry of Environment and Forest (MoEF) EIA Notification on Environmental Clearances (September 14, 2006) –also indicate the requirement of a detailed EIA and Environmental Management Plan (EMP) for Environment Clearance for Category A and B projects[1]. The EIA report has been prepared in order to meet the requirements of the World Bank Policies as well as the EIA notification GOI, MoEF.

1.3.3.1 The objectives of the EIA study are to:

- Study in baseline conditions (physical, social and environmental) along the identified corridors and influence area of *Champhai –Zokhawthar* Road
- Carry out environmental analysis with respect to proposed *Champhai –Zokhawthar* Road components vis-à-vis existing condition; identify environmental impacts that may be expected to occur during construction and operation; and identify environmental issue/problem that require further studies (if relevant).
- Carry out alternative analysis including comparison with "no project' scenario (with and without project comparison).
- Assess Environmental Impacts of the proposed project components on natural, physical and socio economic environments
- Develop cost-effective and implementable measures for mitigation of adverse environmental impacts and enhancement of positive aspects
- Develop a practical and implementable Environmental Management Plan (EMP) for mitigation of impacts and monitoring of implementation of mitigation measures during construction and operation stages.

[1] Category A project is cleared by the Expert Appraisal Committee or EAC constituted by MOEF and Category B by State Environmental Impact Assessment Authority (SEIAA) constituted by MOEF at State level.

- Consult and inform the project affected parties and other stakeholders, and ensure their active participation
- Advise decision-makers on the environmental issues/ implications, mitigations and implementation of the project

1.4 Structure of the Completed EIA Report

The report is organized the following:

Chapter 2 Project Description gives salient features such as standards, cross sections, realignments, pavement details and proposed design features, etc.

Chapter 3 discusses the **Environmental legislation and Policy** within which the project is set. The chapter presents the clearance requirements at various levels and their current status.

Chapter 4 details out the **Methodology** adopted for the Environmental Impact Assessment.

Chapter 5 describes the **Baseline Environmental Scenario** (baseline) of the existing environment along the project corridor and its area of influence.

Chapter 6 gives an overview of the **Community Consultation** carried out during the project preparation stage.

Chapter 7Analyses the Alternatives considered during the project design.

Chapter 8 Assessment of Impacts identifies and assesses potential environmental impacts of the C-C Road and activity.

Chapter 9 entitled **Avoidance and Enhancement Measures** describes mitigations and enhancement measures based on the findings of the impact assessment (chapter 8).

Chapter 10 describes **Implementation Arrangements**.

1.5 Proponent and EIA Consultant Proponent

Public Works Department (PWD) of the Government of Mizoram is the proponent of the C-C Road. The Project Implementation Unit (PIU) within the PWD will be the implementing agency for the MRSP II including *Champhai –Zokhawthar* Road. The PIU is located in the capital of Mizoram State, Aizawl. The detailed address of the proponent is given below.

Project Director , Project Implementation Unit,
Chief Engineer Road's Office, Tuikhuah Tlang

Mizoram:Aizawl , Tel: 0389 -2324001;Fax: 0389-2321524
e- mail: piupwd@gmail.com, piupwd@yahoo.com

EIA Consultant

STUP Consultants Pvt. Ltd is assigned as a consultant by PWD to carry out the EIA study as per the requirements of the World Bank Policies and Government of India requirements. The address of the consulting firm is:

STUP Consultants Pvt. Ltd

P-11, Darga road, Park Circus, Kolkotta700017
Tel.- 033 – 40109797, 2280 7430, 22807431
E-mail: kolkata@stupmail.com
Website: www.stupco.com

CHAPTER 2 - PROJECT DESCRIPTION

2.1 Champhai -Zokhawthar Road

Champhai -Zokhawthar Road (Champhai -Zokhawthar Road) is presently single laneroad. The *Champhai -Zokhawthar* road is one of the important roads in the Northern Mizoram. The proposed alignment will branch off from *Khankawn* village i.e. Km 146.0 of *Seling to Champhai* Road and then running towards in the E-W direction. (Figure 2.1). The road passes through a number of villages like *Khankawn* (Starting point), *Zotlang* (3.13 KM – 4.79 KM), *Mualkawi* (8.00 – 9.00 KM), *Melbuk* (16.90 KM – 19.40 KM), *Zokhawthar* (23.700 KM – 24.600 KM). village location on proposed road is shown in figure 2.2. A number of villages like *Ruantlang, New Hruaikawn, Tlangsam etc.*are located in the area adjoining to this road. *Champhai*, the District Headquarter, is one of the most important commercial centre in Mizoram. It is also the seat of several state Government Department offices. Large quantities of fruits and vegetables are produced annually in the road surrounding areas. The existing road, in spite of the poor condition, remains an important lifeline for the people in the North Eastern belt of Mizoram. Scale of impacted area, categorized as 0-5 M cut height –Mild, 5-10 M cut height-moderate and above 10 M cut height as severe, is shown in figure 2.3. As seen from figure 2.3, 17% of the total length has a cut height of more than 10m, 26% of the total length has a cut height in between 5m to 10m and 57% of the total length has a cut height less than 5m. A strip map showing important environmental features within 5 Km area as buffer influence zone and 200m as core influence zone of the proposed alignment are shown in Figure 2.3(A).

2.2 Alignment

The *Champhai -Zokhawthar* Road passes through steep and mountainous terrain. Existing length of the road is 28.0 KM. After improvement, road length will be 27.717 km including spur road of 2.53 KM. To avoid costly land acquisition and serious resettlement problems, and prime agricultural land, the existing alignment was diverted at the starting point which is located at the outskirt of Champhai town.

The proposed alignment also realigned at the existing road from Km 7/64 to Km 9/20 and Km 17/05 to Km 24/30 to bye-pass the habitant and heavily built-up areas of the villages

viz, Mualkawi, Melbuk & Zokhawthar to lessen land acquisition cost as well as resettlement problems. The second and third re-alignments pass through a better topographical profile and also reduces the distance between Champhai and Zokhawthar village by 2.5 KM. The reduced length would be greatly benefit in terms of vehicle operating cost and travel time. The proposed improvement in the C-Z Road (00.00 Km to 24.717 Km) is divided into following four segments.

Segment I (0 – 5.0KM): Most of the stretches in this segment are cultivated land. Therefore embankment will be required to achieve the required formation width & formation level.

Segment II (5.00KM – 17.00KM): This segment has steep terrain & is exposed to highly weathered rocky portion. Blasting will be required to widen the existing road except at diversion from Ch 7+760 to Ch9+150.

Segment III (17.00 – 21.50 KM): This segment is also steep with highlyweathered rock.. Therefore, blasting will be required to widen the existing road to obtain the formation width, except at diversion.

Segment IV (21.5 - 24.717 KM): In this segment the general topography is plain and rolling terrain & most of the stretches passing through the cultivated land. Therefore embankment will be required to achieve the required formation with & formation level.

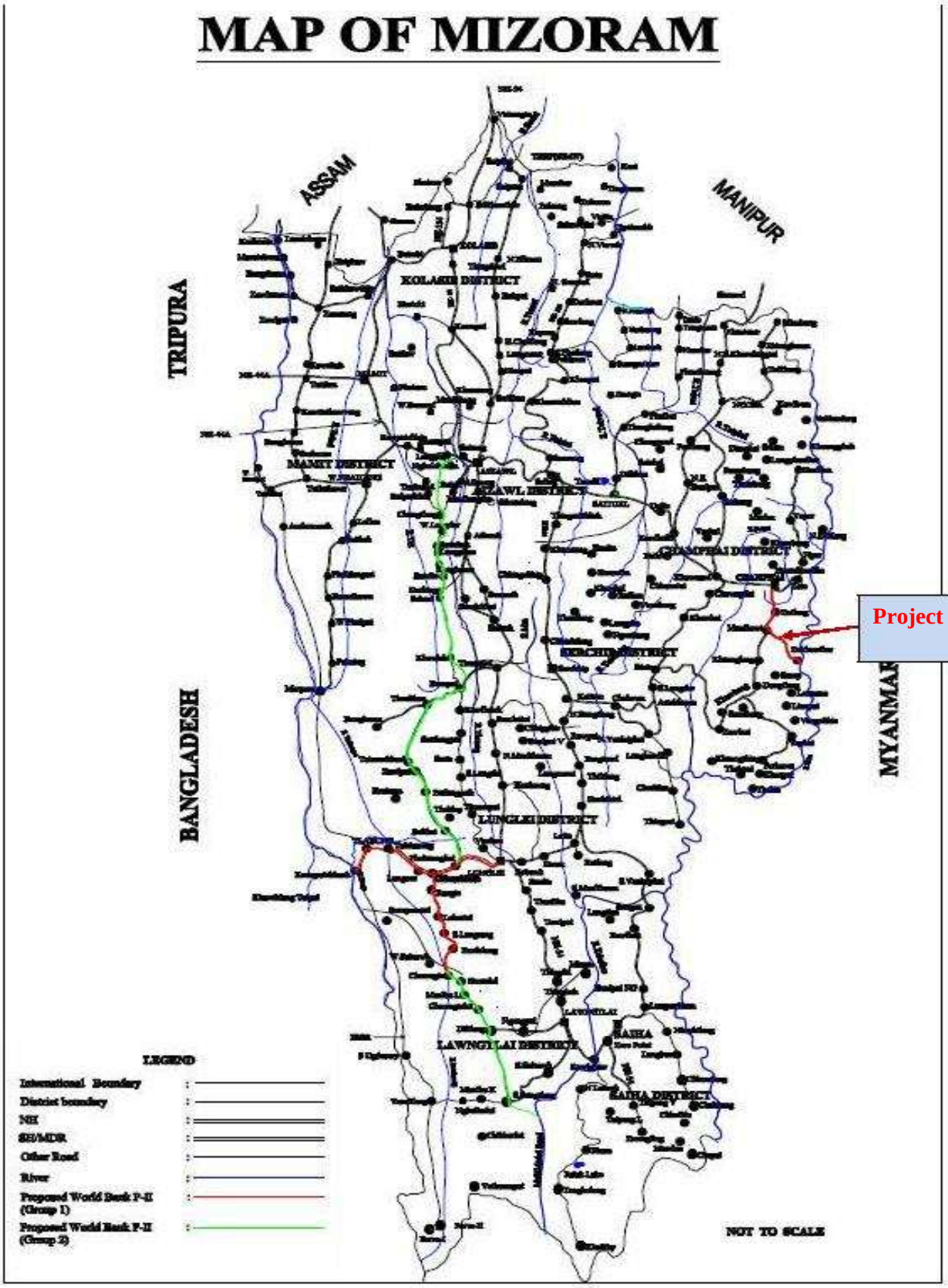


Figure 2.1 Location of Champhai – Zokhawthar road in Mizoram

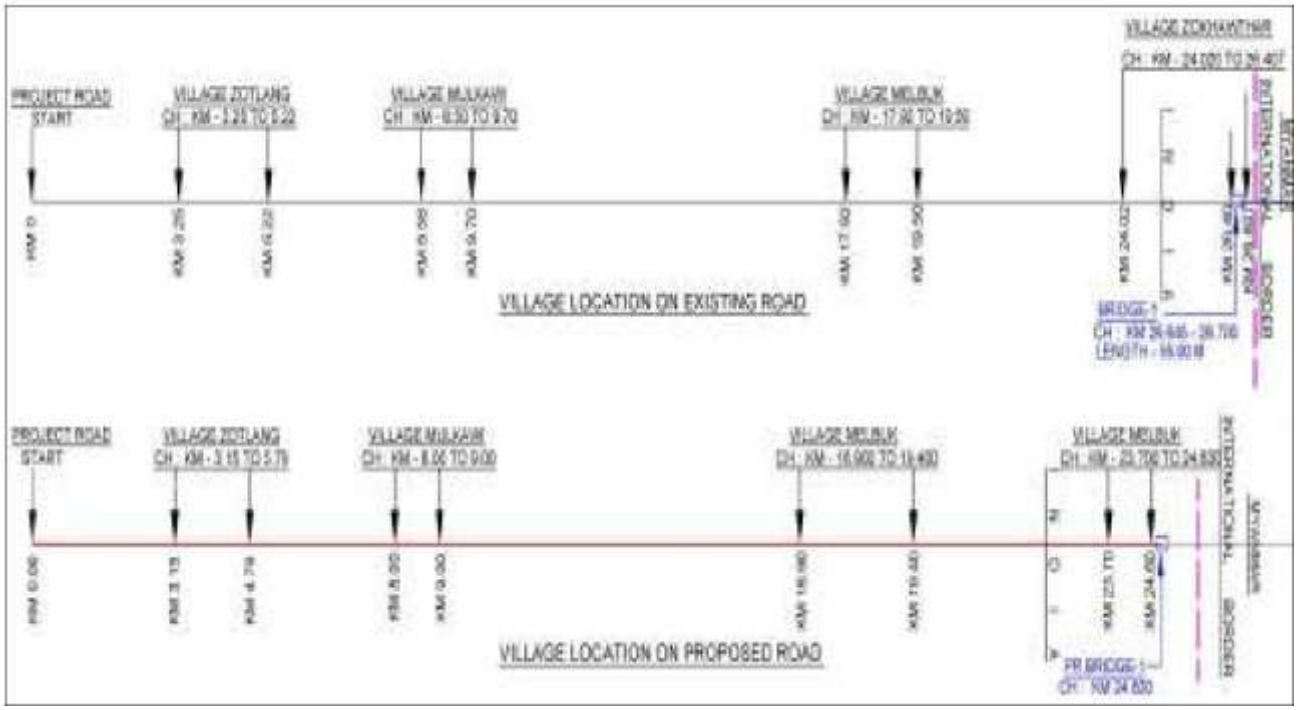


Figure 2.2 Village locations along the proposed road.

Figure 2.3 Scale of impacted area

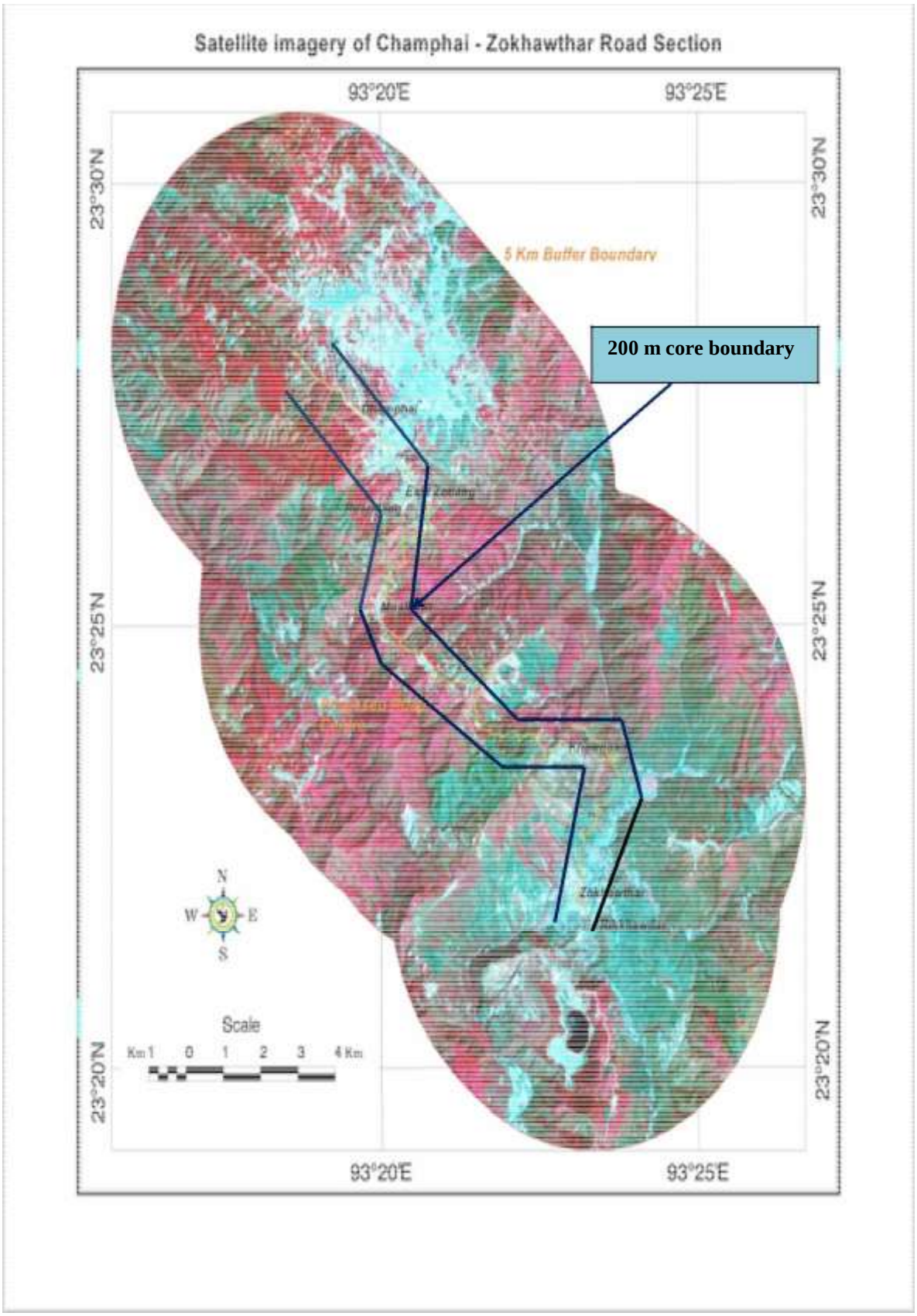


Fig 2.3 (A) C-Z road map with Project influence Area and core influence zone

2.2.1 Re-alignment: In order to avoid adverse impacts on the settlements, new construction/ re-alignments have been proposed in few sections, particularly in the sections where there are roadside settlements along the existing. About 11.99 KM will be re-aligned to avoid the acquisition of houses in the linear settlements along the road. Following are the re-alignment portion:

First realignment. Re-alignment of the existing initial stretch of the Champhai – Zokhawthar road between km 0/00 – 3/00 by shifting the existing take- off point at km 150/00 to a proposed new take-off point at km 146/00 (i.e. located at outskirt of Champhai town) on Seling – Champhai road (refer map 2.3).

Second realignment. It is diversion of Mualkawi village from Km 7+640 to Km 9+200 (refer map 2.4).

Third realignment (Km 17+050 to Km 24+300). The proposed alignment also realigned at the existing road from Km 17+050 to Km 24+300 to bypass the habitant and heavily built-up areas of the villages Melbuk & Zokhawthar (refer map 2.5).

Realignment is proposed due to the following: To reduce the cost of the land acquisition, to achieve 2-Lane National Highway Standard, to avoid Sharp Zigs, to achieve ruling gradient

Map showing 1^{st}, 2^{nd} and 3^{rd} re-alignment portion are shown in **Figure 2.4, 2.5 and 2.6** respectively.

Figure 2.4 Map showing 1st Re-alignment (0.00 – 3.00 KM)

Figure 2.5 Map showing 2nd Re-alignment (Km 7+640 to Km 9+200)

Figure 2.6 Map showing 3rd Re-alignment ((Km 17+050 to Km 24+300)

2.3 Width and gradient

2.3.1 Width

A lower standard road, typically about 5 - 5.2 m wide, (categorized by PWD as other district road – MDR) already exist. This will be improved to two-lane highway standard (roadway width of 12 m – comprising 2-lane carriageway width of 7m and shoulders of 2.5 m on either side of the carriageway). Drawing details of formation cutting and pavement design is shown in **Figure 2.7 and 2.8** respectively. Upgrading of the proposed road will be undertaken mostly on hill side (approximately 15 m from the centreline on the hill side and 9 m on valley side.

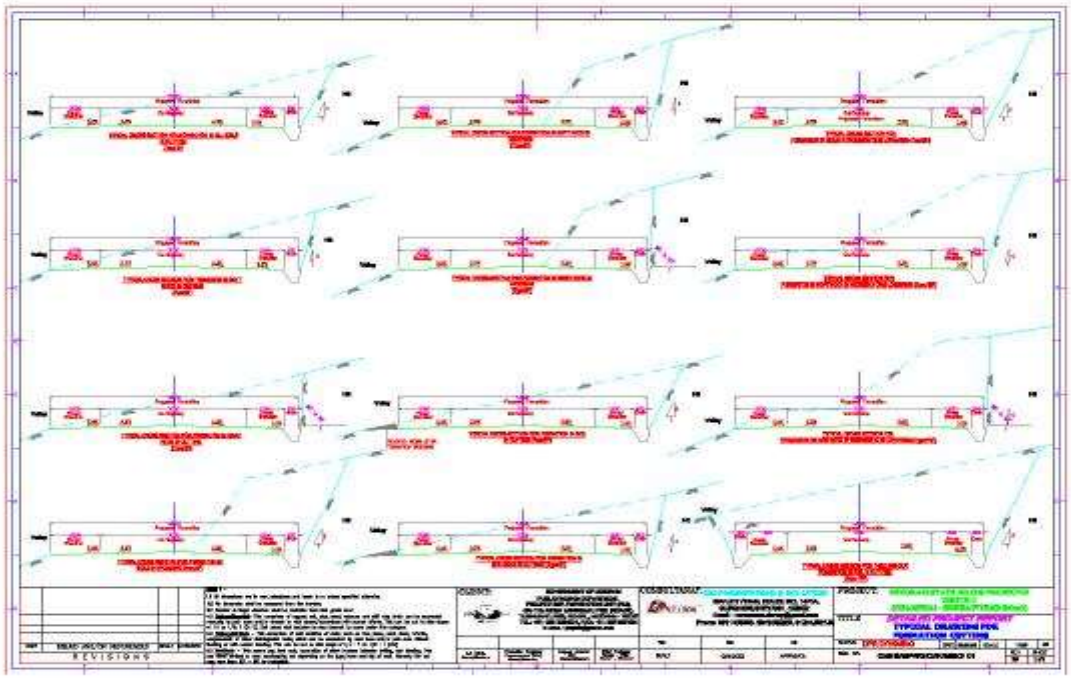


Figure 2.7 Typical cross section of formation cutting

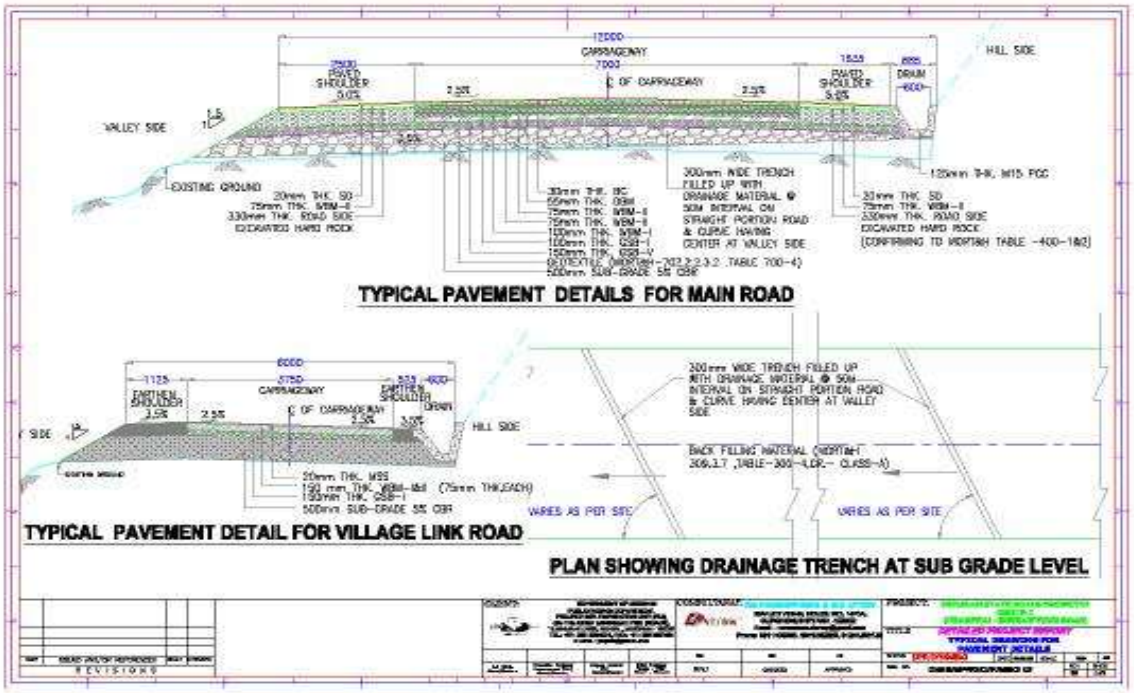


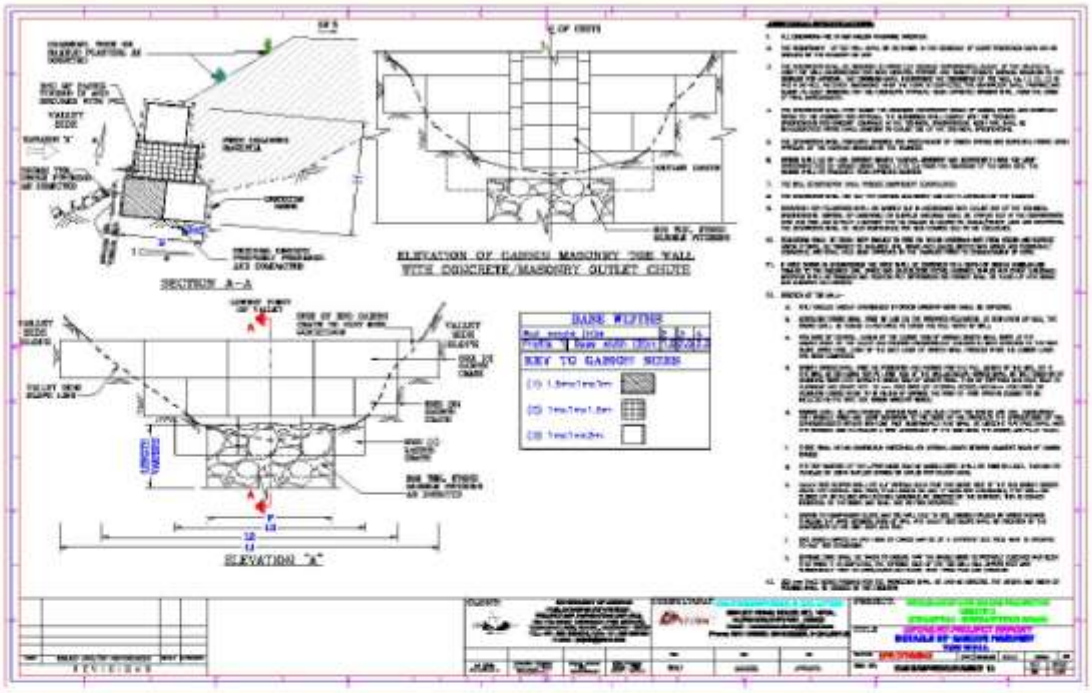
Figure 2.8 Typical cross section of Pavement design.

2.3.2 Gradient

Highway will require gentler gradient. Hence, improvement also includes gradient improvement. The project will maintain a ruling gradient of less than 5.0% with the maximum gradient being 7.2% at few selected stretch. Road geometry, pavement composition and shoulder design is given in **Annexure 2.1**.

2.4 Culverts and drains.

The road crosses several rivulets, small streams, depressions where cross drainages structures are required. Road's technical report estimates 112 pipe culverts and 35 box culverts. There is 1 minor bridge (along the spur road), roadside drains, altogether about 32.22 km, will be constructed. Outfalls of the roadside drains are located at several points along the road, many roadside drains discharge into the natural water channel/stream. Typical drawing details of road side drains, pipe and box culverts are shown in **Figure 2.9, 2.10, 2.11** respectively**. Detail drainage write-up is given in annexure 2.2.**



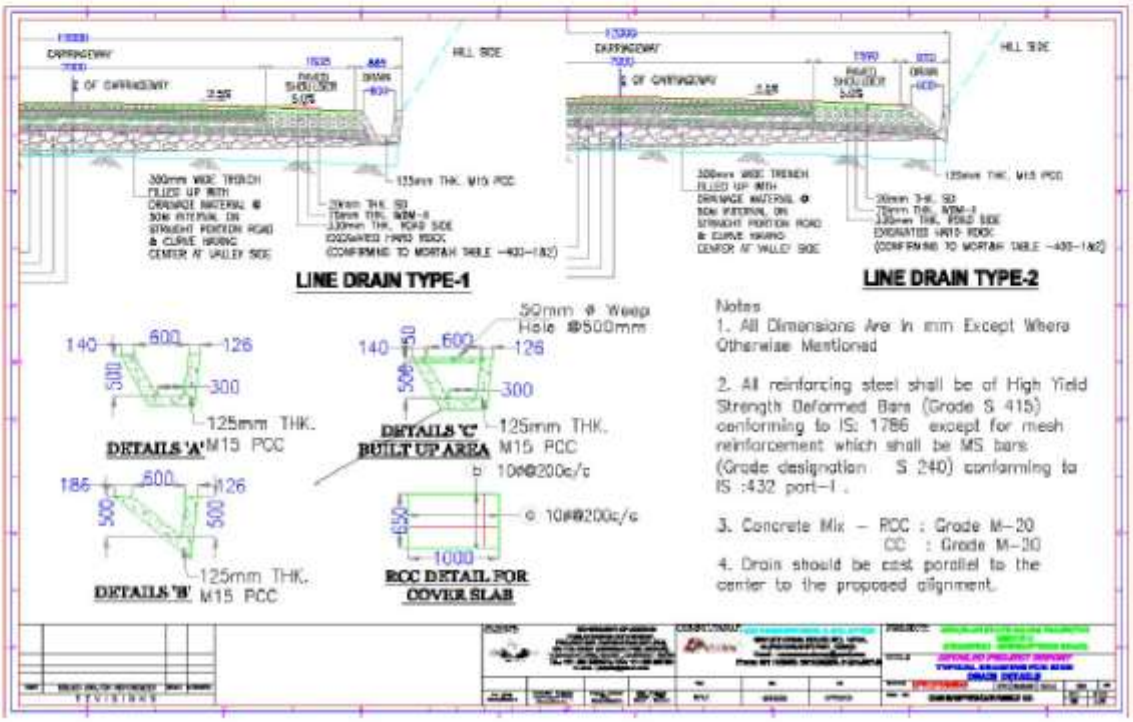


Figure 2.9 side drain detail drawing.

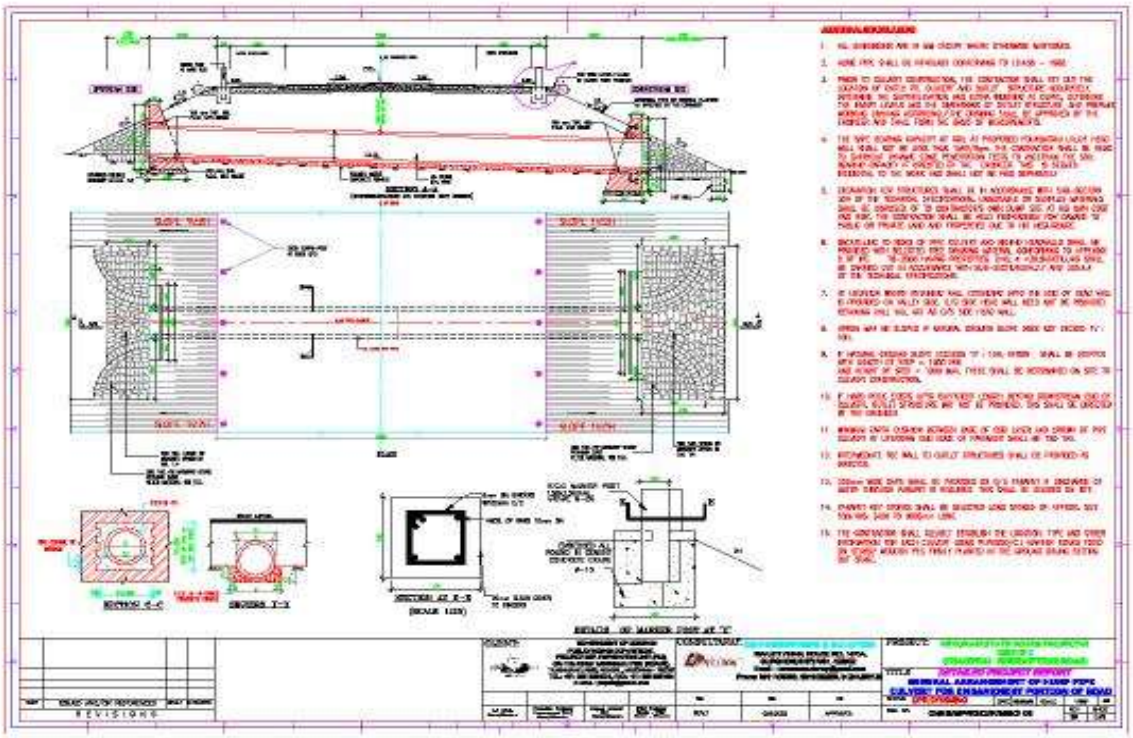


Figure 2.10 Pipe culvert detail drawing

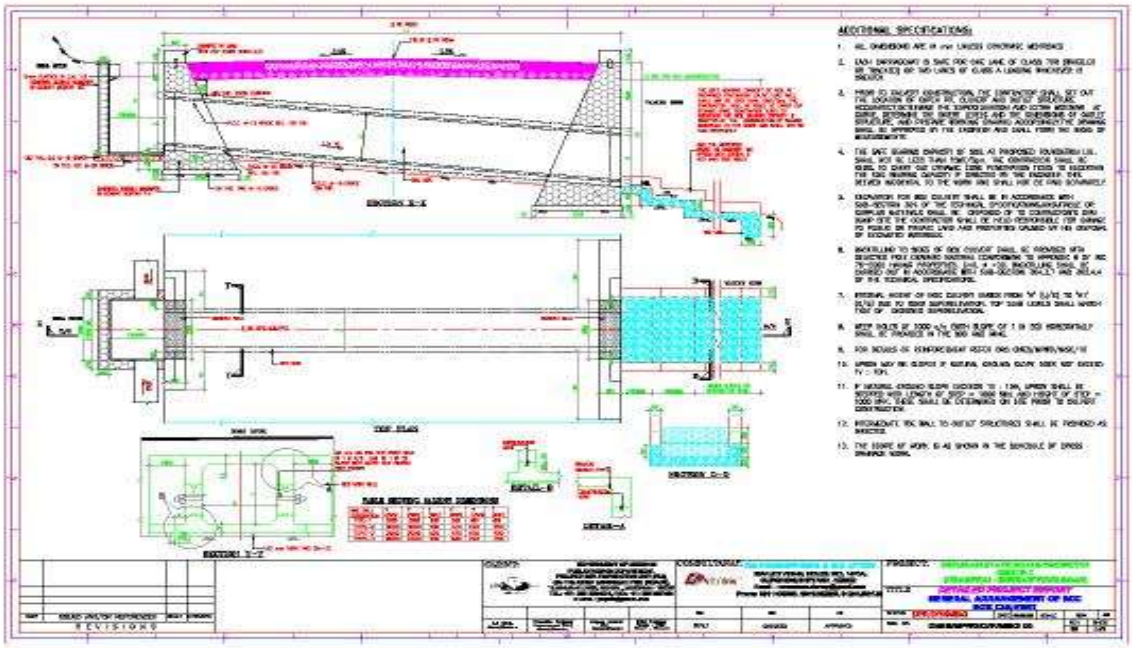


Figure 2.11 Box culvert detail drawing.

2.5 Junction improvement.

Eight Junctions along the proposed alignment are proposed for improvement. Junctions' improvement like widening, black topping and grade improvement has been proposed. A typical drawing for junction improvement is shown in **Figure2.12.**

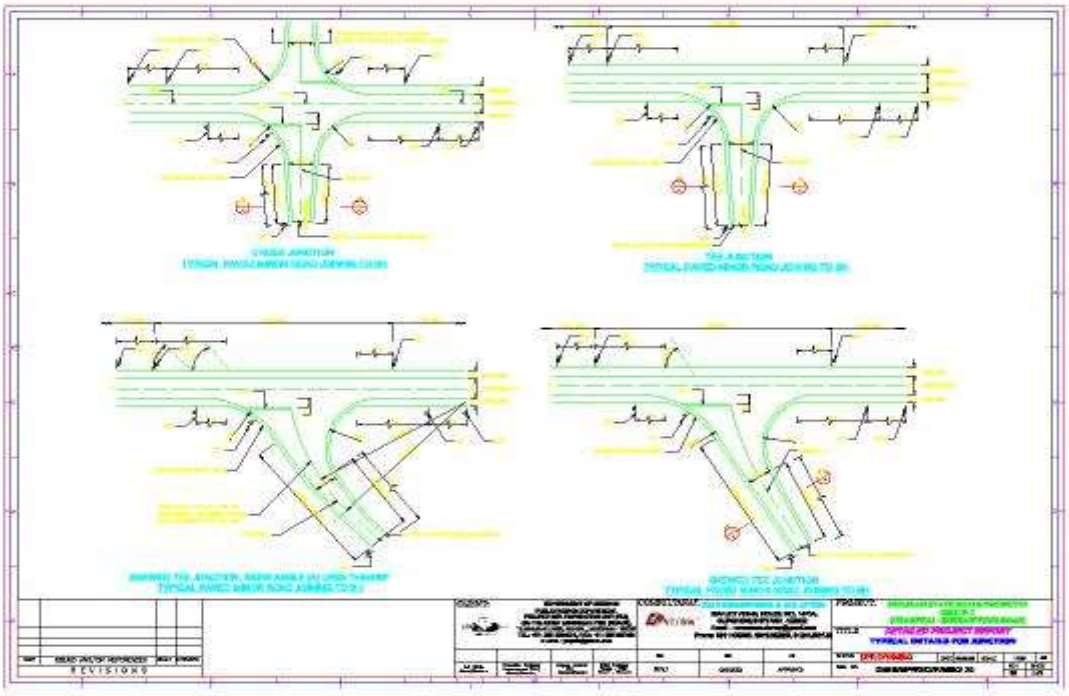


Figure 2.12 Junction detail drawing

2.6 Slope protection works.

The proposed slope protection works at various locations include retaining walls (about 1.31km, 3 to 6 m high), breast wall (about 1.14 km, 2 to 3 m high), gabion-wall (about 43.12 km, 2 to 3 m high), and toe wall (about 1.26 km, 2 to 3 m high). Typical design of slope protection works are shown in **Figure 2.13to 2.16.**

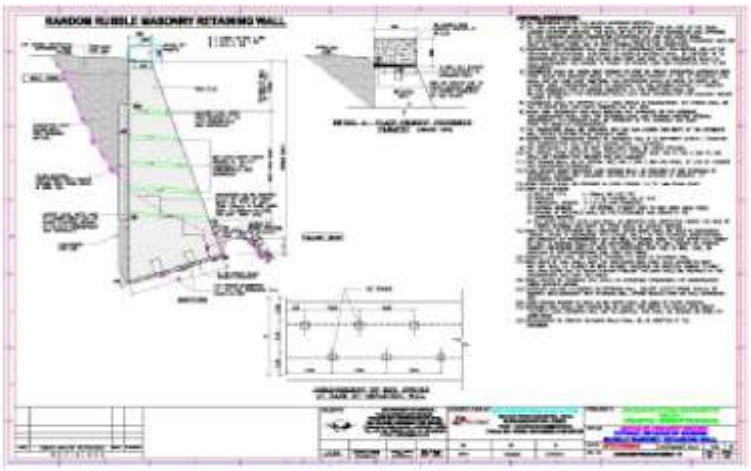


Figure 2.13 Retaining wall typical drawing.

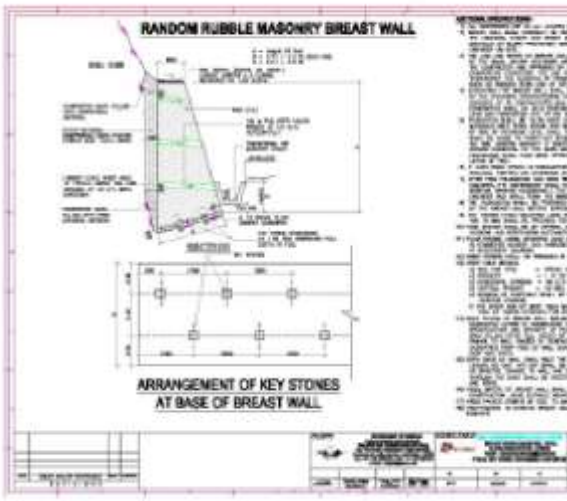


Figure 2.14 Breast wall typical dra

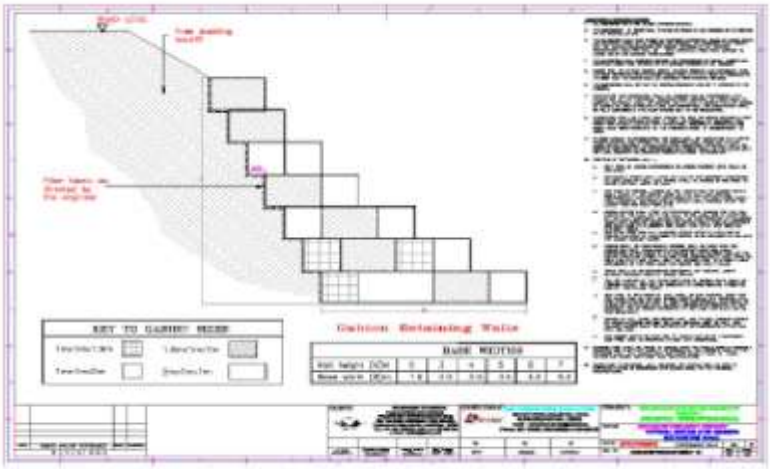


Figure 2.15 Gabion wall typical drawing.

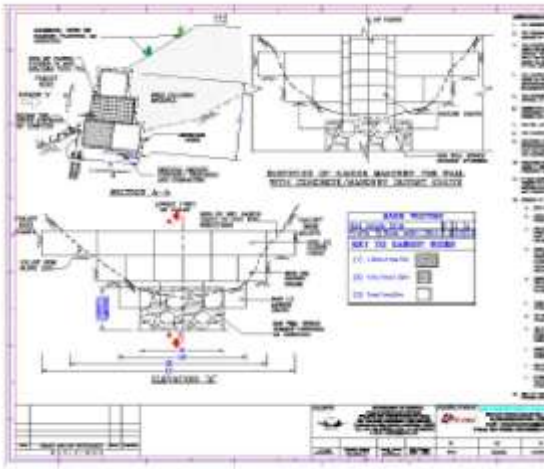


Figure 2.16 Toe wall typical drawi

2.7 Other improvement works

Road and traffic sign, markings and furniture: The proposed improvement includes provisions of mandatory / regulatory signs, cautionary / warning signs, and information signs as well as traffic safety posts and parapet walls.

Roadside Amenities: The proposal also includes provision of- one (1) public toilet, five (5) public urinals, five (5) bus-shed, and five (5) Bazar-shed.

Road stretches crossing towns and villages will be provided with covered drains, sidewalks and parking. It is expected that most of the construction works will take place within approximately 15 m from the centerline on the hill side and 9 m on valley side. Detail location of road side amenities is shown below:

Table 2-1 Location of road side amenities

Sr.No.	Description	Nos.	Location
1	Public Toilet	1	Ch 0.00
2	Public Urinal	5	Ch4120, Ch4950, Ch10580, Ch11800 & Ch12800
3	Bus Shed	5	Ch9000, Ch10580, Ch11800, Ch12800 & Ch.19700,
4	Bazar Shed	5	Ch 0.00,Ch 3250,Ch 7460,Ch Ch 16920 & Ch 24370

2.8 Traffic diversion during construction

Traffic diversions are necessary from the existing road in the following stretches during construction:

- Design Chainage 7.500 – 7.800
- Design Chainage 9.100 – 9.250
- Design Chainage 16.900 – 17.150
- Design Chainage 24.200-24.700

2.9 Blasting

Geological and geo- technical investigation indicate the fact that during widening of the road proposed road alignment will pass through hard rock area from Km 7+050 to Km 7+150, Km 7+300 to Km 7+600, Km 10+100 to Km 10+740, Km 11+ 430 to Km 11+50, Km 12+800 to Km 13+200, Km 15+450 to Km 16+200, Km 18+500 to Km 19+000,Km 20+550 to Km 21+2400, Km 22+900 to Km 23+400. To widen the road in this stretch need blasting.

Provision will be made in the contract that all blasting will be controlled blasting and Environment Health and Safety Guideline provided in the EMP will be implemented.

2.10 Cutting and excavation

Widening and other improvement works requires cutting of slopes and excavations. Length of cut slope varies from **0.65 m to 22.7 m**. About 77.74% of the work goes to cutting of hill and 22.25 % are embankment. It has been estimated that about 2.62 million M^3 of spoil will be generated due to cutting. Out of 2.62 million m^3, 257060M^3 i.e. 9.8% will be disposed at the proposed disposal sites, 213979m^3 i.e. 8.18% for embankment, 43083m^3 i.e.1.64% for sub-grade preparation and 70458 M^3 at football playgrounds for construction/renovation by dumping the earth debris. Typical drawing of earth cutting is shown in **Figure 2.17.**

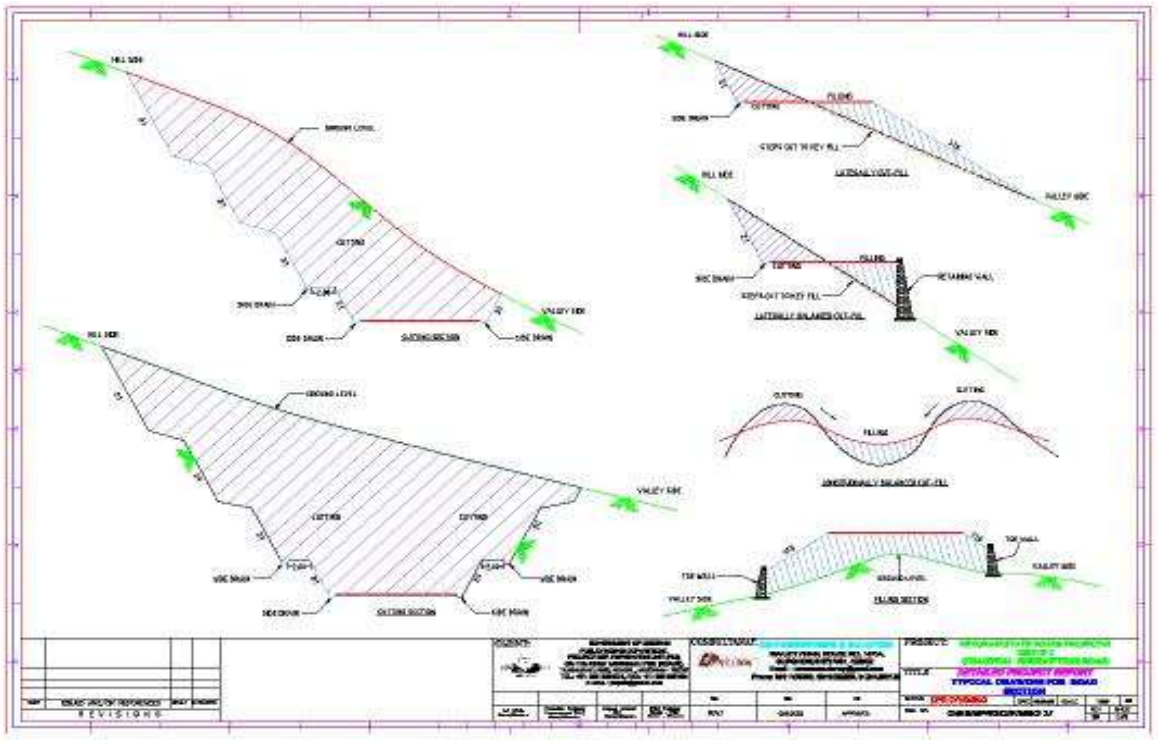


Figure 2.17 Typical drawing of earth cutting

2.11 Construction materials and construction equipment

2.11.1 Local construction material

Sand, gravel, cobbles, pebbles, and rocks will be obtained from local places including from local rivers or streams. The amount locally available construction materials needed for the proposed improvements are estimated as follows;

- Sand: 7480 m^3
- Aggregates (Pebble/cobbles/ rocks): 182868 cu.m

2.11.2 Quarry

Construction materials for GSB, WMM, DBM ,BC, Cross drainage & Masonry R/Wall etc. works, will be available at Patea (Champhai), Pa Zualtea (Zotlang) , Zarzoliana , Tuichang, C.Malsawma Khawzawl quarry and from the nearby rivers/ streams.

2.11.3 Crushing: Crushing of GSB materials will be done with Stone Crushers.

2.11.4 Bitumen, Cement, Aggregate, sand, hume pipe and Steel

Quantity of bitumen, aggregates, sand, cement, steel and hume pipe needed in the proposed works are estimated as follows:

- Bitumen: 2115 Mt
- Cement: 337.25 Mt
- Steel: 47.99 Mt
- Aggregate: 44775 Mt
- Sand: 2003 Mt
- Hume pipe: 56.24 Mt

Bitumen, cement, steel will be brought from outside the state (mostly from Assam).

2.11.5 Bitumen heating

Heating of bitumen shall be done by using Hot-mix Plant.

2.11.6 Construction Equipment

Heavy Machineries like Bull dozers, Excavators, Loaders, Air compressors, Vibratory / Static Road Rollers, Wet-mix plants, Electric generator sets, Motor Graders, Tractor–Rotavators, Hot/batch-mix plants, Paver-finishers, etc. as required for the execution of the work will be used for various construction works.

2.12 Constructor Workers and labour camps

The estimated number of labours skilled and unskilled labour during peak construction period is 150 and 400 respectively.

Labour camps may be established at *Zotlang, Mualkawi, melbuk, and New Hruaikawn. Villages*

2.13 Contractor's camp, stockpiling of materials, and garage & maintenance yard

As mentioned in section 2.12, the area and location of Contractor's camp, stockpiling of materials and garage with yard maintenance is given below:

Table 2.2 Area and location of proposed labourcamps

S.no.	Name of village for proposed camp site	Location from village/proposed alignment	Area	Remarks made by the PIU Team
1	*Zotlang*	1.2 Km from 3.6 Km chainage of the alignment..	***2 Ha.***	The proposed camp site is quite appropriate as the site is neither too far from the alignment nor the village. The site can hold not only for the contraction's camp but also stockpiling of construction materials and sufficient parking space. The water requirement for the camping may be harvested from the natural spring located in the vicinity of the camp site area
2	*Zokhawthar*	2.5 Km from Zokhawthar village.	***2.5 Ha***	The proposed camp site is quite appropriate as the site is neither too far from the alignment nor the village. The site can hold not only for the contraction's camp but also stockpiling of construction materials and sufficient parking space. Water requirement for the camp will be harvested from *Lunglohtui*, which is located at 0.7 Km from the camp site proposed.
3	*Mualkawi*	0.9 Km from the proposed alignment	***3 Ha***	Since it is located along the proposed alignment, the idle time for going to the work site may be considerably reduced. Water required can be obtained from *Dam Tuikhur* which is 0.8 Km from the camp site.
4	*Melbuk*	100m away from the proposed alignment.	***3.5 Ha***	Since it is located along the proposed alignment, the idle time for going to the work site may be considerably reduced. The water required for construction of road and labour camp will be harvested from the water point located at 16.900 Km which is 200 m from Melbuk village..

2.14 Land acquisition for the project

For widening of this road 47.54 ha of additional land will be required. This amount of land will be acquired for the project.

2.15 Project cost:

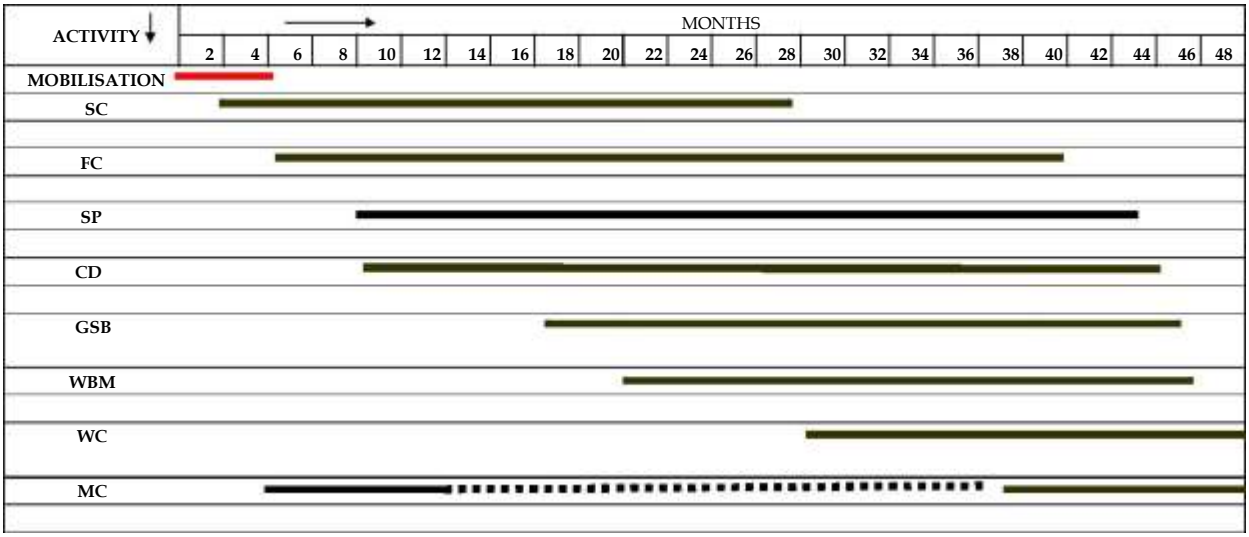
The total Project cost for Civil construction works and other allied charges is Rs. 183.40 crores and the details of cost breakup is given in the general abstract of cost in the DPR.

2.16 Construction schedule

The proposed construction schedule is as follows

IMPLEMENTATION SCHEDULE (ROADS)

From Date of Start



SC = Site Clearance
CD = Cross Drainage Work
FC = Formation Cutting
GSB = Granular Sub Base
BR = Bridge work
WMM = Wet Mix Macadam
WC = Wearing Coat
MC = Miscellaneous
SP = Slope protection work

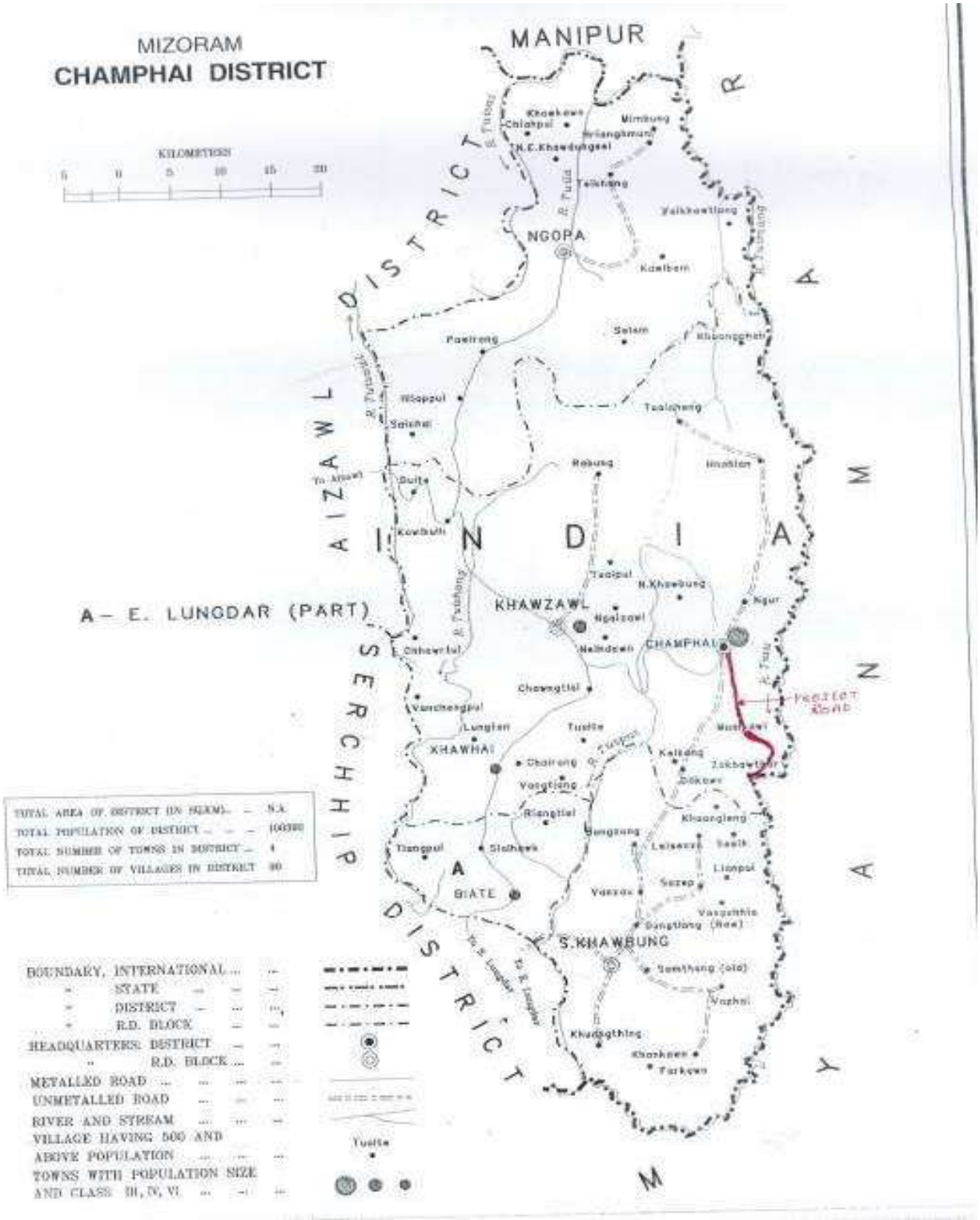


Figure 2.18: Position of the road in Champhai district

CHAPTER 3 - ENVIRONNEMENTAL LEGISLATION AND POLICIES

This section is provided as a reminder that all activities under the proposed project must be consistent with all applicable laws, regulations, notifications that are relevant in the context of the proposed project interventions. It is the responsibility of the various Project Implementing Entities to ensure that proposed activities are consistent with the regulatory/legal framework, whether national, state or municipal/local. Additionally, it is also to be ensured that activities are consistent with World Bank's operational policies and guidelines.

3.1 Implementation and Regulatory Agencies

The Mizoram Public Works Department (MPWD) is the nodal agency for project preparation and implementation of MSRP –II. Various other agencies are indirectly involved in regulation of activities under the project through statutes/laws governing them. The agencies involved, their role in the project is presented in the Table 3-1. The following table provides a summary of select applicable laws, rules and regulation which have a bearing on the proposed project.

Table 3-1 Environnemental Legislation Applicable to the Proposed ProjectRoad

Act	Year	Objective	Responsible Institution
Environment (Protection) Act.	1986	To protect and improve the overall environment	MoEF, CPCB
Notification on Environment Impact Assessment of Development projects (and amendments) (referred to as the Notification on Environmental Clearance)	2006 2009 2010 2013	To provide environmental clearance to new development activities following environmental impact assessment	MoEF,
Wildlife Protection Act	1972	To protect wild animals and birds through the creation of National Parks and Sanctuaries	MoEF
Water (Prevention and Control of Pollution) Act (and subsequent amendments)	1974	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	CPCB

Act	Year	Objective	Responsible Institution
Air (Prevention and Control of Pollution) Act (and subsequent amendments)	1981	To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes.	CPCB and Road Authorities
Forest (Conservation) Act	1980	To protect and manage forests	MoEF
Central Motor Vehicle Act Central Motor Vehicle Rules	1988 1989	To control vehicular air and noise pollution. To regulate development of the transport sector.	State Transport Department
Ancient Monuments and Archaeological Sites and Remains Act	1958	Conservation of Cultural and historical remains found in India.	Archaeological Dept. GOI and Govt. of Mizoram
The Land Acquisition Act	1894 & 1989	Set out rule for acquisition of land by Government.	Land and Revenue Dept.GOI
Noise Pollution (Regulation and Control) rules 2000	2001	Noise pollution regulation and controls	MOEF/CPCB
Ramsar Convention on Wetlands of International Importance	1971	Sustainable utilization of wetlands and conservation of wetlands	MOEF/SPCB/ state fishery dept.

3.2 Key Applicable State level Laws and Regulation

The state level legislation in the environment and Social sectors of relevance to the projects are –

Environmental conservation and protection.

- Assam Forest Regulation of 1891.
- The Mizoram (Forest) Act, 1955 (as passed by Mizo District Council).
- The Pawi Autonomous District Council (Forests) Act, 1979.
- The Lakher Autonomous District Council (Forests) Act, 1981.
- The Chakma Autonomous District Council (Forests) Act, 1992.
- Mizoram Wildlife (Protection) Rules, 1990.

Quarrying and Blasting

Mizoram Minor Minerals Concession Rules 2000

Land and Revenue Administration

- The Liushai Hill Districts (House Site) Act 1953;
- The Mizo District (Land & Revenue) Acts, 1956;
- The Mizo District (land & Revenue) Rules, 1967;
- The Mizo District (Agricultural Land) Act, 1963;
- The Mizo District (Agricultural Land) Rules, 1971, and;
- The Mizo District (Transfer of Land) Acts, 1963.

3.3 Key Statutory Clearance Requirements

3.3.1 GoI Requirements

Environment Clearance

EIA Notification on Environmental Clearances (September 14, 2006) -According to this, latest gazette[2] notification, there are two categories of projects via, Category A and Category B.

Category A project is cleared by the Ministry of Environment and forests at central level (Expert Appraisal Committee or EAC constituted by MOEF)) and the category B project will be cleared by the State Environmental Impact Assessment Authority (SEIAA) constituted by MOEF at State level.

As this project is a State Highway projects and State Highway expansion projects in hilly terrain above 1,000m MSL and within 10 km of international boarder, hence this will be categorised as Category A Project and require Environmental Clearance from Expert Appraisal Committee or EAC constituted by MOEF (*Sources: Gazette Notification, GOI dated 14th November1, 2009)*

[2] Refer EIA notification 2006 and its amendment in 2009 and 2013

3.3.1.2 Forest Clearance

As per Forest (Conservation) Act 1980- diversion of any amount of forest land for non-forest purpose and cutting of trees need prior clearance from State Forest Department and GOI forest department depending on the size of the land needed for diversion as given below

Forest area	**Forest clearance authority**
Forest area< 1 ha.	State PCCF
Forest area up to 5 ha.	State PCCF with approval from Regional MOEF office
Forest area 5 ha. to 40 ha.	Regional MOEF office
Forest area > 40 ha.	MOEF ,GOI

Only 230m of the alignment (Km 9+300 to 9+530) is passing through forest plantation area and about 0.28 ha of forest land need to be acquired for widening of the road. Hence, forest clearance from State PCCF office is needed.

3.3.1.3 Current Status of Clearance: The current status of Clearance for the proposed construction of C-Z road is:

Forest Clearance: Forest Clearance for diversion of 0.28 ha of Forest land for non-forest purpose for upgradation of C-Z road has been issued by Principal Chief Consevator of Forest on 22nd January 2014.

Environmental Clearance: For environmental clearance from MUEF is required for C-Z Road. For this purpose, Form-1 and TOR has been approved by MOEF and Sate Pollution Control Board according to which draft EIA and EMP has been prepared. On 17th January 2014, Mizoram Pollution Control Board organized public hearing at at Champhai on the findings of draft EIA and EMP of C-Z Road. The Mizoram Pollution Control Board, on 27th January 2014, has submitted Minutes of the public hearing meeting along with video and photographs to MOEF Government of India for processing environment clearance. PIU plans to submit the draft EIA and EMP to MOEF on 4 February 2014

3.3.2 Clearance during Construction Stage

During the construction stage, some of the key statutory requirements that need to be obtained by the Contractor as part of mobilization have been listed in the table given below.

Table 3.2 Key Statutory Clearances to be obtained by the Contractor

S.No.	Clearance Required for	Statute under which clearance is required	Statutory Authority
1	Hot mix plants, Crushers and Batch Mix Plants	Air (Prevention and Control of Pollution) Act, 1981 and Noise Pollution (Regulation and Control) Rules, 2000	State Pollution Control Board
2	Storage, handling and transport of hazardous materials	Hazardous Waste (Management and Handling) Rules, 1989 and Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	State Pollution Control Board
3	Location/ layout of workers camp, equipment and storage yards	Environment Protection Act, 1986 and Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	State Pollution Control Board
4	Quarries (in case of opening of new quarries)	Environment Protection Act, 1986	Dept. of Mining; Concerned District Administration
5	Discharges from Labor Camp	Water (Prevention and Control of Pollution) Act, 1974	State Pollution Control Board
6	Permission for withdrawal of groundwater for construction	Environment Protection Act, 1986	State Ground Water Board
7	Permission for sand mining from river bed	Environment Protection Act, 1986	Irrigation Department; Concerned District Administration
8	Disposal of bituminous wastes	Hazardous Waste (Management and Handling) Rules, 1989	As per state norm/ Local Civic Body

3.4 MORTH and IRC Specifications

The MORTH specifications have special provisions towards protection of environment under Clause 501, Annexure A and the contractor is to satisfy the provisions. Apart from the Annexure A to clause 501, there are provisions for control of erosion, drainage, dust suppression, borrow area and haul road management under relevant sections.

3.5 Other Applicable Laws and Technical Guidelines

The contractor will be required complying with following laws and guidelines of the land:

- Workmen's Compensation Act 1923
- Contract Labour (Regulation and Abolition) Act, 1970
- Minimum Wages Act, 1948
- Payment of Wages Act, 1936
- Equal Remuneration Act, 1979
- Child Labour (Prohibition and Regulation) Act, 1986
- Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979
- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996
- The Factories Act, 1948
- Hazardous Wastes (Management and Handling) Rules, 1989
- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996
- IS: 5182-1977 - the methods of measuring air pollution
- IS: 3028-1980 for measurement of noise emitted by moving road vehicles;
- IS: 4758-1968 for measurement of noise emitted by machines;
- IS: 10399-1982 for measurement of noise emitted by stationary road vehicles
- IRC: SP: 21-1979 - Manual on Landscaping of roads and its subsequent revised versions

3.6 World Bank Policies

Following World Bank's environmental safeguard policies are applicable in the proposed Champhai – Zokhawthar (C-Z) Road up-gradation.

Environmental Assessment OP 4.01: The upgrading works in C-Z Road is likely to have significant adverse environmental impacts in its area of influence: these includes slope instabilities/

landslides & soil erosion/ hill slopes, air (dust)/ water/ noise (vibration) and land pollutions, loss/degradation of trees/ vegetation, workers & community health and safety etc. Environmental Management Plan (EMP) provides mitigation measures.

Natural Habitats OP 4.04: The C-Z Road's influence area is rich in bio-diversity. The policy is applicable as the proposed alignment passes through 48 ha virgin agriculture land required for diversion , about 4.3 km has been proposed along the River Tiau and 2 km road through

Champhai valley land. Even though the proposed alignment does not pass through any critical natural habitat area but the upgrading works and operational phase activities may lead to adverse impact. Precautionary measures to avoid any impacts are incorporated into EMP.

Forestry OP 4.36: About 0.28 ha of forest land (forest plantation area) will be converted into non-forest (road widening and improvement). There are village council forests near/ within the project influence area. Compensatory plantation will be carried out. Activities that may degrade forest quality will be controlled. These are included in the EMP.

Physical Cultural Resources (OP 4.11): There are cultural properties like church, graveyards

and memorial stones in close proximity to the C-Z Road. EMP includes measures to avoid, mitigate and control adverse impacts on the PCRs.

IFC WBG Environmental, Health, and Safety (EHS) Guidelines: The EHS Guidelines has elaborate provisions regarding environmental, occupational health and safety, and community health and safety. The community and workers environment Health safety provisions in terms of protection measures, relevant to the Champhai to Zokhawthar road upgradation works have been included in the EMP as well as in the bidding documents together with relevant national requirements. As EMP is part of the contract document, hence EHS guidelines will be implemented during project implementation.

CHAPTER-4 –METHODOLOGY

The environmental assessment in this project employed an iterative approach in which potential environmental issues have been examined in successive levels of detail and specify at each step in the process. This chapter presents the methodology adopted for the EIA preparation for the Champhai – Zokhawthar Road. Methodology for assessment of social impacts is dealt with in the R&IPDP.

4.1 Influence area.

Broad influence area of the proposed upgrading of C- C Road is defined as 5(five) kilometers on both side of the road as per MoEF guidelines. Most of the impacts are likely to occur in a narrower corridor defined as about 100 m towards hill side and 200 m on the valley (a tentative width of about 300 m along the road) and this is called Core Influence Zone (CIZ). Actual CIZ may vary from issue to issue and site to site.

4.2 Literature and Secondary Data Review

The available published literature, documents and maps (e.g. topographic, geological maps, forest, satellite imagery, Google image maps etc) related to the Champhai – Zokhawthar Road influence area was reviewed. The existing policies, legislations, guidelines and manuals related to the road and environment in India and World Bank's policies and guidelines were also reviewed. Apart from the above, the EIA Screening documents, and the Detailed Project Report (DPR) were thoroughly reviewed.

4.2.1 Satellite imagery

The satellite data products that is used for thematic mapping are Geo-referenced and rectified mosaic of LISS-IV MX image. The geo-referenced and rectified satellite imagery is displayed as a raster in ArcGIS, with the project road buffered at 5 km boundaries as a vector overlay, the 2D based visual or onscreen interpretation is limited to the area inside the buffered boundary. The land use and land cover map is prepared using RESOURCESAT LISS IV satellite data. All the Land Use / Land Cover classes were visually interpreted based on tone/ texture, contextual and ground information.

4.3 Consultations with Stakeholders

Series of discussions and consultations were carried out with the Champhai – Zokhawthar Road Technical consultant to understand the upgrading details e.g. re-alignment, widening, design aspects, project construction and operation modalities, concentration of activities in the different periods of project construction and operation, etc. Design merits and demerits of the various alternative options of project development and operation were also discussed.

Discussions were carried out with people living in the neighborhood of the Champhai – Zokhawthar Road, NGOs and Village Councils, District Forest Office etc during Screening, EIA and social assessment. Dates, places and group with whom Focused Group Discussion (FGD) was held during EIA are described in Chapter 6. Formal consultations were carried out as follows:

Table 4.1: Date and place of Focused Group Discussion.

Date	Place	Group with whom FGD was held.
27.12.2013	Melbuk village	Village Council Members, YMA Office Bearer, PAPs, MHIP leaders.
28.12.2013	Mualkawi	Village Council Members, YMA Office Bearer.
17.12.2013	Lalnutui	Village Council Members, YMA Office Bearer, PAPs, MHIP leaders.
28.12.2013	Zotlang	Village Council Members, YMA Office Bearer, PAPs, MHIP leaders.
28.12.2013	Zokhawthar	Village Council Members, YMA Office Bearer, PAPs, MHIP leaders.
29.12.2013	Champhai	Village Council Members, YMA Office Bearer, PAPs, MHIP leaders.

Comments, feedbacks and suggestions from the above consultations are summarized in **table 6.1 and annexure 6.3 .**

4.4 Field Study

During EIA, the field investigation was carried out by a multidisciplinary team, which comprised of the following experts:

- Air quality monitoring expert
- Water quality expert
- Ecology and biodiversity expert
- Noise and vibration expert
- Socioeconomic and R&R expert
- Hydrology and Ground water expert
- Geologist
- Land use remote sensing and GIS expert
- Soil expert
- Highway Engineer

The team was supported by Team of Environment Cell, PIU Office, Aizawl, Mizoram and Team of Design Consultant: CM ENGINEERING & SOLUTION, Gurgaon, Haryana.

Field survey of environmental condition was carried out during August 2013 to October 2013 to collect the baseline information. The study team carried out site visit in the following places: Champhai, Melbuk village, Mualkawi, Lalnutui, Zotlang and Zokhawthar

The required baseline information on physical and biological environment of direct and indirect impact areas of the C-Z Road upgrading were collected during the site visit. The information on different environmental components was collected by using the following tools:

4.4.1 Physical Environment

Status of land use patterns, topography and soil erosion was collected through direct observation and field mapping. The methods employed for collection of data on physic-chemical characteristics of ambient environment (air, water, soil noise) . The slope stability and landslides, and fan deposits within the influence area were studied through site observation and on-site delineation in maps.

Data collection: Following approach were used in collecting data from the field.

Air - Ambient air quality data was collected along the up-gradation corridor by the consultant through Mizoram Environment Consultant , a unit of Zirtiri Science college under Mizoram University and recognized by Mizoram State Pollution Control Board.

Noise – Noise levels along the C-C Raod were monitored at 10 locations by using a portable noise meter (LUTRON MSL 4001) by the consultant through the said agency .

Water – Water samples were collected from stagnant and flowing water bodies along the corridor to assess the present water quality. Tests for physico-chemical and biological characteristics were carried out and the results have been recorded to establish baseline conditions. Four groundwater samples was collected and analysis was carried out by the consultant through the said agency as per procedure of APHA and results compared with the Indian drinking water Standard (BIS 10500).

4.4.2 Geomorphology – A detailed geo-morphological assessment has been carried out along the route to identify vulnerable locations and inventory weak zones.

4.4.3 Biological Environment

(i) Forest and Vegetation: Composition, distribution patterns and characteristics of vegetation and forest types and sensitive habitat in the project area were assessed from direct field observations, quadrate sampling, transect walk survey, photography, maps, interaction with village councils, and collection of information from district forest offices. The type of forests and management practices around the project area were studied and identified. The total area of the affected forest and vegetation were quantified during the field survey. Tree and shrub densities were estimated using the line transact method, with each longitudinal traverse measuring a distance of 100 m, with 10 replicate samples each section (for tree species 10m X 10m spacing of 20 quadrate has been laid, and for Shrubs species 5m X 5m spacing of 20 quadrate was laid).

(ii) Bio-diversity assessment (including medicinal plants, protected & endangered species): Species-richness, densities of ground flora was estimated with the help of 1 m^2 quadrates, with 20 replicate samples in each 2 km section of the corridor. "Biodiversity

rich" regions due to the presence of important floral species were also identified and discussed in Chapter 5 of this report

A biodiversity assessment has been carried out by the consultant with the help of Mizoram Environment Consultant, a unit of Zirtiri Science College under Mizoram University and was assisted by the Environmental Team of PIU Office, Team of Design Consultant, NGOs and local people.

Apart from the above information, discussions were carried out with local communities to fill the gaps in thus collected information such as history of forest cover, bio-diversity, flooding events, landslide events and locations and land degradation process among others.

4.5 Impact Identification, Analysis and Assessment

After the full documentation of the baseline environmental situation, each of the environmental aspects was examined against the road upgrading component and activities. Each of the direct and indirect impacts was further evaluated in terms of its magnitude, extent, severity, temporal aspects and sensitivity to determine significance.

Environmental issues have been assessed to describe the potential impacts that may result from road upgrading and construction. The assessment of impacts was carried out for all the three stages: design, construction and operation. Quantification has been difficult in light of the limited availability of data. Findings of the impact identification, analysis and assessment fed into:

- Formulation of specific mitigations and enhancement measures;
- Preparation of the Environmental Management Plan (EMP).

4.6 Analysis of alternatives

As part of alternative analysis, comparisons were made among different alternatives of re-alignments, as well as comparison of selected option with "no project" option in terms of environmental, social and technical parameters.

CHAPTER-5: BASELINE ENVIRONMENTAL SCENARIO

This chapter assesses the nature, type and dimensions of the study area with specific focus on the project roads and their relevant physical and biological environmental components.

5.1 METEOROLOGICAL BASELINE

5.1.1 Climate

Project influence area has a typical tropical climate whereas in the mid-region, sub-tropical moist climate prevails. In the upper reaches, temperate climate is experienced. On the whole, the area has a pleasant climate. The summers are generally warm and wet, but winters are cool and dry. Three seasons may be recognised in the state, viz:

Winter extending from November to February

Summer from March to May

Rainy season from June to October

5.1.2 Temperature and humidity:

The temperature ranging from 8°C to 28°C with moderate Humidity varies from 70 to 85%. Relative humidity in the dry season is 50 –70% and in the monsoon period is about 90%. During southwest monsoon, February to April is comparatively dry when humidity is between 60 –70%.

5.1.3 Rainfall: The average annual rainfall for the year 2013 is about 2590 mm (most of it occurs during rainy season of June to October). Pre monsoon rains occur during March to till mid-May, whereas regular monsoon commences from June till October. The annual average rainfall of eastern belt of Mizoram, recorded by Science and Technology Department, Government of Mizoram for the last five years is shown below.

Table 5-1 Annual average rainfall in Champhai

S.No.	Year	Rainfall Magnitude (mm)
1	2009	2310
2	2010	2850
3	2011	2540
4	2012	2780
5	2013	2590

Wind speed. Average wind speed during site visit around 12.2km/hr and the Sunshine duration about <10 hours during August 2013.

Monthly meteorological data of Champhai for the year 2013 is shown in figure 5.1 below

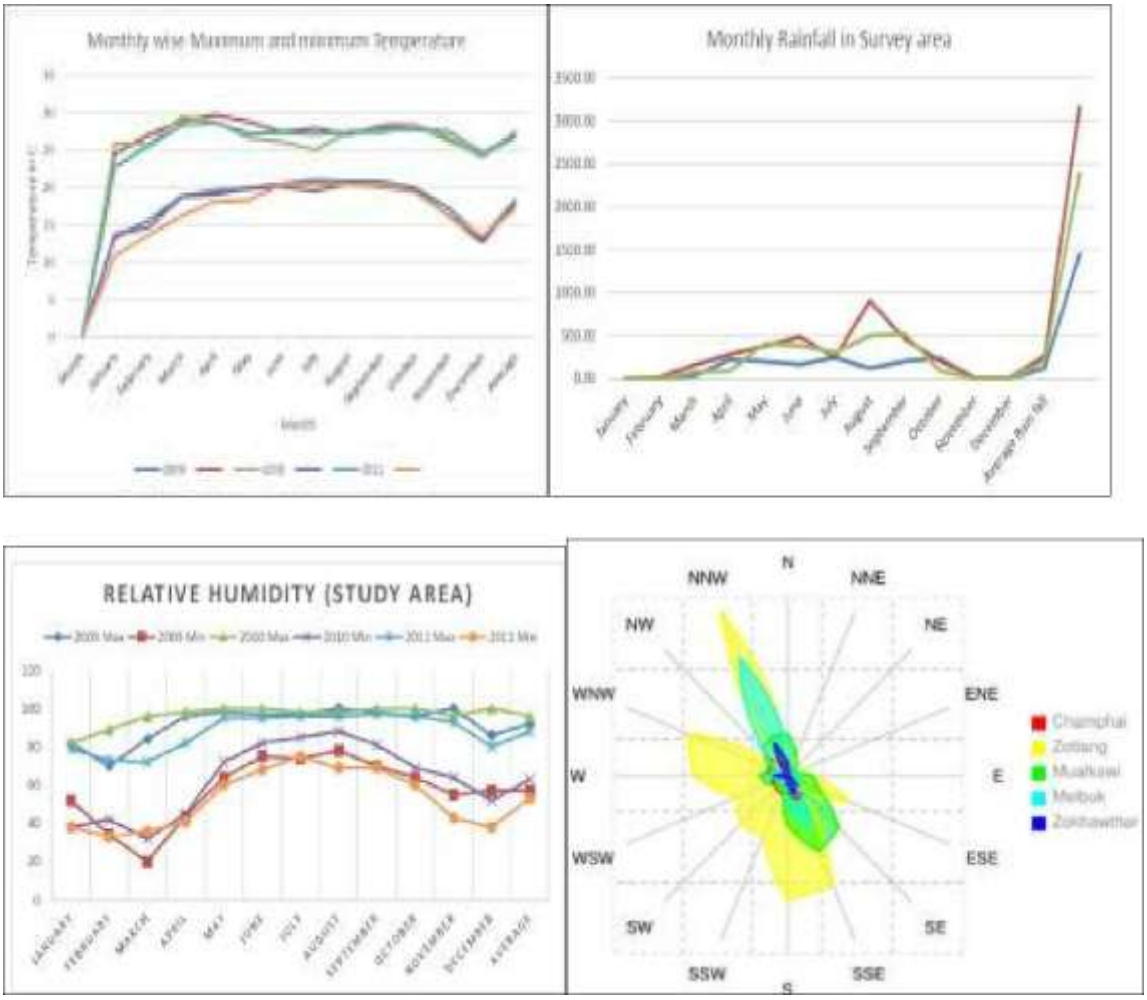


Figure: 5.1: Meteorological Data of Champhai (Temperature, Rain fall, Relative humidity and Wind direction)

(Source: The Meteorological Data of Mizoram for the Year 2012, Statistical Handbook of Mizoram, Directorate of Economics & Statistics, Aizawl (2012)

(Source: Windrose Diagram adapted from Pavanaarekh - free online plotting windrose diagram.)

Table 5.2: Sun Shine duration, Rain Fall and Temperature during August 2013

Sl No.	Location	Sunshine Duration		Rain Fall (mm) (August 2013)	Temperature ^{o}C		Cloud Cover during Site visit
		Sunrise	Sunset		Min	Max	Online weather Data
1	Champhai	05:34	04:48	0	21	23	90% fog
2	Zotlang	05:55	04:50	0	19	22	>60 %
3	Mualkawi	05:39	03:30	0	19	23	>65% Day
4	Melbuk	05:33	04:16	0	16	22	Clea r
5	Zokhawthar	05:45	04:18	0	18	21	>20

5.2 NATURAL AND BIOPHYSICAL ENVIRONMENT

5.2.1 Physiography

In general the topography of Mizoram is largely immature except for the eastern part. There are N-S trending mostly anticlinal strike ridges with steep slopes and narrow intervening synclinal valleys and series of parallel hummocks or topographic highs.

The Champhai area is formed by medium structural hills along the ridges which runs from Chhawrtui to Pawlsang Village, and low structural hills in the western side of the ridge with many streams and rivulets. The streams are mostly ephemeral in nature. (Refer map 5.2 and 5.3)**.** The alignment of the project road passes through mountainous and steep terrain exceeding 30 % ground slope across the alignment. The height of the road at various locations varies from 1350 m near take off point to 700.00 m River Tiau above mean sea level (MSL) (Refer table 5.2).

Within the 5 KM area of the proposed project corridor, Champhai is the highest point (altitude is 1665m) located at chainage 0.00 KM along the existing alignment.

The other landforms of the proposed project corridor such as dissected ridges with deep gorges are found in chainage -

- Within Khankawn village area*:* O.3km, O.7km, 0.86km, 1.28km, 1.98km,
- Within Zotlang village area: 2.48km, 3.00km, 3.63km, 3.7km, 4.1km, 4.34km, 4.55km, 4.72km, 5.0km, 5.75km, 6.16km, 6.6km, 6.67km,

- Within Mualkawi village area: 7.04km, 7.28km, 7.59km, 7.9km, 8.3km, 9.0km, 9.67km,11.03km, 11.70km, 11.87km, 12.0km, 13.5km, 13.83km, 14.13km, 14.35km, 14.83km, 14.97km, 15.64km, 16.46km,
- Within Melbuk village area: 16.91km, 17.15km, 17.33, 17.76km, 17.88km, 18.27km, 18.48km, 19.07km, 19.27km, 19.6km, 19.89km, 20.3km, 21.6km, 21.96km,
- Within Zokhawthar village area: 22.64km, 23.52km, 23.93km, 24.14km, 24.5km, 24.68km,

Faulting in many areas of the above mentioned chainages has produced gentle fault scarps. Fluvial processes coupled with mass wasting are the main agents for development of the diverse landform of the region.

5.2.2 Soil and erosion:

The Champhai to Zokhawthar road influence area is highly susceptible to erosion and rain induced landslides events during rainy season due to loose sedimentary rock, with high porosity and permeability. Weak soil, vegetation loss, and construction activities make the area susceptible to erosion during monsoon rains. Following are the zones with high risks of soil erosion along the Core Influence Zone of the Champhai to Zokhawthar Roads:

(i) CIZ – I (0.00 KM to 4 KM i.e. 4 KM length): The topography of CIZ – I is a steep terrain on hill side and mountainous to rolling terrain on valley side .Few stretches are exposed weathered disintegrated rock. To obtain the required formation width of 12.0 m wide, blasting operation will be required. 30% of the area is wet land rice cultivation, in which 72% of plant growth is rice, only few shrubs and herbs are available. About 50% of soil is stabilized soil and another 10% is highly susceptible eroded soil.

(ii) CIZ – II (5.1 KM to 9.4KM i.e. 4.3KM length): The topography of CIZ – II is again steep terrain on hill side and mountainous to rolling terrain on valley side. To obtain the required formation width of 12 m wide, blasting will be required at from 7.6 km to 7.8 km and 6.8 km – 8.75km. From Km 7.6400 to Km 9.2, the land is exposed with weathered disintegrated rock and very steep terrain. Within the CIZ –II, a few exposed rocky portions with seepage of water from the hill sides are found on

existing road. 65% of the plant growth is trees, only few shrubs and herbs are available. About 85% of soil is porous Sandy loam.

(ii) CIZ – III (15.65 KM to 16.48KM i.e. 0.83KM length): The topography of CIZ – III is again steep terrain on hill side and mountainous to rolling terrain on valley side. To obtain the required formation width of 12 m wide, blasting will be required at, from 15.65 km to 15.8 km. From Km 15.65 onwards the land is exposed with weathered disintegrated rock and very steep terrain. At 15.7km and 16.18km chainage, active landslide is observed during site study. Within the CIZ –III, a few exposed rocky portions with seepage of water from the hill sides are found on existing road. 70% of the plant growth is trees, only few shrubs and herbs are available. About 85% of soil is porous Sandy loam.

5.2.3 Land use

By using the thematic mapping, satellite data products were analyzed for broad influence area of 5 Km both sides of the road. Analysis show that the major part of the broad influence is forest both open dense and bamboo forest. The analysis show following category of land uses: (i) Forest: 31.6 %, (ii) Crop land: 9.7 %, (iii) Grass land: 8.9%, (iv) Settlement: 5.1 %, and (v) Water body (river): 0.1%, (vi) Water body (lake/tank): 0.2%, (vii) scrub land: 11.6% and (viii) Scrub forest: 32.8%.

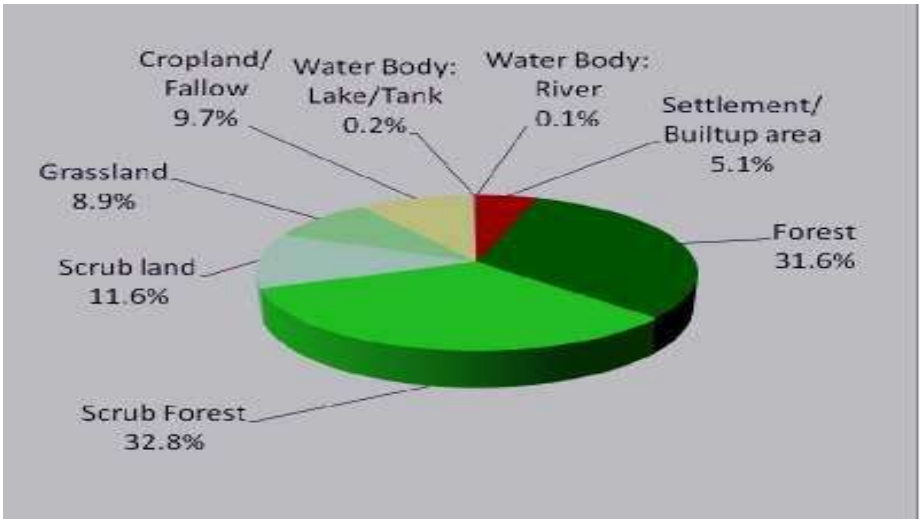


Figure 5.2 Pie chart showing land uses within proposed project corridor.

5.2.4 Soil

The soils of the project area with a 25% - 50% slope with abandoned jhum, current jhum land and horticulture plantation in small scales are clayey Typic Hapludults, L.S. Umbric Dystrochrepts, FL Typic Hapludults and Typic Dystrochrepts.

However in a less sloped areas, F.L Humic Hapludults and Clayey Typic Dystrochrepts are also found.

5.2.5 Geology

The project area represents Barail Group of rocks which comprises a monotonous sequence of shale interbedded with siltstone and hard compact, thinly bedded, grey to khaki, fine grained sandstone. Locally, a few hard, dark grey compact, medium to fine grained quartzwacke bands are present.

The ridge area of the project is formed by Sandstone which are fine to very fine grained, not too bluish grey to light brown in colour, compact and hard, thinly bedded, rarely yellowish brown, medium grained and friable. The low structural hill is formed by Siltstone and Shale which are dark grey to grey in colour and are usually splintery (Refer map 5.4) *(Source: Geological survey of India)*

5.2.6 Slope Stability and Landslide

In the project road in general the hill slopes are relatively stable. Potential major landslide areas were not noticed /reported in the project road. Engineering as well as bioengineering techniques will be proposed to stabilize the soil and slopes. Major landslide prone areas were not noticed during the field visit to the project stretch. However some minor land slide was noticed during field visit in following locations – Km. 8+700 , Km. 8+900, Km. 9+400, Km. 14+900, Km 15+300,Km 15+500 Km 15+900,Km16+300,Km. 18+600,Km 19+200, Km 22+800. During construction following area will be considered as landslide risk zone: Km 7+640 to Km 9+200 and Km 17+050 to Km 24+300.

5.2.7 Surface water

The project road traverses through mountainous and steep terrains with several natural drainages such as deep gorges, depressions, etc., where perennial water and rain water runoff are collected. Sometimes the storm runoff is accompanied by large quantities of debris from upstream side of the nallahs. The project is crossing 124 surface water

crossings which are in the form of minor streams and nullah. The road ends at the Tiau River which is the international boundary with the Myanmar. Some of the streams crossings along the project road are:

Tuipui Hnar at km 2.080, Verhpui Lui at km 3.600, Saisih stream at km 7.6, Vawmkaw Lui at 22.400 km, Dil Lui at 21.900 km, Thei ba Lui at km 23.7

5.2.7.1 Drainage channels

Table 5-2 lists the drainage channel cutting across the proposed Champhai to Zokhawthar Road (including the re-alignment sections).

Table 5-2 Lists of drainage channels found in proposed alignment.

S.No.	Name River/ Stream	Location/ chainage	Description (Nature, flows, use/ value, risk)
1	Vawmkaw Lui and Dil Lui	Vawmkaw Lui at 22.400Km Dil Lui at 21 .900 Km (within Melbuk village area)	These stream are perennial, both of them are flowing the proposed alignment, the local people do not use for domestic purposes. The risk of decreasing the stream flow rate, polluting due road construction is minimal.
2	*Saisih* stream	7.6 Km along the proposed alignment (within Mualkawi village)	This stream is perennial. This stream is not used for agricultural and domestic purposes. The risk of decreasing the stream flow rate, polluting due to construction is minimal. The source of pollution is mainly from rainwater debris.
3	Tuipui Hnar and Verhpui Lui	Tuipui Hnar located at 2.080 Km, Verhpui Lui located at 3.600 Km	These streams are perennial. Risk of decreasing the stream flow rate, polluting due to road construction is negligible. The source of pollution is mainly from rainwater debris.
4	Thei ba Lui located at 23.7 Km along the proposed alignment.	located at 23.7 Km along the proposed alignment (within Zokhawthar village)	The stream is perennial. The local people do not use for domestic and agricultural purposes. Risk of decreasing the stream flow rate, polluting due to road construction is negligible. The source of pollution is mainly from rainwater debris.

5.2.7.2 Ponds and other water bodies

Along the project corridor, fish ponds owned by individuals residing in Champhai, Zotlang and Ruantlang at chainages 0.3 km, 2.15 km, 2.22 km, 2.265 km, 3.00 km, 4.525 km and 4.685 km are observed, and others water bodies are also observed

within 200 m along the proposed alignment between 10.71 km – 12.20 km. In the low lying area dual cultivation of rice and fish is practiced during monsoon season.

5.2.7.3 Local flood risk area

One low lying or depressed area which is prone to localized flood during monsoon is observed at Zokhawthar village.

5.2.7.4 Waterfalls/Spring along the Champhai to Zokhawthar Road:

No waterfalls or spring was observed within 5 KM of broad influence area.

5.2.7.5 Water Uses and Scarcity

Notwithstanding heavy monsoon, the Mizos face water problems every year during dry season (November to till mid-April) as the geological formation does not permit water retention, because surface runoff is quick and non-perennial streams dry up when there is no rain. The Mizoram Government has a policy to replace all thatch roofs with CGI sheets for promotion of rainwater harvesting. In continuation to the policy, the rainwater harvesting campaign was taken up by the Government under its public water supply programmes only in 1986.The norm for domestic water consumption by an average Mizo is 10 litres per day3. Thus the average quantity of water required by a family of eight to last a dry season is 9600 litres. In the village area, 95% of harvested rainwater is mostly stored at water tanks which are made of CGI sheets or galvanized plain sheets.

The scarcity of water during dry season is also observed within the proposed project corridor. Watery ponds, streams, and tanks are used for drinking, fishing, cultivation, bathing etc by the community and several road users. Other than rainwater harvesting, the community and several road user use watery ponds, and springs are used for drinking, fishing, cultivation, bathing etc. At someplace along the project corridor, spring/stream water is harvested by using bamboo pipelines for use of domestic purposes. Wetlands/ stagnant water and water logged areas such as low lying areas may host a variety of aquatic life and birds. **Table 5.3** highlighted the name of stream/spring used for storing of water for use of domestic and other purposes.

Table 5-3 Name of streams/rivers used for storing of water

Sl.no.	Name of stream/Spring/river	Location	Comments
1	1) Thingthupui Lui located along the proposed alignment at chainage 2.2KM RHS. 2) Zotui Lui located at 3KM from the proposed alignment of chainage 3.5KM	Zotlang village	The local people of Zotlang village harvested water from these rivers by gravity. The water is potable and can be used for domestic purposes without giving much treatment. These rivers are not likely be impacted. One of the river is located within the CIZ of Zotlang area and other is within BIZ.
2	1) Rekphuana Sih (Spring) located at 200m from chainage 6.65KM (RHS) uphill side, 2) Chalte Buk located at 150m from 6.75Km of the proposed alignment (RHS) uphill side. 3) YMA tui located at the southern side from the village and downhill side the proposed camp site.	Mualkawi	These springs are used for domestic purposes after treatment by the people of Mualkawi village. The water is harvested by means of pipeline. These springs are not likely be impacted by construction/operation works. It is located within the core influence area of Mualkawi village.
3	1) Zangdak Lui, located at about 4 km from Melbuk village up in Hringlangtlang hill. 2) Lungsum Lui located at about 700m up in Hringlangtlang. 3) Tuikhur Lui located YMA tui located at chainage 15.05 km along the proposed alignment (RHS) on the hill side.	Melbuk Village	These springs are used for domestic purposes after treatment by the people of Melbuk village. The water is harvested by means of pipeline. These springs are not likely be impacted by construction/operation works. It is located within the broad influence area of Melbuk village.
4	1) Zangdak Lui, located at about 4 km from Zokhawthar village up in Hringlangtlang hill. 2) Lungsum Lui located at about 700m up in Hringlangtlang. 3) Tuikhur Lui located YMA tui located at chainage 15.05 km along the proposed alignment (RHS) on the hill side.	Zokhawthar Village	These springs are used for domestic purposes after treatment by the people of Melbuk village. The water is harvested by means of pipeline. These springs are not likely be impacted by construction/operation works. It is located within the broad influence area of Melbuk village.

5.2.8 Ground water / Hydrogeology

Geologically, the area is underlain by sedimentary rocks of Tertiary age, which have been tightly folded in a series of anticlines and synclines. Ground water occurs under confined and unconfined conditions in sandstones, sandy shales etc. In the northern and north western part of the State, the relief is much subdued. Mizoram is an abode of springs. These springs are widely utilized by people for domestic needs. Recent study suggests that there is good scope of tapping ground water in the riverbeds with sumps connected to infiltration galleries.

Dynamic Ground Water Resources

Annual Replenish able Ground water Resource	0.04 BCM
Net Annual Ground Water Availability	0.04 BCM
Annual Ground Water Draft	0.0004 BCM
Stage of Ground Water Development	0.90 %
Ground Water Development & Management	
Over Exploited	NIL
Critical	NIL
Semi- critical	NIL

In the low-lying areas, the ground water potential is categorized as good which are those jhum areas, abandoned jhum land and current jhum land. The ground water potential is moderate along the ridges which need to be focused upon to increase the sources of spring heads and fountains (Refer map 5.5).

Ground water analysis indicate the chemical characteristics as - Fe 0.1 mg/l, Chloride 15 - 20.0 mg/l, PH 5.5 to 6 mg/l, Alkalinity 15-40 mg/l, Turbidity 0.1 to 1.0 NTU, Hardness 12- 16 mg/l .

Along the project road three samples for testing is collected from Zothlang, Melbuk and Zokhawthar villages. The result of analysis is given in Annexure 5.2. Analysis of groundwater samples shows that the water is alkaline in nature (pH <8). The total dissolved solids (TDS) in three locations are below the permissible limit (500mg/l). Chloride concentration is well below the desirable limit (250mg/l) in all locations.

Sulphate and Nitrate concentrations are low and within the permissible limit and thus indicate low degree of organic pollution. Fluoride is absent in all samples. Amongst the cations, Calcium (Ca) and Magnesium (Mg) are below the permissible

limit (200mg/l). Concentration of iron is above the desirable limit of 0.3 ml/l in all samples but below the permissible limit. Hence it causes no adverse effect on domestic uses and water supply system and also does not promote growth of iron bacteria. Groundwater in general is soft in the area and the Hardness is below the permissible limit of 600mg/l. Groundwater samples are free from heavy metals like cadmium, arsenic, lead, chromium etc. Bacterial quality of groundwater shows all the samples drawn from tube-wells are free form fecal coliform and total coliform and hence the water samples are potable and suitable for human consumption after treatment process.

5.2.9 Flora

5.2.9.1 Forest resources

As noted in section 5.2.3, over 68% of the area in the broad influence zone of 5 km is under forest/vegetation cover, including village council forest, plantation forest, Jhum land, shrubs etc. The forest and vegetation is important because forestry in Mizoram plays a very important role in sustainably livelihood of both human settlement and wildlife. Within the project corridor, the local people use forest resources like woods, eatable wild plants, jhum cultivation etc. A good forest cover reduces occurrence of soil erosion, landslides. Moreover the forest land enhances scenic beauty of the study area. Due to the practice of jhum cultivation, the forest land has been decreasing over the past years. The Jhum cultivation, commonly known as slash and burn practiced, is nothing but the habit of felling trees and foliage of forests and burning them and destroy natural vegetation, thus causing ecological imbalances (water retention, soil erosion, loss of species, degradation of habitat etc).This usually led to spread of forests fire. The practice of jhum cultivation affects quality and coverage of forest area.

Within the Core Influence Zone of 300 m, there is no notified/demarcated forest area or village council forest adjacent to the proposed Champhai – Zokhawthar Road alignment including in the re-alignment sections, and hence the proposed alignment/ re-alignment will not pass through such government notified or demarcated forest.

Although 68% of the land within broad influence area of 5 km bothsdie or road is under vegetation cover, only 230m of the alignment (Km 9+300 to 9+530) is passing

through forest plantation area and about 0.28 ha of forest land need to be acquired for widening of the road**.**

Roadside Trees and Plants

All trees having girth of 30 cms were counted along the Champhai to Zokhawthar road. Population of trees within right of way is given in Table 5-5. Tree inventory survey data indicates that the total population of trees is 693, of which 407 nos are trees having 30-60 cm girth size, 178 nos are 60-90cm girth size, 78 nos are 90-180 cm girth size and girth size having more than 180 cm are 30. It is obvious that 58.73% of tree population occupies a girth size of 30-60cm.

Table 5-5 Details of trees and plants within CIZ/RoW of the C to Z Road

Species	**Girth (cm)**	**30 – 60 cm**	**60 – 90 cm**	**90 – 180 cm**	**>180 cm**
All trees are indigenous trees	No of trees	**407**	**178**	**78**	**30**

5.2.10 Biodiversity

The biodiversity are the state's priceless possession forming a part of the **Indo-Burma Global Biodiversity Hotspot.** The Indian hotspots are the most vulnerable regions due to population pressures, over-exploitation of natural resources, global warming and climate change and need immediate attention.

The proposed project corridor has a very taxonomic range, in proportion to the enormous diversity of ecosystems and geographical conditions, which these species inhabit. However, in the last few decades, this diversity has faced increasing erosion. Habitat loss, hunting and over exploitation, introduction of exotic species in river ecosystems, poisoning and other factors including progressive disempowerment of local communities and destabilization of Mizo traditional management systems, have caused this loss. Some elements of the loss, which have remained undetected or severely under-studied, include decline of the sub-species and varieties of a species.

5.2.10.1 Flora

Within the core influence area of the C-Z Road, 27 tree species were observed, in which

Alseodaphne petiolaris was the most prominent species found through the analysis of abundance . Sapium baccatum comes second and Albizziachinensis (Local Name: Vang),third and so on.. They were all local common species (Refer Annexure 5.1).

14 shrub species were observed. Through the Important value index analysis Saccharum longisetosum (Local Name: Luang) has the highest score, Bambu salongispiculata, Thysanolaena maxima (Local Name: Hmunphiah) comes next. These were all poaceae family which has been mostly used for domestic purpose (Annexure 5.1).

12 herb species were observed, *Smilax prolifera* has thehighest abundance , *Mimosa pudica* and *Microlepia strigosa* comes next. These three species has all medicinal purpose. They all were local common species. (Refer Annexure 5.1).

From the sampling 107 species of floral were observed out of which tree species constitute 55 species , 17 species of shrub, 14 species of herbs, 5 species of palms, 5 species of grasses and 10 species of Climbers. *Tectona grandis Linn.F., Michclia champaca, Duabanga grandiflora, Ficus semicordata, Deris robusta and Albizzia procera, were common tree species . Eupatorium odoratum, Clerodendrum viscosum, Costus speciosus, Thysalomina maxima, Curculigo crassifolia, etc* were the common shrubs and herbs species (Refer table 3 of Annexure 5.1)

From the data it is evident that like other Indian hotspots biodiversity of this part of the hot spot are at the vulnerable stage. The vulnerability may be attributed to, high population pressures, indiscriminate selective logging of trees, destruction of biodiversity due to mono culture agricultural practices, damming of rivers in these habitats resulting in habitat destruction, Overexploitations of natural resources in these regions have reached critical levels, Global warming and climate change which is altering the rain pattern and snow line in higher altitude, resulting in permanent change in the habitat.

Fauna

Protected Area: There is no wildlife protected area within 5 KM influence area of the proposed project corridor. Neither wildlife movement route has been identified.

Birds and Wildlife

List of birds and animals that were spotted and as told by the local people during the site visit of C-Z road's influence area of 5 km (zoological names and local names) are given in table 4 and 5 of Annexure 5.1.

Biodiversity in Jhum Area: About, 35% of the C-Z road's influence area, is under current Jhum cultivation land. The remaining area is unfit for such cultivation, either as the slope is unsuitable, or as the areas is inaccessible. Most of the Jhum areas are covered by bamboo especially *Melanocana bambusieides* and *Dendrocalamusha mitonii* or a secondary growth of species like *macaranga*, and *callicarpa*. In the valleys, beyond the Jhum Area, different types of palms like *Pinangagracilis*, Caryota species, *Licuala species* and canes of various kinds grow at a lower storey. Citaminous herbs like *Alpinia*, *Curcuma species*, *Amonum species*, and ferns of various species are found in the distant forest areas. However, in the C-Z Road adjoining area such growth is more or less absent due to Jhum practice. No higher bio-diversity rich zone is identified within the CIZ of C-Z proposed road.

5.3 AIR QUALITY

Being an industrially backward state with no major polluting sources along the Champhai – Zokhawthar, in terms of air quality, the ambient air quality in Mizoram is generally pristine. Traffic in the existing road is an air pollution source. Low traffic volumes along the existing roads also point to lower pollutant concentrations even when close to the roads.

The air quality monitoring in Zotlang and Zokhawthar settlements show that ambient air quality is within the acceptable limits or below the NAQQS standard (Table 5-6.

Table 5-6: Air Quality Data and Comparison with National Standards

Pollutants	**Average monitoring Time (Hours)**	**Monitoring at** Zo tlang	**Monitoring at** Zokhawthar	**Standard***
SO_2	24	2.5 µg/m^3	5.7 µg/m^3	80 µg/m^3
NO_2	24	10.5 µg/m^3	14.5 µg/m^3	80 µg/m^3
PM_{10}	24	80.5 µg/m^3	95.5 µg/m^3	100 µg/m^3
$PM_{2.5}$	24	28.0	35.5	60 µg/m^3
CO	1	1.5 mg/m^3	3.0 mg/m^3	4.0 mg/ m^3

* As per CPCB Publication: Ambient Air Quality Status and trends in Delhi (2009)

5.4 NOISE QUALITY

The existing sources of noise in the Champhai – Zokhawthar road influence area:

1. Traffic movement Noise
2. Localised Furniture workshop
3. Noise coming from Residential areas such as playing music etc.

The ambient noise monitored at six locations (Table 5.7) shows that the ambient noise quality of the areas was quite moderate, and was below the upper limit prescribed by the Central Pollution Control Board (Table 5.8).

Table 5.7: Noise Level Monitoring Results

Sl. No	LOCATION (Location Category)	Units in Leq. dB (A)					
		DAY TIME (06.00 AM TO 9.00 PM)			NIGHT TIME (9.00 PM TO 06.00 AM)		
		Min	Max.	Average	Min..	Max	Average
1	Khankawn (Residential)	53.88	67.36	63.87	43.19	61.71	56.046
2	Zotlang (Residential)	53.73	64.69	61.56	41.58	59.34	54.697
3	Ruatlang (Residential)	52.26	64.60	61.6	45.78	60.86	57.202
4	Mualkawi (Residential)	51.52	66.05	62.55	42.59	61.45	55.591
5	Melbuk (Residential)	53.45	66.13	62.71	48.51	65.11	58.541
6	Zokhawthar (Residential)	51.25	65.88	61.11	42.93	61.3	54.817

(In each case number of observations are 20)

Noise level limits prescribed under Gazette Notification 643 dated 26.12.1989 of Ministry of Environment & Forest, GOI is given in Table 5.6

Table 5.6: Noise Level Limits of GoI {in Leq dB(A)}

Area/Class	Day Time (6.00 AM to 9.00 PM)	Night Time (9.00 PM to 6.00 AM)
	Standard	Standard
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

Data indicate the fact that in all the monitoring locations average level of noise exceeds the standards of the residential area. It may be due to commercial activities and vehicular movement along the road during the monitoring period.

5.5 Prime Agricultural Land

5.5.1 Jhum Cultivation: Agriculture is the mainstay in Mizoram, with about 70% of the population dependent on agriculture**.** Shifting cultivation in Mizoram is cultivation on a periodic cycle on the hilly slopes, over a traditional 8-year cycle. With the increasing pressure on land, the Jhum cycle has come down. In Champhai – Zokhawthar Road influence area, **7.5** % of land is under current Jhum cultivation and abandoned shifting cultivated land is 14%.

5.5.2 Prime Agricultural land: Prime agricultural lands are commonly located in the river/ stream valleys and gentle slopes. Often these are small isolated patches. Such prime agricultural lands in the Champhai – Zokhawthar Road influence area are located at different places and are about 25% of the land. Pressure is increasing on such lands over recent times due to population increase, expansion/ development of settlements. Implementations of the project need acquisition of 48 ha of agriculture land, oOut of which 35.8ha is Jhoom land which is used for traditional jhum cultivation. This may be classified as –

- Jhoom land – 35.8 ha
- Tiau river valley land – 10.7 ha
- Champhai valley land – 1.5 ha
- Forest land - 0.28 ha

Champhai valley land – are the prime agriculture land. These types of land are only present in Champhai valley. These are only irrigated land in Mizoram and used for Paddy production throughout the year and produce paddy three times in a year. Loss of 1.5 ha of prime agriculture land will have impact on rice production of Mizoram.

Tiau River valley land- Tiau river valley land are also prime agriculture land and used for paddy production. Loss of 10.7 ha of riverine prime agriculture land will have impact on rice production of Mizoram.

The Champhai – Zokhawthar Road and Mizoram has comparative advantage in ginger, citrus fruits, potato, kiwi, tea/coffee, bamboo shoot, banana, etc. The prime agriculture land is the foundation for this and hence is important resource/ basis for poverty reduction and prosperity.

5.6 HUMAN USE VALUES

5.6.1 ROAD SAFETY

Number of road mishaps, resulting in serious injuries and fatal casualties of the travelling public also happened in the roads of Mizoram as in other places around the world, including the existing Champhai – Zokhawthar road, are reported every year. These road accidents may be classified as:

1) Public conveyance service cars colliding with another car driven by drivers, both unaware of the design speed at blind curve,

2) Cars overshoot at curves without proper geometrical design, which pass through hilly terrain, negotiating sharp curves and bends without adequate signages. The cause of the accidents, however, is reported to be mainly due to the negligence of drivers.

3) Poor road condition.

5.6.2 COMMON PROPERTY RESOURCES

A number of common property resources such as community bus stops, public urinals and market shed are located along the Champhai – Zokhawthar Road corridor. Almost all the villages traversed by the Project road were found to have public urinals along the road. The community common resources located within the CIZ is listed in Table 5.7

Table 5.7 : Common property resources along Champhai – Zokhawthar Road

Sr.No.	Description	Nos.	Location
1	Public Toilet	1	Ch 0.00
2	Public Urinal	5	Ch4120, Ch4950, Ch10580, Ch11800 & Ch12800
3	Bus Shed	5	Ch9000, Ch10580, Ch11800, Ch12800 & Ch.19700,

4	Bazar Shed	5	Ch 0.00,Ch 3250,Ch 7460,Ch Ch 16920 & Ch 24370
5	Playground	2	1) Ch 2.600 – 2.800, Zotlang Village 2) Ch 4.400 – 4.500 Ruantlang Village
6	Churches	3	1) Presbyterian church, Zotlang, 50m RHS Ch 3.650, 2) Presbyterian Church, Mualkawi, 95m RHS, Ch 8.600, 3) Presbyterian Church, Melbuk, 75m RHS, Ch 17.250 4) Presbyterian Church, Zokhawthar, 75m RHS, Ch 23.800
Sr.No.	**Description**	**Nos.**	**Location**
7	Irrigation canal		Spur Road 1) From Ch 0.160 – 1.200 RHS, 2) Ch 0.160 – 0.400 LHS, 3) Ch 0.700 – 1.300 LHS 4) Ch 1.450 – 1.650 LHS 5) Ch 1.680 – 1.850 LHS 6) Ch 2.000 – 2.540 LHS 7) Ch 1.600 – 1.850 RHS, Champhai – Zokhawthar 1) Ch 2.500 – 2.900 LHS 2) Ch 2.500 – 2.600 RHS 3) Ch 2.700 – 2.800 RHS
8	School	6	1) Government Comprehensive School, Zotlang 85 m LHS from Ch 3.600, 2) Presbyterian School, Zotlang, 125 m LHS from Ch 3.800, 3) Springdale School, Zotlang, 50m LHS from Ch 4.100, 4) Government Middle School, Mualkawi, 200m LHS from Ch 9.100, 5) St. Joseph School, Zokhawthar, CL,Ch 23.980, 6) Pine Hill Seventh Day Adventist school, 285m RHS from CH 1.340 Spur Road.
9	Hand pump		Zotlang village, Mualkawi, Melbuk and Zokhawthar

5.7 CULTURAL ENVIRONMENT

A fine blending of different shades of culture is noticeable in the festivals observed throughout the district. Almost all the festivals are associated with the underlying principle of the anthropomorphizing of the divinity and the ascriptions of human conduct and affection to it. The Champhai is not only an ideal choice for mountains, valleys, waterfalls and scenic beauties, but also for colourful fairs and festivals.

5.7.1 Cultural properties

There is no nationally or internationally recognized archeological or cultrural or religious site in the unfkuence area of the C-Z Road. Local cultural sites, such as Churches , graveyards and memorial tombs and stones, are located in the close surroundings of the road. These are:

Churches – Presbyterian Church, Zotlang, 50m RHS Ch 3.650, boundary wall of the church is falling with in the CIZ of the road

Grave yards

The Proposed alignment is passing through five grave yard area

Km 3+200 Grave yard and portion of the church in Zotlang village
Km 5+450 Grave yard at the side of the road

Km 10+500 Grave yard at the side of the road
Km 16+ 600 Grave yard at the side of the road
Km 24+ 300 Grave yard at the side of the road

These are of human sentimental attachments and some time is of places of cultural and religious interest. Hence during finalisation of the road alignment due consideration should be given to avoid these graveyards if possible, without compromising the technical aspect and safety aspect of the road.

Photograph 5.2: Graveyard at Melbuk village Km16+700

Photograph 5.3: Graveyard at Km10+500

Memorial tomb and memorial stone along the road

Sapian Maksak: *Sapian Maksak* is a memorial tomb constructed by *Zamunga* in the year 1952. *Zamunga* is a famous great and brave hunter of *Mualkawi* village. He used to hunted many wild animals like Wild boar, Bear, Tiger and wild Buffaloes. The villagers gave him due respect and proud of him during his lifetime. Before he was deceased, he erected this memorial tomb, mentioning the types and numbers of wild animals he hunted. So the village people wanted to preserve this memorial tomb either by relocating the tomb to suitable place and making a good fencing or by diverting the proposed alignment around the tomb site. It is located in the RHS of chainage 9.95Km.

Mangkhaia Lung: *Mangkhaia Lung: Mangkhaia Lung* also known as *'Chhura fa rep"* was constructed by a great king of *Zotlang* village named as *Mangkhaia*. It is located in the LHS of chainage 3.40Km. This tomb highlighted social life of the village during his reign. The village people wanted to preserve this memorial tomb.

No religious heritage site has been observed near the project corridor.

Mangkhaia Lung in Zotlang village

5.8 Quarries

The locations of existing or proposed or potential quarry within the 5 km influence area of the Champhai – Zokhawthar Road are listed in **Table 5.8.**

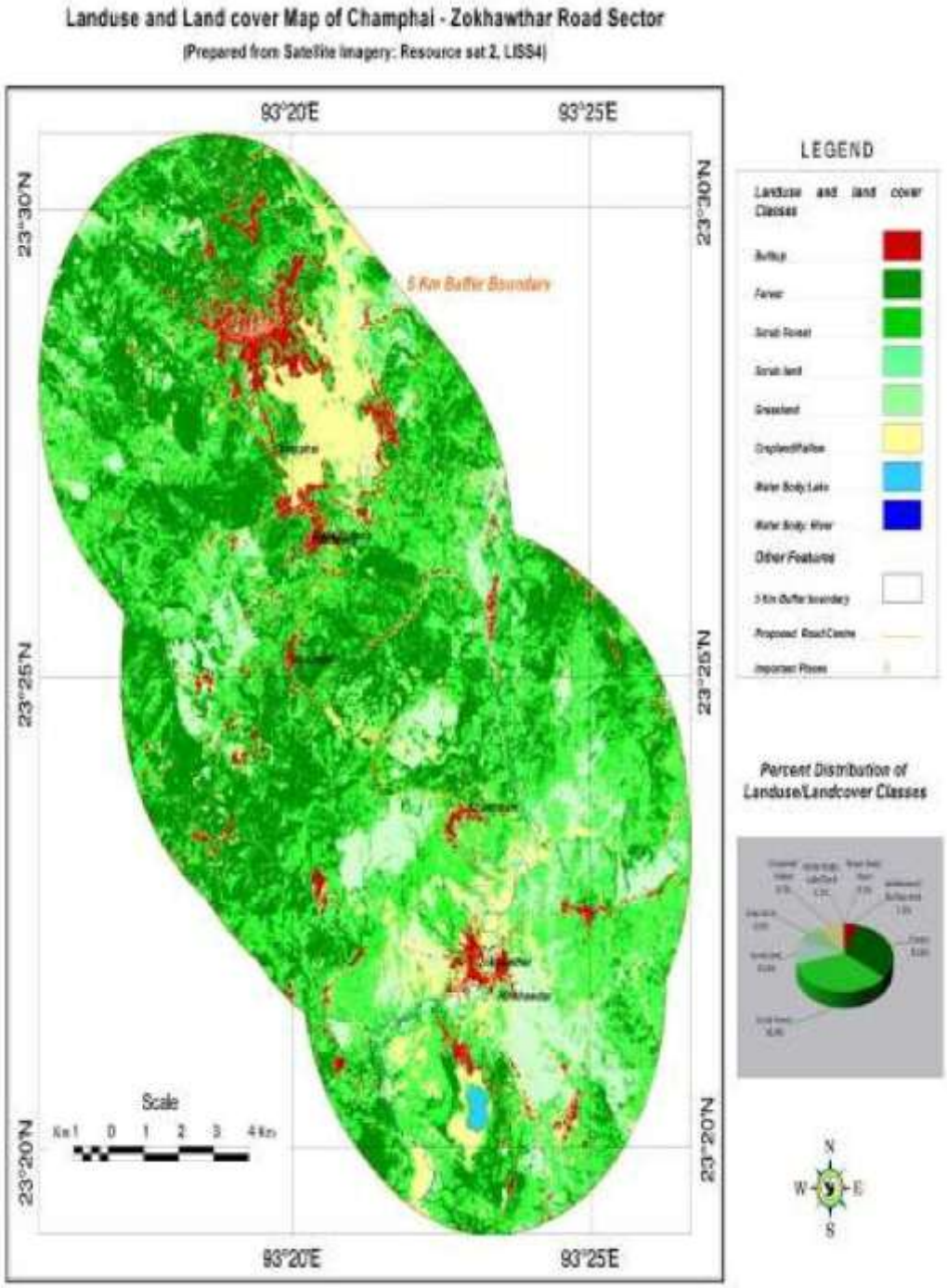
Table 5.8 : Location of Quarries

S.N.	Quarry name & location	Tentative yield (cum)	Description (existing condition, nature of surrounding area, potential issue/ risk)
1	Patea Quarry	42,500 cum	The quarry is located at Champhai village.
2	Pa Zualtea Quarry	49,500 cum	The quarry is located at Champhai village.
3.	Zarzoliana quarry	32,000 cum	The quarry is located at Near Tuichang River.
4	C.Malsawma quarry	46,130 cum	The quarry is located at Khawzawl
5	Quarries owned by other individuals of New Hruaikawn Village	30,250 cum	There are other quarries in the RHS of the proposed alignment held by other individuals residing in New Hruaikawn village, the quality of the stone is yet to be determined, these quarries will not affect the proposed Road

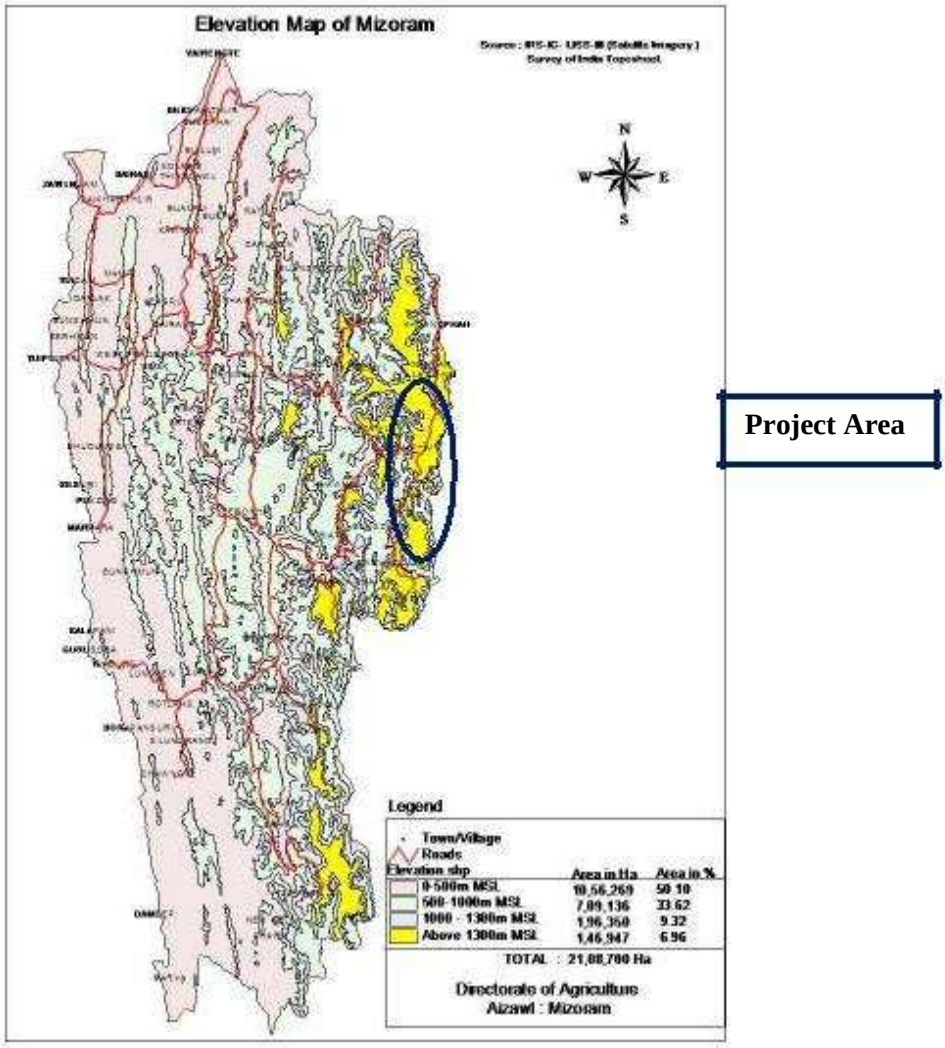
5.9 Borrow area

Sand, pebble, gravel and river bed materials are available in the following river/ stream locations. Quality of this material is suitable for GSB materials.

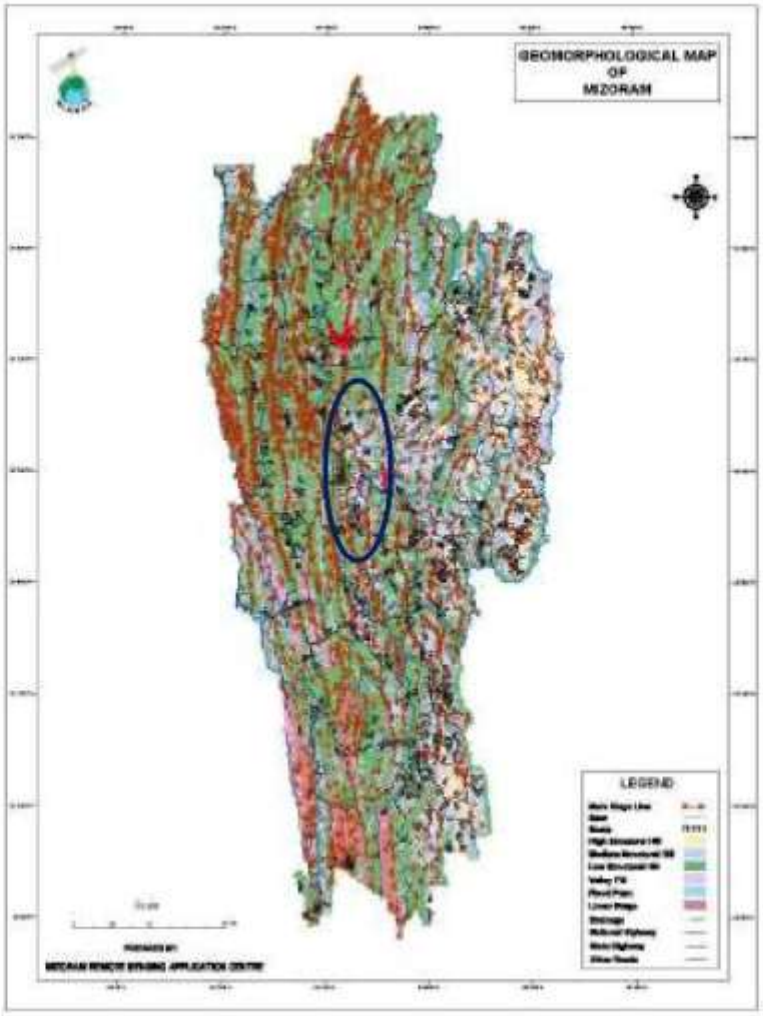
S.no.	Location/ (River/ stream)	Distance from tentative road/ yield	Remarks
1	Tiau river	2.5 km from end of proposed roads/ 3,750 cum	Existing sand mine run by individuals residing in Zokhawthar village
2.	Tuipui River	300 m from existing Seling to Champhai road/ 3,920 cum	Existing sand mine run by individuals residing in Champhai Village



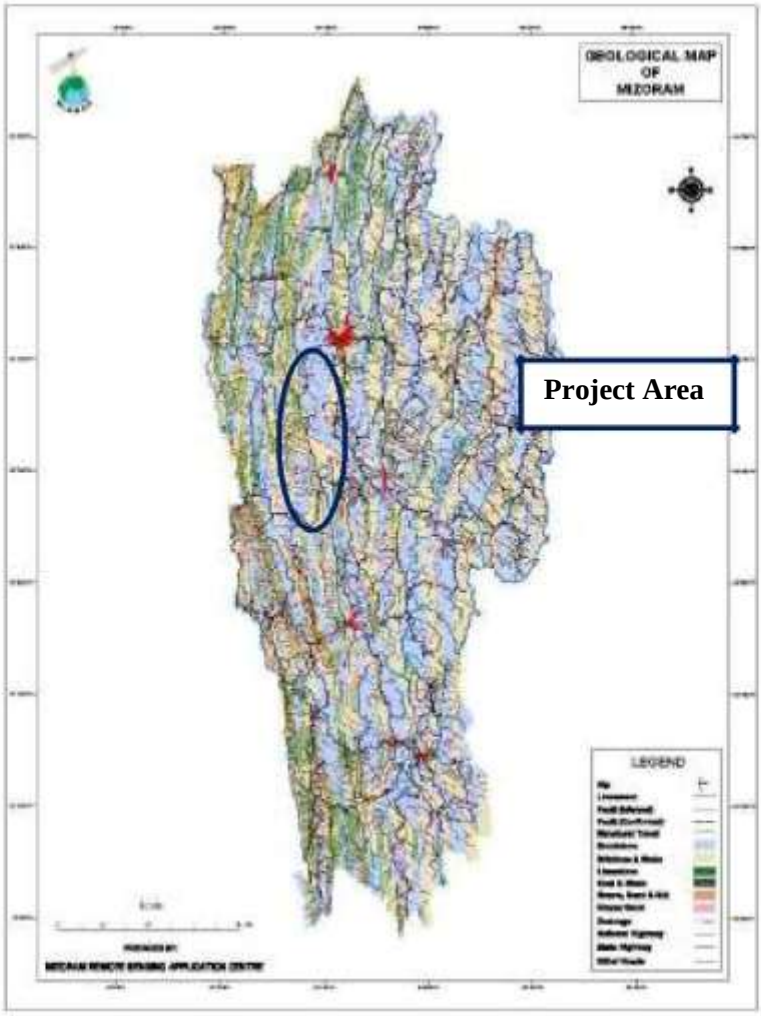
Map 5.1:.The land use and land cover map is prepared using RESOURCESAT LISS IV satellite data



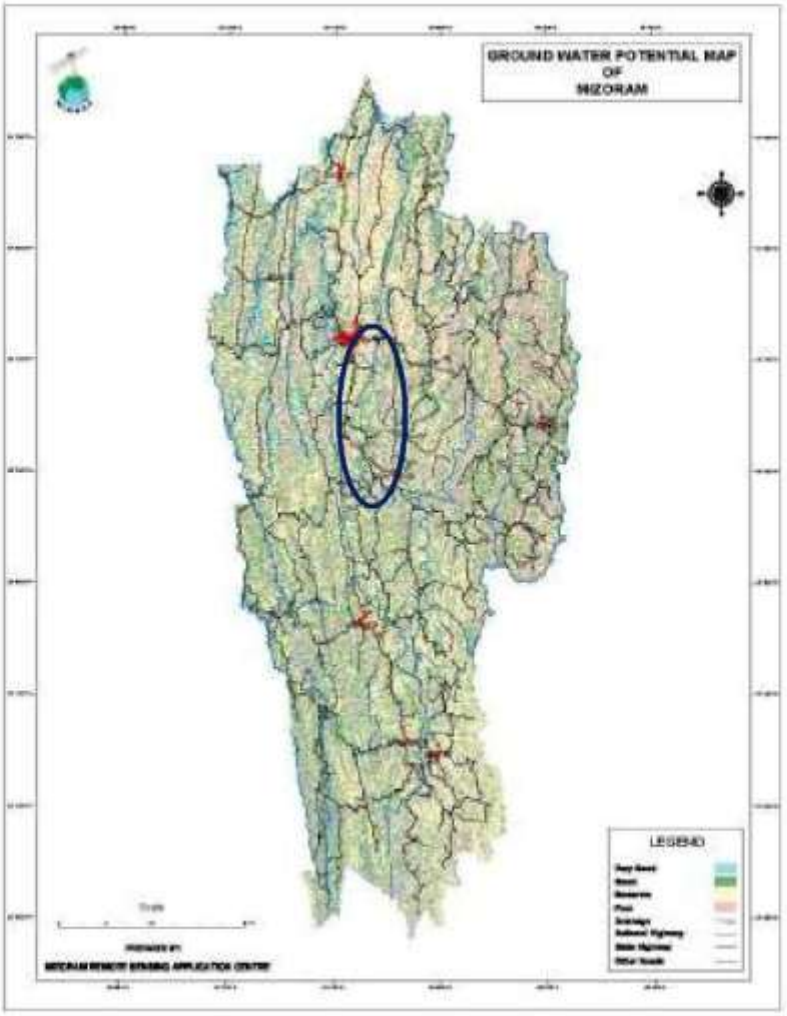
Map 5.2: Elevation Map of Mizoram



Map 5.3: Geomorpholgy Map of Mizoram



Map 5.4: Geological Map of Mizoram



Map 5.5: Ground water potential Map of Mizoram

CHAPTER- 6: COMMUNITY CONSULTATION

6.1 Introduction

Public participation and community consultation has been carried out at different stages of Champhai –Zokhawthar (C-Z) Road planning and design. It is a continuous two way process, and will continue during remaining period of preparation as well as during implementation. Various tools and methods, as described in the Environmental Management Framework (EMF)[4] and Social Management Framework (SMF), were/will be used in different consultations depending on the stage of project, the target audience, and purpose of the consultations. In order to solicit the views of the project affected persons and other stakeholders about the project and its impact on them; public information and consultation (PIC) meetings were conducted at different stages of project-preparation during August to December 2013.

Following consultations and stakeholder meetings were carried out prior to EIA:

- During the process of screening site visit to C-Z Road (from June 2013 to August 2013) informal discussions with roadside settlers/ road neighbors at different places along C-Z Road (Champhai, Melbuk, Mualkawi, Zotlang, Ruatlang and Zokhawthar village) for getting local people's views/ observations/ insights on the secondary environmental information as well as potential sensitive environmental sites and issues. (Refr

Photo 6.1: Discussion with villagers in Melbuk & Zotlang Vilages

- From October 2013 to December 2013, meetings with the NGOs/ CBOs and village councils at Champhai, Melbuk, Mualkawi, Zotlang, Ruatlang and Zokhawthar

[4] *See consultations objectives, methods and tools in EMF and SMF prepared for the MSR II – RTCP.*

village; as well as meeting with site offices of the government at Champhai Mualkawiand Zokhawthar.

Photo 6.2: Discussion with villagers in Zokhawthar & Mualkwai Vilages

Photo 6.3 : Consultation with villagers in Melbuk village for finalization of diversion and road alignment

- Formal consultation on the C-Z Road's Screening Report[5].

  A consultation was organized at Conference Hall, PIU,PWD Aizawl on 31.08.2013 to discuss the findings of the environmental screening of C-Z Road and to get suggestions. Another objective of the consultation was to finalize the TOR for EIA study of C-Z Road. Issues raised during consultation and response of PIU have been given in Annexure- 6.1 of this report.

- Formal Consultation on EMF.

  A stakeholder consultation was organized at Conference Hall, Aijal club, Aizawl on 18.11.2013 to discuss the findings of reviews done in the process of EMF

[5] *See C-Z Road Environmental Screening Report*

development, and content of the draft EMF. Issues raised during consultation and response of PIU have been given in Annexure- 6.2 of this report.

Photo 6.4: Stakeholder consultation workshop on EMF and SMF

6.2 Consultations during EIA

In the process of EIA, following consultations were carried out: (i) Focus Group Discussions, and (ii) Community Consultations,

Focus Group Discussion

Following FGDs were carried out[6] in the places along the C-Z Roads at the dates (from 26th December to 28th December 2013) indicated with the group identified.

- NGO and CBO
- Vehicle operators
- Roadside inhabitants
- Religious/ cultural groups

Community Consultation

[6] Refer section 4.3 and table 4.1

Formal community consultations were carried out at Champhai, Melbuk, Mualkawi, Zotlang, Ruatlang and Zokhawthar At the village/ community consultation, PAPs and local government leaders (the Village Council Leaders), the local voluntary organisations (including the "Young Mizo Associations"YMA, and MIHP) had been consulted. Most of the village meetings were conducted in the form of group discussions, based on an open-ended schedule. The minutes of the village meetings had been recorded/ documented.

6.3 Environmental Issues / concerns raised during consultation

From all consultation sessions (household, village and state levels) it was found that the participants were aware of the project. They also made several recommendations about the plan, design location of disposal sites, source of water during construction and location of campsites.

The principal issues raised during the various stages of community consultation and the perceptions about the project are summarised in **Table 6.1.** There are several recommendations about the plan, design location of disposal sites, source of water during construction and location of campsites.

Table 6.1: Principal Issues, Opinions & Perceptions of the Communities

Sl. No.	Issue	Perceptions, Opinions & Suggestions	Response of PIU
1	Landslide	People want a good road, but are concerns on the issue of landslides that may trigger due to fresh hill cutting.	PIU explained them the design and slope protection measures considered in the project and assures them to reduce the same.
2	Water Harvesting structures	The location of their water collection points are close to the road, Villagers were concerned that these may be damaged during construction. .	PIU assured them to minimize the impact on such structure and reconstruct the same in suitable location in consultation with villagers. PIU also assured for some additional water harvesting structure in the villages
3	Water Requirement during construction	Water Scarcity being felt throughout the year, water required for road construction was a concern for the villagers. They also suggested some source of water which contractor can develop during construction which will be beneficial for the community.	PIU assured to follow the suggestion of the villagers and also assured that community water source will not be disturbed and affected during construction.

Table 6.1: Principal Issues, Opinions & Perceptions of the Communities

Sl. No.	Issue	Perceptions, Opinions & Suggestions	Response of PIU
4	Construction waste disposal	Dumping of earth/soil residue should be done at a sites designated by the respective village representatives. If crop or land is damaged due to waste disposal, the affected persons should be compensated fully. Fear of landslides due to cutting down of trees and bringing down of hill slopes.	PIU assured the dumping in designated disposal sites and also explained them the toe protection , compaction and slope protection on the disposal sites. PIU also informed that community will be involved in management of disposal sites.
5	Bypasses/ diversion	In most of the villages, the communities were in favour of developing the road along existing alignment through the village. Conversely, people were not in favour of bypasses. (This is related to the fact that the village settlement pattern in Mizoram, otherwise a difficult terrain, was entirely dependent on the roads and the road-form.) .	PIU explained them about the trade corridor and safety issues related to the road development and convinced the villagers for diversions
6	Degraded forest land/ plantation area	About 0.28 ha plantation area mostly rubber plantation will be affected due to the widening of the road. .	PIU assured the villagers that plantation area will be compensated with double the number of trees. Vegetation cover in the area will increase due proposed plantation along the road and for slope protection
7	Road Safety	People expressed concern about safety of the local inhabitants (as the residential and/or commercial properties in the villages are located very close to the road, and the roadway is not very wide). Due to increase in motorized traffic, the people are willing to limit their commercial activities on the roadside and shift their residence away from the road, for the safety of their children.	PIU assured that safety issues has been taken care in the design and will be implemented. PIU also explained that time to time they will also organize safety awareness programs for the safety of the villagers and childrens.
8	Alignment options	People living on the valley side of the road were concerned about the difficulty to move their properties away from the road (as the valleys	PIU informed the community that widening of the road has been considered mostly on the hill side but due to technical, environmental

Table 6.1: Principal Issues, Opinions & Perceptions of the Communities

Sl. No.	Issue	Perceptions, Opinions & Suggestions	Response of PIU
		were very steep), and had suggested cutting the hillside for widening the road.	and R&R issues some time valley side has been considered. PIU also assured all type of assistance to the PAPs
9	Labour Camps	People want that the labour camp should be established away from the village and habitation. People do not want that the labourers should settle down, in their neighborhood, after completion of the project.	PIU assured that labour camp will be constructed in consultation with village council and also explained them the guideline to be issued to the contractors for camp establishment.
12	Quality Control	There was apprehension about timely completion of, and quality control in the project.	The implementation schedule and arrangements, including the procurement of supervision consultants and technical auditors were explained to the people.
13	Dust pollution	Dust, rubbles from demolished (or cut) hillside, and those from dismantling of building structures worried the community. Without proper precaution, the houses and gardens (or orchards) on the valley side would be impacted due to dust, debris or construction wastes.	PIU assured that time to time water will be sprinkled in the villages during construction within the settlements and dust suppression measures will be installed in Hot mix plant, batching plants, crushers and WMM plants
14	Noise Pollution	Noise pollution was also an issue particularly on the stretch with in the villages	PIU assured the villagers that all measures will be implemented during construction to reduce noise within settlements especially during night, prayer time and Sundays.
15	Community Involvement and employment	The communities were of the view that they should be consulted at various stages of the project, from preparation to project implementation and local people should get employment during construction.	PIU assured that local people will be given priority for employment in contractor as per their skill and qualification.

6.4 Consultations for identification of disposal sites and construction water

Consultations in terms of Focus Group discussions (FGD) were carried out with the villagers in all the villages to identify the probable disposal sites which may be individual land or community land which can be used for community welfare purpose – like football ground, village market etc. Note on such consultations has been given in

annexure 6.3 of this report. During these consultations suggestions were also received from villagers for identification source of water for construction and construction camp locations. Additional disposal sites[7] identified are-

- The existing football ground is located about 800 Km from the proposed alignment of 17.50 km.
- The community market shed is proposed to construct along the alignment at 16.80 Km
- The existing football grounds are located about 0.70 Km (Playground 1) and 0.90 Km (Playground 2) from 9.3 Km of the proposed alignment.
- The existing football grounds are located along the alignment in between 2.6 to 2.8 Km in Zotlang village
- community market shed is proposed along the alignment of 3.6 Km in Zotlang village

Suggested water source for construction are-

- Water required for construction of road and labour camp will be harvested from the water point located at 16.900 Km which is 200 m from Melbuk village.
- *From Dam Tuikhur* which is 0.8 Km from the proposed alignment in Mualkwai village.
- Water may be harvested from the natural spring 1.2km from proposed alignment at km 3.6
- Water requirement for the construction may be harvested from Lungloh tui, which is located at 2 Km from the proposed alignment at Zokhawthar village

[7] 12 disposal sites have already identified by design consultant


Consultation at Hruaikawn


Consultation at Zotlang


Consultation at Mualkwai


Consultation at Melbuk

Photo 6.5: Consultation with villagers for identification of potential disposal sites and water source for construction

6.5 Perception and felt needs of the community

6.6.1 Community perception

The overall opinion, among the villagers in general and the PAPs in particular, was that the project is very beneficial to all of them. The people welcomed the idea of road improvement and expressed willingness to support the project activities in all possible/feasible ways. The communities' opinion regarding the positive effects of the project were:

- The project would accelerate development of trade and commerce, which in turn would lead to an overall increase in the standard of living in the villages.
- The project would enable the people to save time, money and fuel.

- Travelling to places like Lunglei and Aizawl , Champhai for medical treatment would be easier.
- Villagers would be able to sell agricultural produces more profitably as improved road condition will enable access to a wider market area. More villages would be able to sell perishable goods to the urban centres (which is difficult now due to the long travel time).
- More individual households would be able to open small roadside businesses (such as provision shops, 'vehicle repairing' shops, restaurants) either as an alternative source of income, or to augment their income.
- Influx of tourists and visitors would help the local entrepreneurs.
- Value of land will increase after the project is operationalised.
- Communication with other villages and urban areas will be improved or facilitated.

6.6 Plans for Continued Consultations and Information Dissemination

The EIA/ EMP will be disclosed in the following places.

- Aizawl.
- Champai

The disclosed EIA/ EMP as well as social documents will be kept for public reference at State Public Library, Aizawl and with the village council of the affected villages along the C-Z Road. All these places will be open to the public without any restriction.

The reports shall also be available at the World Bank Infoshop at Washington DC, as per the World Bank disclosure policy. In addition to this, the copy of the report shall be available with the PWD headquarters at Aizawl, PIU Aizawl, and the C-Z Road site office. The report from these places will be available to the public on request for reference.

PIU, PWD will provide actual information on the policies and other provision in the EIA and EMP to the people, in regular basis. For this, following actions are proposed;

- The Environmental Cell of PIU, PWD will appraise the communities about progress in the implementation of the EMP.
- There will be a grievance redressed mechanism described in RIPDP
- Consultations will take place with communities regarding improving existing local amenities and/or creating new community's amenities as proposed in the DPR of C -Z road.

CHAPTER 7- ANALYSIS OF ALTERNATIVES

7.1 Introduction

The objective of the route alignment study is to determine various alternative alignment options and to identify relative acceptable and preferable alignment. With a view to appreciate the feasibility and relative strength, weakness of the alternative proposals marked on the toposheets, and site evaluation of the same have been carried out. This was manifested through identifying the problems, shortcomings along with probable route.

The Project Road from Km 0.0 to Km 26.0 has road geometrics of State Highway (SH) Standards with single lane and in some place with intermediate lane. For the up-gradation of the road to the double lane standards, the existing gradients & radius have to be improved for safe and smooth flow of traffic. However, in many stretches, the gradients are very steep and the road has to be realigned. Based on the reconnaissance and other surveys, it is identified that more or less the complete road has to be improved. In this effort, there are two situations for improvement of the road geometric:

Realignment Sections: The existing road geometric in certain stretches cannot be brought within the permissible level of the road geometric of the double lane standards. In view of that, the realignment has been resorted to. Design Consultant has studied a number of options before finalizing the realignment sections.

Regradient Sections: The balance portion of the road after realignment is to be regraded in order to remove kinks, undulations, unevenness and fast changing gradients so as to bring the geometrics to the parameters of the two lane standards.

7.2 The alternative routes / re-alignment sections

Following three re-alignment options have been studies[8] (Refer figure 7.1).

- Re-align the existing initial stretch of the Champhai – Zokhawthar road between km 0+000 to 3+000 by shifting the existing take-off point at km 150+000 to a proposed new take-off point at km 146+000 (i.e. located at outskirt of Champhai town) on Seiling – Champhai road

[8] Refer section 2.2.1 of chapter 2

- The realignment has been proposed for Mualkawi village (Km 7+640 to Km 9+200)

- The integrated realignment avoids the settlement at Melbuk village and Zokhawthar (Km 17+050 to Km 24+300).

The details of each option is given below.

7.3 Comparison of re-alignment options

7.3.1 Re-alignment 1 (0+000 to 3+000): Champhai

The initial stretch of the Champhai – Zokhawthar road passes through heavily built-up areas of Champhai town. The overall existing alignment passes through steep terrains which are unstable and landslide prone area at many locations and could pose serious problems in the future. Due to these reasons, it was necessary to re-align the existing initial stretch of the Champhai – Zokhawthar road between km 0+000 to 3+000 by shifting the existing take-off point at km 150+000 to a proposed new take-off point at km 146+000 (i.e. located at outskirt of Champhai town) on Seiling – Champhai road. (Refer figure 7.1). Table 7.1 compares implications of upgrading in the existing alignment and constructing new ones in terms of technical, social and environmental consequences.

Table 7.1 Analysis of Alternatives for Diversion/Realignment - 1 of C-Z road

Sr. No	Indicators	Unit	Upgrading the existing alignment	Constructing new alignment
1.	Length	Meters	0 to 3660	0 to 3560
2.	Proposed Row	Meters	24	24
3.	Approximate land area required	sq.mtr (hectare)	82680 (8.268 ha)	82680 (8.268ha)
4.	Approximate cost of land to be acquired	Rupees (Million)	156	156
5.	Impact on agriculture land	Hectare	Nil	Nil
6.	Impact on forest land	Hectare	Nil	Nil
7.	PAPS affected	Number	1250	350
8.	Structures likely to be affected	Number	190	27
9.	CPRs likely to be affected	Number	10	2
10.	Cost of Resettlement	Rupees	23	5.2

Table 7.1 Analysis of Alternatives for Diversion/Realignment - 1 of C-Z road				
Sr. No	**Indicators**	**Unit**	**Upgrading the existing alignment**	**Constructing new alignment**
	and rehabilitation	(Million)		
11.	Volume of excavated material/ debris	cubic meter	Cut 50429/ Fill 50429	Cut 50429 / Fill 50429
12.	Number of trees likely to be affected	Number	121	212
13.	Risk of landslides/ slope instabilities	High/low	Low	Low
14.	Impact on Water sources	Number	Nil	Nil
15.	Impact on Cultural sites	Number	Nil	Nil
16.	Impact on Bio-diversity(important species, habitat etc)	High /low	Low	Low
17.	Risk of traffic accidents	High/low	High	Low
18.	Civil construction cost	Rupees (Million)	260	260

Based on comparison of constructing new alignment option with existing alignment it may be concluded that constructing new alignment option is better than the existing alignment because widening with realignment will require same amount of land , impact on structures is, community structures, no project affected family, resettlement and rehabilitation cost is less than the existing alignment upgradation. It will also generate same amount of excavated earth and better safety for the villagers and less construction cost.

7.3.2 Realignment -2 (Km 7+640 to Km 9+200): Mualkawi

Existing alignment is passing through Mualkawi village, where width of carriage way is about 5 to 5.2 m. widening within the village is difficult due to linear settlement along the road and heavily buildup areas within the village. Within this road stretch there are few sharp curves and children and villagers are most of the time are on the road. Realignment has been proposed for this portion of the existing road considering - minimum displacement of people, improvement of the alignment considering high speed corridor and international trade rout, safety of villagers during construction and operation of the road .

The proposed realignment take off points are near the village which will not deprive the connectivity with villages and hence, the villagers would be the benefited with the proposed alignment (Refer figure 7.2).

Table 7.2 Analysis of Alternatives for Diversion/Realignment - 2 of C-Z road				
Sr. No	**Indicators**	**Unit**	**Upgrading the existing alignment**	**Constructing new alignment**
1	Length	Meters	1800	1600
2	Proposed Row	Meters	18	24
3	Approximate land area required	sq.mtr	32400 (3.24)	38400 (3.84)
4	Approximate cost of land to be acquired	Rupees (Million)	18.70	22.17
5	Impact on agriculture land	Hectare	0.97	1.1
6	Impact on forest land	Hectare	Nil	Nil
7	PAPS affected	Number	285	120
8	Structures likely to be affected	Number	56	6
9	CPRs likely to be affected	Number	2	1
10	Cost of Resettlement and rehabilitation	Rupees (Million)	8.5	2.4
11	Volume of excavated material/ debris	cubic meter	Cut 195475/ Fill 12565	Cut 231385/ Fill 10404
12	Number of trees likely to be affected	Number	976	1123
13	Risk of landslides/ slope instabilities	Rupees (in Million)	127.8	113.6
14	Impact on Water sources	High/low	Low	Low
15	Impact on Cultural sites	Number	Nil	Nil
16	Impact on Bio-diversity(important species, habitat etc)	Number	Nil	Nil
17	Risk of traffic accidents	High /low	Low	Low
18	Civil construction cost	High/low	High	Low

Based on comparison of realignment option with existing alignment it may be concluded that realignment option is better than the existing alignment because widening with realignment will require less amount of land, impact on structures, community structures, project affected family, resettlement and rehabilitation cost, generation of excavated earth, better safety for the villagers and less construction cost.

The realignment option has been finalized mainly in view of the large scale adverse impacts on structures resulting in displacement and in light of the road safety concerns expressed by communities at Mualkawi village.

7.3.3 Realignment -3 (Km 17+050 to Km 24+300): Melbuk and Zokawthar

The proposed alignment also realigned at the existing road from Km 17+050 to Km 24+300 to buy pass the habitant and heavily built-up areas of the villages Melbuk & Zokhawthar. Within this road stretch, there are few sharp curves and children and villagers are most of the time are on the road. Realignment has been proposed for this portion of the existing road considering - minimum displacement of people, improvement of the alignment considering high speed corridor and international trade rout, safety of villagers during construction and operation of the road .

The proposed realignment take off points are near the village which will not deprive the connectivity with villages and hence, the villagers would be the benefited with the proposed alignment (Refer figure 7.3).

Table 7.3 Analysis of Alternatives for Diversion/Realignment - 2 of C-Z road

Sr. No	Indicators	Unit	Upgrading the existing alignment	Constructing new alignment
1	Length	Meters	8100	7300
2	Proposed Row	Meters	24 & 18	24
3	Approximate land area	square meter (hectare)	172800 (17.28)	175200 (17.52)
4	Approximate cost of land to be acquired	Rupees (million)	99.76	101.15
5	Impact on agriculture land	Hectare	5.18	5.25
6	Impact on forest land	Hectare	Nil	Nil
7	PAPs affected	Number	356	162
8	Approximate Structures likely to be affected	Number	110	28
9	Approximate CPRs likely to be affected	Number	6	3
10	Cost of Resettlement and rehabilitation	Rupees (million)	20	6
11	Volume of excavated material/debris	cubic meter	Cut 1435872/ Fill 98283	Cut 1228872/ Fill 118283
12	Number of trees likely to be affected	Number	830	1856
13	Risk of landslides/ slope instabilities	Rupees (in Million)	127.8	113.6

14	Impact on Water sources	Number	Nil	Nil
15	Impact on Cultural sites	Number	Nil	Nil
16	Impact on Bio-diversity(important species, habitat etc)	High /low	Low	Low
17	Risk of traffic accidents	High/low	High	Low
18	Civil construction cost	Rupees (Million)	575.1	518.3

Based on comparison of realignment option with existing alignment it may be concluded that realignment option is better than the existing alignment because widening with realignment will require less amount of land , impact on structures, community structures, project affected family , Resettlement and rehabilitation cost , generation of excavated earth better safety for the villagers and less construction cost.

The realignment option -3 has been finalized mainly in order to avoid impacts on structures in Melbuk and Zokhawthar, steep gradient of the existing road, and in light of the road safety concerns expressed by communities at these locations.

The re-alignment portions of the road also pass through areas with a much better topographical as well as soil conditions. Apart from the reduction in distance between Champhai and Zokawthar boarder point by Km 2.50, which would greatly benefit terms of vehicle operating cost and travel time, the proposed re-alignment is technically far better and financially cost effective in the long run.

7.4 Without project and with project scenario

Without project scenario

Because of the limited scope of the alternatives in hilly terrain of the state roads, existing alignment was generally followed. The up-gradation corridor is generally free from the traffic pressure. Because of the poor pavement condition and generally bad geometry of the road need to be upgraded. The “Without Project” (only routine maintenance) scenario entails:

- Increase in travel time
- Increase transportation cost
- Increased accidents

- Increased vehicle operation cost
- Reduced employment / economic opportunities.

The (Without Project) scenario would in fact be a major setback to effective solutions to traffic hazards and associated problems. It would also arrest the possible significant enhancement and economic development of the region.

With project scenario

The proposed project road up-gradation and improvement programme would provide better level of service in terms of improved riding quality and smooth movement of traffic. Socio-economic benefits that will accrue from the project includes all weather access, reliability, reduced transportation costs, increased access to markets for local products, access to new employment centers and employment to local workers on the project itself, better access to health care and other social services and strengthening of local economies.

Improvement of the corridor would not only reduce the travel time and operation costs of vehicles of Champhai, Aizawl and Lunglei bound traffic, but would also enhance the development of entire area, and help the marketing of the agricultural and horticultural produce of the region. This will enhance trading and would also help develop tourism.

Adverse environmental impacts of the project include topographic changes in the area due to hill cutting and eventual landslides, materials handling from local resources and marginal rise of air and noise pollution levels.

The impacts associated due to the project will be mitigated / compensated through providing appropriate mitigation measures, so that adverse impact will be minimized and development becomes environmentally sound and sustainable.

7.5 Comparison of without and with project

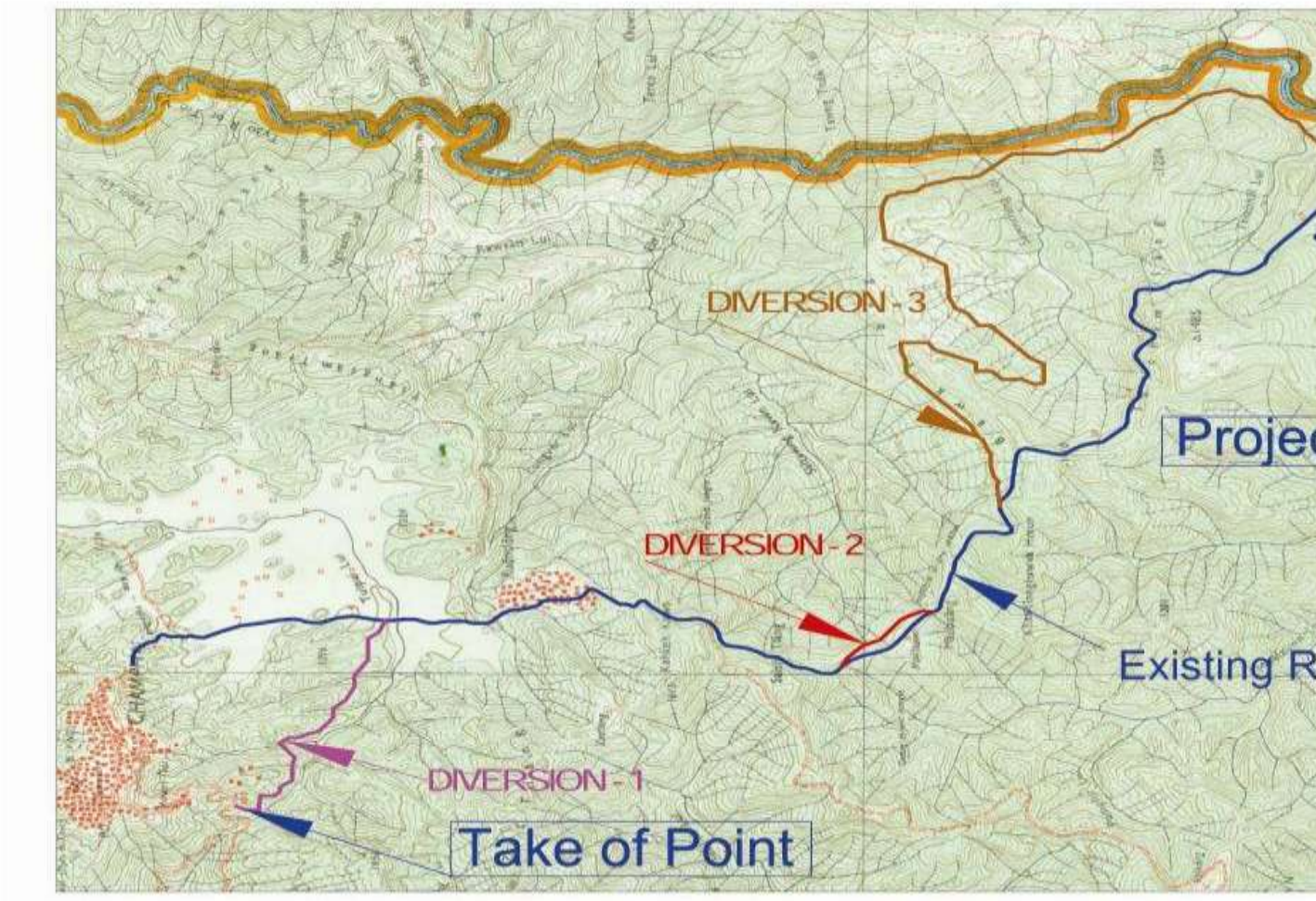
Following table7.4 compares implications of without and with up-gradation of Champhai – Zokhawthar in terms of technical, social and environmental consequences.

Table 7.4 Comparison of options without and With up-gradation scenario of CHAMPHAI – ZOKHAWTHAR road

S.N.	Parameter/ factor	Unit	With the existing alignment	With upgraded alignment
1.	Length	Meters	28.5 km	26 km
2.	Proposed Row	Meters	20	24
3.	Approximate land to be acquired	Hectere	34.2	64.2
4.	Impact on Agricultural land	Hectere	10.26	18.72
5.	Forest land affected	Hectere	0.28	0.28
6.	Approximate cost of land to be acquired	Rupees in million	170	300
7.	PAPs affected	Number	1881	632
8.	Approximate Structures likely to be affected	Number	356	61
9.	Approximate Community properties likely to be affected	Number	18	05
10.	Number of trees likely to be affected	Number	1927	3201
11.	Cost of Resettlement and rehabilitation	Rupees in million	51.5	13.6
12.	Civil construction cost	Rupees in Million	2441.40	2441.00
13.	Volume of excavated material/debris	In million cubic meter	1.0	1.05
14.	Risk of landslides/ slope instabilities	High/low	High	Low
15.	Impact on Water sources, number	Number	Nil	Nil
16.	Impact on Cultural sites	Number	1church wall and 2 graveyard	Nll

17.	Impact on Bio-diversity(important species, habitat etc)	High/low	Low	Low
18.	Risk of traffic accidents	High/low	High	Low
19.	Travel time		Increase	Reduce
20.	Transportation cost		Increase	Reduce
21.	Vehicle operation cost		Increase	Reduce
22.	Employment opportunity		Status -quo	Increase

Based on comparison of existing alignment with upgraded alignment it may be concluded that upgraded alignment is better than the existing alignment because it will enhance the quality of life of the people along the road as well as the people of that region.



Map 7.1: Project road showing Diversion / Realignment

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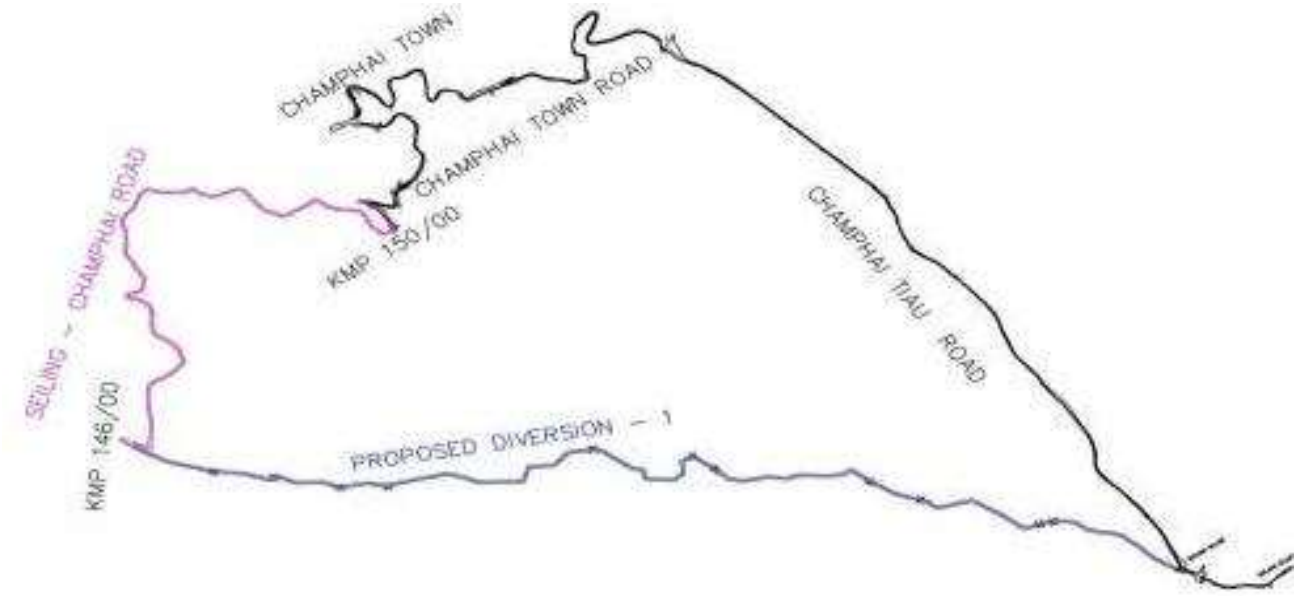

Figure 7.1: Diversion/Realignment – 1

The existing route cutting through busy Champhai town. The proposed new alignment through virgin land. There will be a 4.00Km long spur connection to Champhai-Tiau (Zokhaethar) road which will connect Champhai-Hnahlan road Zero point.

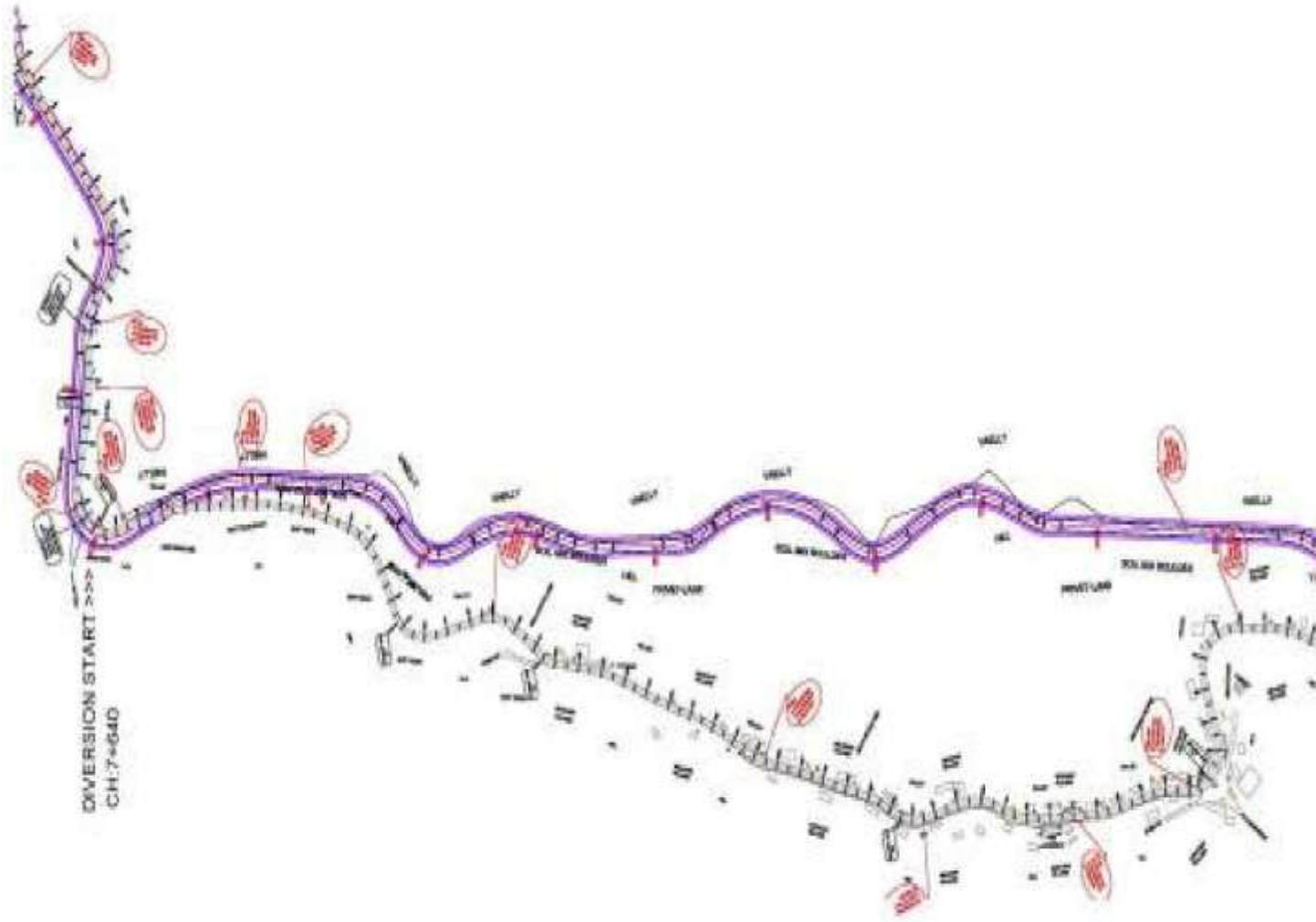

Figure 7.2: Diversion/Realignment – 2 for Mualkawi Village

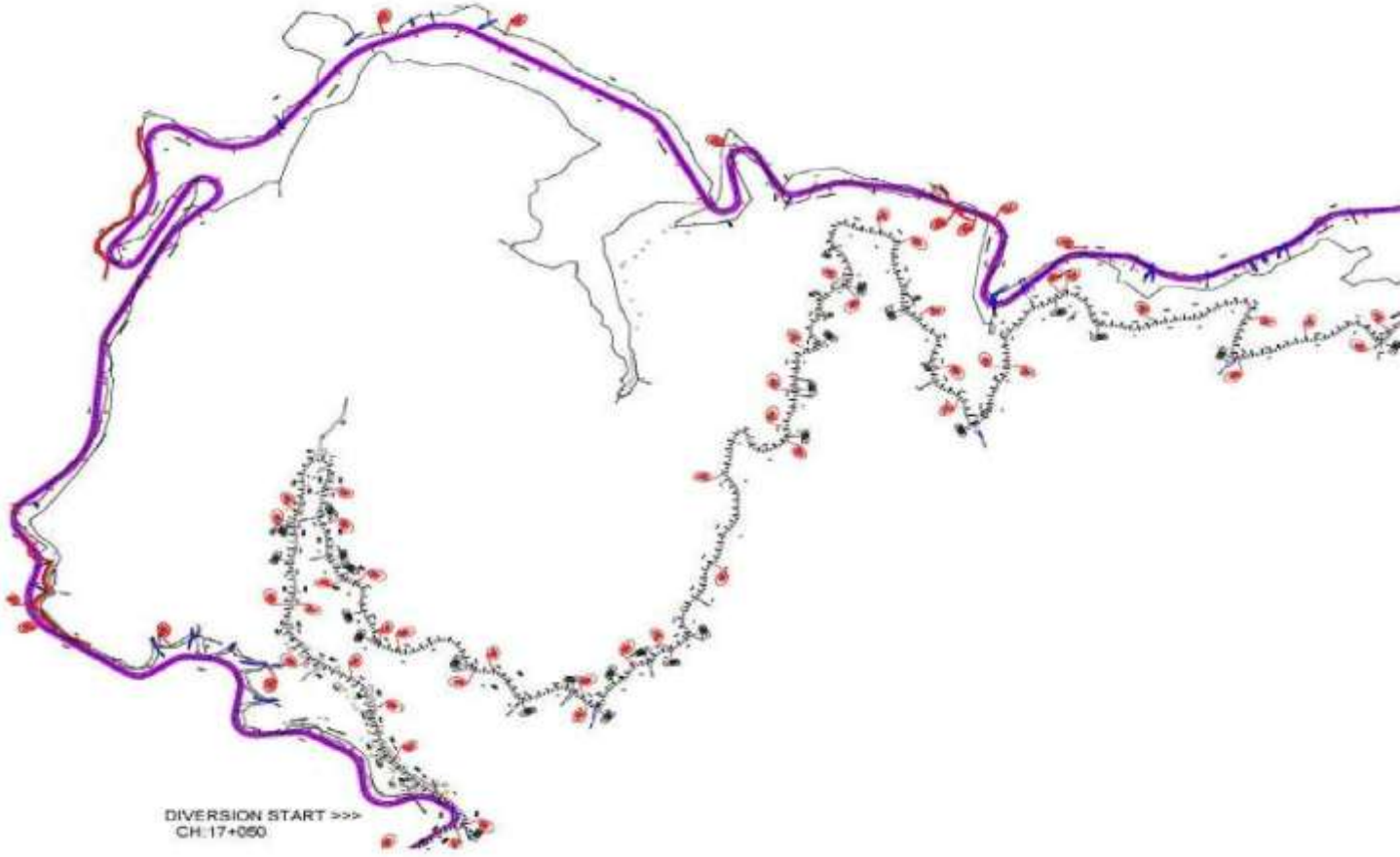

Figure 7.3: Diversion/Realignment – 3 (Melbuk Village & Zokhawthar Village)

CHAPTER 8 - ASSESSMENT OF IMPACTS

8.1 Background

Improvement of Champhai – Zokhawthar road in MSRP-2 project involves major up-gradation works including relaying of pavement and widening it to 7.0 m for up-gradation corridor. At almost all locations, the existing alignment is followed. Only at critical locations where the engineering, environmental and social aspects have warranted, a shift from the existing alignment has been proposed.

The impacts on various environmental components can occur at any of the following stages of the project planning and implementation:

Planning and design stage;

Construction stage; and

Operation stage.

8.2 Identification and assessment of impacts

The proposed project will have both positive and negative impacts on the surrounding environment. This chapter assesses the nature, type and magnitude of the potential negative impacts on the various relevant physical, biological and cultural environmental components along the project corridor. For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

8.3 Natural & Biophysical environment

8.3.1 METEOROLOGICAL PARAMETERS

Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by the loss of vegetation all along the roadside hill slopes. This shall result in increased micro temperatures, as the rock faces stand exposed devoid of shade giving vegetation. Moisture

loss from the soil will also increase due to loss of cover. Cumulatively, the construction of the road will make itself felt in terms of increased temperatures. As such no change in the wind patterns or precipitation is envisaged as only the roadside hill faces up to height of 10-20m are likely to be cut.

Although the impact is insignificant, it is reversible nature and shall be compensated for by additional plantation of trees and groundcover. All the lost vegetation cover shall be replaced in 2-3 years and microclimatic condition will return to its original state within 2-3 years.

Therefore, the overall impact on meteorology of the region is insignificant and has been categorized as low.

8.3.2 Physical Settings

The impact on physical settings means the impact of the project on Land Use, Geomorphology, Drainage, Geology, Soils erosion problem, Material Quarry area and Borrow Pits etc. Impacts on the above elements during construction and operation of the project have been discussed in the subsequent sections.

8.3.2.1 Impact on Land and Land use

Construction Stage. The project road is proposed to be compatible with NH. Accordingly it has been proposed to provide carriageway width of double lane standards. The formation width has also been proposed for 12m. The cross-drainage structures like 112 culverts are also proposed to be of two-lane standards.

Loss of agriculture land. Implementations of the project need acquisition of 48 ha of agriculture land. This may be classified as;

- Jhoom land – 35.8 ha
- Tiau river valley land – 10.7 ha
- Champhai valley land – 1.5 ha
- Forest land - 0.28 ha

The Jhoom land is 35.8 ha which is used for traditional jhum cultivation. Agriculture is the mainstay in Mizoram, with about 70% of the population dependent on agriculture. Shifting cultivation (Jhum) in Mizoram is cultivation on a periodic cycle on the hilly slopes, over a traditional 8-year cycle. With the increasing pressure on land, the jhum cycle has come down to 3 or 4 years. Loss of Jhum land will have impact on agriculture production. The Champhai valley land – are the prime agriculture land. These types of land are only present in Champhai valley. These are only irrigated land in Mizoram and used for Paddy production throughout the year and produce paddy three times in a year. Loss of 1.5 ha of prime agriculture land will have impact on rice production of Mizoram. Tiau river valley land are also prime agriculture land and used for paddy production. Loss of 10.7 ha of riverine prime agriculture land will have impact on rice production of Mizoram.

It is envisaged that at locations of Worker's camp, stockyards, storage go-downs etc. if these are located on fertile areas there will be impact on productivity of the soil in future. In the proposed project there is provision of earth fill high embankments. This will require huge quantity of earth. Fallow land is scare as most part of the project area passes through hilly area.

Provision has been made in EMP to ensure that no productive areas are used for these purposes. Effort has been proposed that earth generated during cutting will be used for the high embankment and other filling purposes. A guide line has been given in the EMP document for use of earth generated during hill cutting to minimize the impact on agriculture lands and hence the productivity of the soil.

If EMP will be followed during implementation of the project then the impact on soil productivity will be low in nature.

Destabilization of slopes and erosion. Slopes in project stretch are generally of shale and rockbound clays, which have poor strength and stability in cuts. Cutting of the hill faces to widen the road will have direct and long-term impact on various factors including stability of hills, safety, loss of vegetation, etc. Some of the impacts due to cutting of the hill are

- Disruption to stability of the cut slopes.

- Modification of drainage patterns and resulting erosion.
- Denudation of the hill slope, which triggers various secondary impacts.
- Increase in overburden on the valley slopes due to dumping of the debris from cut slopes resulting in their instability.

When natural conditions are modified by the construction activity, it marks the start of a race between the appearance of erosion and the growth of vegetation. Disturbances of the slopes will result in erosion, which will further trigger cumulative impacts far beyond the road itself, affecting slope stability, increasing turbidity in downstream water sources and causing other impacts as well.

However, geological profile along the C-Z Road corridor indicates bedding planes of the rock formation to be in favourable direction, due to which project corridor is stable and potentiality of land slide is less. Following locations have been identified as the vulnerable locations for landslides, due to unfavorable direction of bedding planes, opening of joint planes and joint planes dipping towards the road as well as the possible locations of soil slippage as well as possible impacts in these sites:

Km. 8+700 , Km. 8+900, Km. 9+400, Km. 14+900, Km15+300,Km 15+500 Km 15+900,Km16+300,Km. 18+600,Km 19+200, Km 22+800

During construction following area will be considered as land slide risk zone and will contribute more land slide – Km 7+640 to Km 9+200 and Km 17+050 to Km 24+300.

Slope destabilization and soil erosion is a potentially significant adverse impact, particularly in the core impact zone.

Potential mitigation measures that needs to be taken at vulnerable locations are worked out as presented in Chapter 9 (Avoidance and Mitigation of Impacts).

Impact on Land Use. Preparatory activities like use of existing access roads with/without improvements, construction of new haul roads, construction of temporary staff quarters, camp, and storage go-downs, stockyards etc. will be spread over the entire project area. This will change the land use pattern of the project influence area for a temporary period.

In the EMP provision has been made to ensure proper restoration of the land after the use. Though it will be a direct impact but the scale will be low in nature except marginally altering the land use pattern in these places for a short period.

Operation Phase. The project is a road-development project and as stated earlier it requires about 48 ha of land for development of the road. So land use pattern of the acquired land and the existing vacant land will change permanently. This will be a direct impact on land use pattern but side by side it will improve the socioeconomic condition of the area, which is a positive social impact.

Due to the development of the new roads there are chances of economic development and in the long run there is chance of ribbon development along the roads in most of the commercial areas which will have additional impact on the land use pattern of the project area in long run.

8.3.2.2 Geology and Drainage

Geology

The construction and operation of the project road will have no any significant impact on the regional geology.

Drainage

Construction stage. There are more than 112 water channels in the form of streams and nallah cascading down the hills of the up-gradation corridor. The proposed road entails cutting of the hill slopes to accommodate the widened road. Alteration of these drainage regimes brought about by road building can induce instability through erosion or release of pore pressure. The resultant impact could also bring out a new drainage pattern altogether, which has the potential to trigger other impacts.

The project is crossing over many canals and streams. Provision has been made in the EMP that during construction of the road contractor will adopt all possible measure not to disturb the flow of any natural and irrigation channel. No natural drainage channel will be

diverted during the construction of the road. So Impact on drainage during construction stage will be insignificant.

Operation Stage. Sufficient number of cross drainage structure like culverts and bridges have been provided in the design so that widening of road and construction of embankments will not impede the normal flow of the water channels in the operation stage. Hence impact will be insignificant.

In project road during field visit it was noticed that cross drainage structures which are in the form of hume pipe culvert or slab culvert are not adequate for drainage and water flow on the road and damage the road. The problem may be due to following:

- Lack of proper calculation of catchment area and volume water and selection of size of the drainage structure and drain
- Lack of cleaning of the drains and catch pits.

It was also noticed that most of the culvert got damaged due to erosion problem at the outlet of the culverts which in turn creating problem to the settlement and agriculture land below.

Drain out fall. Roadside drain outfall in the hill, sometime, leads to erosion and flooding/ stream bank scouring. Selection of proper outlet point and provision of erosion and scouring protection measures may be needed around the drain outlet points.

8.3.2.3 Impact on Soil

Construction Phase

Earthwork for Up-gradation corridor and dumping of spoils. Construction of the road will involve substantial quantities of earthworks including rock cuts. While balancing a portion of this excavated material has been achieved by designing the road in fill, massive quantities of cut material shall have to be disposed off. The quantities of the excavated material estimated to be used for the road construction and disposal at the dumping sites are as follows:

Earthwork in cutting - 1.05million cubic metres

Material used in road works - 0.32 million cubic meters

Earthwork to be disposed at dumping sites. - 0.73 million cubic metres

Dumping of excess spoil is a highly significant and a major environmental concern with multitude of environmental implications. Dumping of spoils/ debris/ construction material is likely to result impacts including triggering slope destabilization/landslide &erosion, destruction of agricultural land/ irrigation/ property, disruption of natural drainages, degradation of water bodies /siltation/ turbidity, degradation of vegetation/ vegetation cover, loss of bio-diversity, etc.

Potential sites for dumping[9] have been selected in such a way that these are away from the habitation and hence impact of dust on humans due to dumping of debris is not anticipated. Generation of dust due to debris disposal can be minimized through judicious selection of dumping grounds. The impacts due to disposal of debris shall be minimized by enforcing requisite precautions by the contractor.

Loss of agriculture productive soil. The most immediate, direct and long-term effect of cutting of the slopes is the elimination of the productive capacity and topsoil. Removal of topsoil will not only have implications in terms of loss of micronutrients to sustain growth of vegetation but also other socially useful plants and crops such as bamboo etc.

It has been estimated that 48 ha of agriculture land will be transformed in to road permanently and loss of productive soil. About 0.28 ha of forest land will also get transformed into road permanently.

Impacts due to Quarrying and Borrowing operations. Impacts due to quarrying will last for the construction period. The aggregate for construction shall be procured only from quarries operating with NoC from mining and geology department and with permission from forest department. Extraction of stones and development of quarries will also lead to loss of soil.

No borrowing of river sand is proposed. This will be substituted by stone dust, which will be procured from licensed quarries

[9] Refer section 9.1.4.6. In chapter 9 (12 dump sites)

The average embankment height of the project road is 1m and in some places 3m to 3.5m (high embankment regions) which requires quantity of material for embankment construction.

For the construction of shoulder and sub-base considerable amount of earth material is required. Material considered for the same is will be taken from the barren land and debris the project area and will be transported from shortest possible distance.

Provision has been made in the EMP that borrows areas will be selected as per the guideline of the EMP: for example spoil generated need to be reused for filling and other purposes. River banks and fertile agriculture lands will not be used as borrow area.

In some places the depression formed due to extraction of soil from the field will be used as ground water recharge area and will also act as a water body.

Provision has been made in EMP to ensure that no productive areas are used for these purposes. Effort has been proposed that earth generated during cutting will be used for the high embankment and other filling purposes. Use of fresh earth will be minimum. A guide line has been given in the EMP document for use of earth generated during hill cutting to minimize the impact on agriculture lands and hence the productivity of the soil.

If EMP will be followed during implementation of the project then the impact on soil will be low in nature. Hence, proposed improvement of the C-Z Road is unlikely to have highly significant adverse impact on soil of the locality.

Soil Erosion. All major construction activities tend to create certain changes in the soil condition of the area. Excavation denudes the topsoil and makes it loose. Destruction of topsoil leads to reduction of fertility and removal of vegetation cover with associated hazards of soil erosion. Hill cutting and dumping of spoil in improper dumpsite without erosion protection measures will lead to soil erosion. Construction of contractor’s camp will also lead such problems.

During construction of high embankments there is chances of soil erosion due to rain-wash especially during the monsoon but provision for slope protection measures has been

provided in the design. Implementation of such protection measures during construction[10] of the road will not create any adverse impact on erosion potentiality of the embankments.

Provision has been made in the EMP for proper disposal of earth spoil and guideline for Selection dumpsites and disposal techniques of spoil and its management. If EMP will be followed properly then impact will be minimum.

Operation Stage. During the operation phase the soil condition of the project site would be allowed to stabilize. The topsoil in the dumpsites areas would be restored and major portions of the area would be subjected to extensive plantation.

In case with the other highways it has already been observed that the highways pass through old stable soil and presently the impact of soil erosion from these highways is very less. There may be chances of soil erosion at high embankment. But, the impact will be minimum as due consideration has been given for the slope protection in high embankment areas during embankment design[11].

8.3.2.4 Impact of Quarry operation

Construction Phase. Construction materials for GSB, WMM, DBM ,BC, Cross drainage & Masonry R/Wall etc. works, will be available at Patea (Champhai) ,Pa Zualtea (Zotlang) , Zarzoliana , Tuichang and C.Malsawma Khawzawl quarry. Sand from local stream has been proposed for road construction.

No quarry is available on the C-Z Road and within 5 Km distance from the project area. Potential quarry identified above are outside the project area. Project proposes that the quantity of stone aggregates for the road construction (pavement and concrete) works is to be sourced from the above existing quarry sites and hauled to work sites. As the above mentioned quarry sites are sufficient to the requirement of C-Z Road improvements, there is no need to open a new quarry site. Therefore no major additional impact on environment / natural resource is anticipated. The existing stone quarries that may be used for getting material for the C-Z Road also, may or may not have environment management plan. In

[10] As suggested in EMP
[11] Refer DPR for Protective designs of high embankments

such situation, contractor will submit environmental due diligence report of the stone quarries for the approval of the PIU/ Supervision Consultant/ Environmental Specialist prior to sourcing material from the quarry. Any new quarry, if needed during construction, can only be opened with prior approval of quarry management plan by the environmental specialist/ PIU and supervision consultant/ Environmental Specialist as well as by State Pollution control Board.

Operation Phase. As discussed earlier no quarry sites are getting to be exhausted since the available stone materials are more than sufficient. During the operation phase there will be least impact from quarry operation or sourcing materials from quarry as the stone requirement during the operation phase will be negligible because material required for maintenance of the road very less.

8.3.2.5 IMPACTS ON AIR QUALITY

Construction stage. Along almost the entire up-gradation corridor, widening is to be carried out by cutting the hill rather than filling up the valley. Air quality along the project corridor will be adversely impacted both during the construction and initial few years of operation till the slopes are stabilized. Since massive cutting is involved, effects of the increased particulate (PM10 and SPM)[12] concentrations during pre-splitting/blasting and earthworks will dominate the construction stage impacts. Localized degradation in air quality will occur in areas close to hot-mix plants and batching plants.

Generation of dust. Generation of dust is the most likely impact during this stage due to:

Cutting of slopes towards hillside for widening of the Up-gradation corridor

Activation of Landslides and rock fall etc during construction

Quarrying operations

Handling and storage of aggregates in the asphalt plants:

Concrete batching plants;

[12] PM 10 (Particulate matter <10μ) and SPM – Suspended Particulate Matter

Asphalt mix plants due to mixing of aggregates with bitumen; and

Construction and allied activities on new re-alignments.

The impacts will mostly be concentrated in the Right of Way. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

Generation of dust will trigger further secondary impacts which are likely to be more severe, prime among which is impact on health of construction workers, especially workers in quarries, borrow areas and stone crushing units.

Generation of Dust is envisaged during operation for the first 3-4 years till the cut slopes are relatively stabilized and covered with vegetation. In the dry seasons during the operation stage, dust is likely to be generated from cut sections or slope faces.

Dumping of debris – source of dust. Since substantial cutting is envisaged along the up-gradation corridor and fill sections are short and the disposal of the excess cut material poses a real problem for the project. This will have to be done during the construction period and before road works begin. Both, transportation and tipping of the material are sources of dust into the environment. While the former is felt over the entire stretch between the cutting location and dumping site, the latter is more location specific albeit more intense.

Potential sites for dumping have been selected in such a way that these are away from the habitation and hence impact of dust on humans due to dumping of debris is not anticipated. Generation of dust due to debris disposal can be minimised through judicious selection of dumping grounds. The impacts due to disposal of debris shall be minimised by enforcing requisite precautions by the contractor.

The impacts will mostly be concentrated in the Right of Way. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

Generation of dust will trigger further secondary impacts which are likely to be more severe, prime among which is impact on health of construction workers, especially workers in quarries, borrow areas and stone crushing units.

Generation of Dust is envisaged during operation for the first 3-4 years till the cut slopes are relatively stabilized and covered with vegetation. In the dry seasons during the operation stage, dust is likely to be generated from cut sections or slope faces.

Generation of exhaust gases. Generation of exhaust gases is likely during the construction stage due to movement of heavy machinery, oil tankers etc. Movement of heavy machinery and vehicles uphill on steep slopes shall contribute to relatively higher emissions of gases.

High levels of SO_2, HC and NO_X are likely from hot mix plant operations. In the construction period the type of effect is limited to construction vehicles like dampers, trucks and other construction vehicles. The movement of these heavy vehicles through haulage roads will have air and noise pollution problems in pollution free areas.

Particulate matter would be the predominant pollutant affecting the air quality during the construction phase. Mostly the construction heavy vehicles will generate undesirable gases such as SO2, NOx, and CO. However, this would not lead to any tangible effects, as the expected traffic volume is very low and are mostly concentrated to the construction camp areas, haulage roads etc.. Volatile & toxic gases are released through heating of bitumen during the production of hot mix. Although the impact is much localized, (with in 500m) the effect shall be felt in the downwind direction. Implementation of the EMP will minimize the problems significantly.

Operation stage.

Generation of dust. Generation of Dust is envisaged during operation for the first 3-4 years till the cut slopes are relatively stabilized and covered with vegetation. In the dry seasons during the operation stage, dust is likely to be generated from cut sections or slope faces.

Generation of gases. It has been found that due to faster movement (60 km/hr) and good pavement condition impact on air quality in terms of concentration of carbon monoxide, Oxides of nitrogen and Hydrocarbon will be insignificant i.e. concentrations of the pollutants will be well within the limit of the CPCB[13] Government of India for residential and sensitive areas. Vehicular emission is a major contributor to the air pollution both in urban and rural environment. The vehicular

[13] CPCB- Central Pollution Control Board

emissions are determined by several factors like fuel composition, level of engine maintenance, vehicle age, speed and congestion, traffic and road condition. Human health, terrestrial flora and faunal health are the most immediate receptors of the vehicular pollution/emissions.

Simulation model used. TRRL model developed by the Transport Road Research Laboratory, U.K has been used for air-quality modeling. The model considered forecasted traffic up to the year 2035 and the emissions factors recommended by the Indian Institute of Petroleum, an autonomous body of Government of India mentioned below:

Diesel Driven Vehicles								
Speed								
Pollutant	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
CO	**37.80**	**18.80**	**12.53**	**9.40**	**7.52**	**6.27**	**5.37**	**4.70**
NOx	**66.83**	**33.42**	**22.28**	**16.71**	**13.37**	**11.14**	**9.55**	**8.36**
Petrol Vehicles (Independent of speed)								
Pollutant	**Cars**			**Two wheelers**		**Three Wheelers**		
CO	**2.72**			**2.0**		**4.0**		
NOx	**0.58**			**0.05**		**0.05**		

The projected concentrations at all stages of the Project Highway development were within the National Ambient Air Quality except for the suspended particulate matter.

The construction of improved highway will provide improved speed for the through traffic and reduction in congestion of traffic and improved pavement. So the project development will not have any significant impact on the air quality along the roadside as compared to present situation. As the 50% of the proposed road is on a virgin land and most of the residential areas are away from the proposed alignment i.e. at least 50m away from the edge of the road, so it will have no any significant impact on the residential areas due to road construction.

The highway construction will provide service areas, parking lay-byes and rest areas away from the human settlements, thereby diverting the trucks and other vehicles away from the human settlements/villages This will aid in improvement of air quality near the human settlements/villages along highway particularly at nighttime,

Government of India is committed EURO III& IV emission norms and providing cleaner fuels, the emissions can be expected to be lower than present levels in the coming years with the increased availability and usage of cleaner fuels.

Major impact on air quality during operation stage will be due to plying of vehicles. The impacts on air quality will, at any given time depend upon traffic volume/rate of vehicular emission within a given stretch and prevailing meteorological conditions. Since even at the end of the design life the vehicular traffic is unlikely to exceed 3000 PCU per day, the level of emissions of concern from the traffic during operation phase is quite low.

8.3.2.6 Impact on Water Resources

Impact on Surface water

Construction stage.

Impacts on Streams and nallah. The upgradation corridor between Champhai and Zokhawthar do not crosses any river only some small streams - Vawmkaw Lui at km 22.400, Dil Lui at km21.900, Saisih at km 7.900 , Tuipui hnar at km 2.8000 , Verhpui lui at km 3.6 and theiba lui at lm 23.700. These streams are perennial and shall be subject to adverse impacts especially during the construction period as:

There are chances of improper drainage of wastewater from the construction sites and thereby the formation of stagnant pool. The stagnant pool will promote breeding of mosquitoes and create generally insanity conditions. If this waste water get channelized in to the stream it will contaminate the streams.

But implementation of the guidelines as provided in EMP in construction camp will minimize all such problems.

During construction of culverts, in addition to disposal of the spoils into the riverbed, the increased sediment load due to the constricted waterway and consequent

increased sediment load will cause increased turbidity downstream of the culvert location. Discharge of culvert construction wastewater with high concentration of suspended solid load will disturb the aquatic ecosystem of the receiving water body. But implementation of the guidelines as provided in EMP for culverts construction sites will minimize all such problems.

Impact on the streams can be minimized if the culverts construction is taken up in the lean flow season.

Liquid and solid waste discharges from petroleum; oil and lubricant (POL) storage areas, work force camps and all other operational areas may impact the water quality of the receiving water body if disposed off directly. But implementation of the guidelines as provided in EMP in construction camp will minimize all such problems.

Construction workers' camps pose another major problem unless located in a planned manner. Sewage generated from these camps, unless disposed in a safe manner, can lead to problems of contamination of surface water sources.

Effluents from the hot-mix plants in the form of oil, grease, etc., if not contained and disposed properly could lead to pollution of land and water in the adjacent areas. This impact would be more pronounced in the km 0+500 to km 4+000, contaminating soil in agricultural fields and at 4+950 at the pond location.

112 culverts and Hume pipes have also been proposed for streams and canals. Thus these developmental activities will not have any significant impact on existing drainage systems.

Impacts on Pond. Along the project corridor, ponds owned by individuals residing in Champhai, Zotlang and Ruantlang at chainages 0.3 km, 2.15 km, 2.22 km, 2.265 km, 3.00 km, 4.525 km and 4.685 km are observed, and others water bodies are also observed within 200 m along the proposed alignment between 10.71 km – 12.20 km.

These ponds near the road are likely to be impacted during construction. The mechanism of contamination of the ponds will be same as discussed for streams and nallahas.

Operation Phase. Accidental spillage and highway runoff containing hazardous material may contaminate the receiving surface water body and the aquatic ecosystem may be disturbed. Garbage dumping on highways may also contaminate the aquatic eco-system. Waste discharge from the wayside amenities and the storm water run-off from the Project

highway may impact the watercourses. But implementation of the guidelines as provided in EMP during operation will minimize all such problems.

Impacts on Ground Water Resources

Construction Phase. In addition to these surface drainage channels, there are a number of hand pumps located along the up-gradation corridor which are used by the local community. A total of 3 hand pumps are to be impacted due to widening of the project road. Since ground water table is lower in the region as also being highly dynamic with large flows seeping into the streams, impact on the ground water quality due to the project, is insignificant. The area lost for recharge due to construction of black top is restricted to the CoI hence; the impact on ground water recharge is also not significant.

Construction workers' camps pose another major problem unless located in a planned manner. Sewage generated from these camps, unless disposed in a safe manner, can lead to problems of contamination of the ground water.

Effluents from the hot-mix plants in the form of oil, grease, etc., if not contained and disposed properly could lead to pollution of land and water in the adjacent areas. This impact would be more pronounced in the km 0+500 to km 4+000, contaminating soil in agricultural fields

Due to good availability of surface water resources along the project road throughout the year the construction water demand will be mainly depended on surface water not on Ground Water Resources. In some places especially water for the work force camps and construction activities ground water will be required but the quantity will be less. Therefore, there will be no potential impacts on ground water for the construction works.

The average recommended ground water yield of the region is up to 40 cum. per hour for shallow tube wells, 50-100 cum- per hour for medium tube wells and up to 200 cum. per hour for deep tube wells.

Consultation with Central Ground Water Board (CGWB), revealed the fact that considering the ground water yield/potential construction water demand for highway construction works would not have any significant impact on the geo-hydrology of the region.

Operation Phase. During operation of the highways there will be no any impact on the ground water sources except percolation of accidental spillage or hazardous material, if any in future.

8.3.2.7 Noise and vibration impact s

Construction stage. Potential noise affected receptors in C-Z Road include the settlements along the road, and the workers during construction stage.

Noise levels during the pre - construction stage shall be prevalent baseline levels apart from localised noise levels at locations where pre construction stage activities are taking place such as at workers camps, stockyards. These increased noise levels will prevail only for a short duration during the pre-construction stage. Moreover, as these activities are not likely to be near settlements[14] impact due to increased noise will be negligible.

Due to various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include excavation for foundation, grading of the site and construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage. Typical noise levels associated with various construction activities and various construction equipment are presented in Table 8.3:

Table 8.3: Typical noise levels of principal construction equipments
(Noise Level in dB (A) at 50 Feet)

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

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

[14] As per EMP camp will be outside of any settlement boundary (at least 500m away)

Noise generated from these machines will have impact on the potential receptors as mentioned above.

Though the noise levels presented for various construction activities far exceed the permissible standards[15], it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Though the noise level is within permissible limit in project area, the construction traffic and the use of construction machinery will increase the noise level causing, disturbance to the local residents.

Blasting to cut into the hillsides is another important source of noise. Though intermittent, extremely high sound pressure levels present a real risk to the workers on the site.

Operation stage. The operation stage impacts are of relatively less significance since the anticipated traffic volumes are quite low. Even by 2030 A.D., the traffic projections show that average daily traffic is unlikely to exceed 3000 PCU.

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

Thus, the increased noise levels are restricted to the construction phase only.

Vibration. Sources of vibration include blasting, operation of heavy construction plants & equipment, and movement of construction traffic during construction. Vibration could cause slope instabilities/ slips[16], and detrimental effects on the standing structures near the source of the vibration. The potentially risk locations where such risk exists in C-Z Road include the following chainage km- 7+050 to Km 7+150, Km 7+300 to Km 7+600, Km 10+100 to Km 10+740, Km 11+ 430 to Km 11+50, Km 12+800 to Km 13+200, Km 15+450 to Km 16+200, Km 18+500 to Km 19+000,Km 20+550 to Km 21+2400, Km 22+900 to Km 23+400.

[15] Noise rule ,2010, MOEF Govt of India and table 5.9

[16] See section For discussion on potential risk of slope destabilization and erosion.

8.4 Biological Environment

Construction stage

Impact on Forest. Forest clearance for the project road was sought from the concerned authorities in the prescribed Form vide Public Works Department, Mizoram for a land totalling 0.28 hectares which is a forest plantation area from km 9+300 to km 9+530 . The application, accompanied by a map showing the proposed alignment in the prescribed scale also clearly mentioned that the alignment was the best possible one.

The Forest authorities accordingly conducted a detailed survey of the alignment and the following is the findings of that survey:

- The proposed road alignment does not form part of National Park, wild life sanctuary, biosphere reserve, tiger reserve, elephant corridor, etc.
- No rare/endangered/unique species of flora and fauna are found in the area.
- No protected archeological/heritage site /defence establishment or any other important monument is located in the area.
- The requirement of forestland as proposed by the user agency in is unavoidable and barest minimum for the project. No alternative for the project exists.
- No work in violation of the Forest Act has been carried out.

After due verification and assessment, the Estimate for Net Present Value and Compensatory Afforestation has been duly framed by the concerned Mizoram Forest Authorities.

Loss of road side plantation & forest cover. Cutting of hill faces for the proposed widening means a loss of vegetation cover to the cut heights of almost 5-10 m on an average. Based on a most conservative estimate, about 693 trees and 300 bamboo clumps will be felled in the entire project corridor due to earth cutting along the hillside of the road. Potential affected area will be the forest plantation area, i.e. 230m of the alignment (Km 9+300 to 9+530) is passing through forest plantation area.

In addition, ground cover, bryophytes & pteridophytes are likely to be lost during construction, along the road and at locations where construction camp and yard are sited. The cutting of the slopes may trigger further landslides, which may bring down with it the green cover of the higher reaches.

Impacts on endangered species of Fauna and flora. Within the project corridor, the vegetation and fauna include the common herb, shrub, trees and some domesticated animals. No any endangered species of plant and animals have been reported within the project corridor. So highway development through the corridor will not have any impact on bio-diversity rather the bio-diversity will improve with the plantation of 5, 000 different tree species along the highway and in the rest areas. The clearing operations of the corridor will not have any impact on wild life species, threatened or endangered spices as these are not known to occur along the Project Corridor.

The proposed project road is mostly passing through jhoom agricultural Land (degraded jhum land) and few settlements and therefore during the operational phase due to traffic growth concentration of air pollutants will not have any significant impact on flora, fauna and human health.

A proposal for landscaping has been included in the in EMP as a part of the scope of work. Implementation of the landscaping program will give the area a good scenic beauty and bio-diversity of the area will improve. Due to development of green belt impact on air quality in the settlements will improve and impact on human health will be positive in nature.

Impact on medicinal plants. Many herb species were observed. They all were local common species. It is possible that they will be adversely affected when vegetation is affected due to various activities of the project, particularly within the right of way and its immediate surroundings.

8.5 Impact on cultural properties

There are no major protected or archaeological monuments to be directly impacted due to the project. However, there are several structures as graves located within the formation width of the road that will be impacted. However, there are local physical cultural sites near the road that may be affected.

Impacts on grave yards. The Proposed alignment is passing through five grave yard area

Km 3+200 Grave yard and portion of the church in Zotlang village Km 5+450 Grave yard at the side of the road

Km 10+500 Grave yard at the side of the road

Km 16+ 600 Grave yard at the side of the road

Km 24+ 300 Grave yard at the side of the road

These are of human sentimental attachments and sometime are of places of cultural and religious interest. Hence during finalisation of the road alignment due consideration has been given to avoid these graveyards to the extent possible, without compromising the technical aspect and safety aspect of the road. Provision will be made in the EMP to protect other such structures along the road which may be impacted during construction, by providing temporary barricade during construction and permanent protection / barricade will be provided to mitigate the impacts during operation of the road so that vehicle should not hit such structures directly because local people wants to preserve these structures because they have sentimental attachment with these structures .

Hence impact on such structures will be minimum during construction stage and negligible during operation stage of the road.

Chance Find. The upgrading works includes substantial amount of earthwork excavation and cutting along the C-Z Road route. Hence, possibility of findings physical cultural resources during construction may not be ruled out. If physical cultural resource is found during earthwork or other construction activities, the project will follow ”Chance Find” procedures outlined in the EMF (Annexure 18).

8.6 Loss of access

The link roads or village roads located towards the hillside of the up-gradation corridor are likely to be impacted in the proposed widening.

Although the existing link road alignment and slope shall be integrated with the new up-gradation corridor, adverse impacts in terms of difficulty of access, temporary re-routes etc shall be felt during the construction period. This impact though direct is temporary.

The proposed project will have a beneficial impact in terms of improved connectivity and access. There are link roads to every settlement from the up-gradation corridor.

8.7 Road Safety

The proposed road will benefit the road users in terms of improved driving conditions and geometrics, which translates into higher vehicle speeds. The change though mutually

beneficial to road users as well as the local people increases the risk to life of people living along the edge of the Project Road. The road is not only the lifeline of the local people in terms of connectivity but also a space where all daily activities are carried out.

Following are the places/ villages where increased risk to children due to the increased design speeds is likely.

5	Playground	3) Ch 2.600 – 2.800, Zotlang Village 4) Ch 4.400 – 4.500 Ruantlang Village
6	Churches	5) Presbyterian church, Zotlang, 50m RHS Ch 3.650, 6) Presbyterian Church, Mualkawi, 95m RHS, Ch 8.600, 7) Presbyterian Church, Melbuk, 75m RHS, Ch 17.250
8	School	7) Government Comprehensive School, Zotlang 85 m LHS from Ch 3.600, 8) Presbyterian School, Zotlang, 125 m LHS from Ch 3.800, 9) Springdale School, Zotlang, 50m LHS from Ch 4.100, 10) Government Middle School, Mualkawi, 200m LHS from Ch 9.100, 11) St. Joseph School, Zokhawthar, CL,Ch 23.980, 12) Pine Hill Seventh Day Adventist school, 285m RHS from CH 1.340 Spur Road.

8.8 Impact on common property resources

A number of common property resources such as community bus stops, public urinals and market shed are located along the C-Z Road corridor. Almost all the villages traversed by the Project road were found to have public urinals along the road. The community common resources located within the CIZ are listed in Table 5.7. During construction of the upgraded road following common property resources will be impacted.

Sr.No.	Description	Nos.	Location
1	Public Toilet	1	Ch 0.00
2	Public Urinal	5	Ch4120, Ch4950, Ch10580, Ch11800 & Ch12800
3	Bus Shed	5	Ch9000, Ch10580, Ch11800, Ch12800 & Ch.19700,
4	Bazar Shed	5	Ch 0.00,Ch 3250,Ch 7460,Ch Ch 16920 & Ch 24370
5	Churches	1	8) Presbyterian church, Zotlang, 50m RHS Ch 3.650,part of boundary wall
9	Hand pump	3	Zotlang village, Mualkawi, Melbuk and Zokhawthar

All such facilities will be relocated in consultation with the local people and will be reconstructed in suitable locations.

8.9 Other social impacts

Social Impacts & Mitigation

The social impacts due to the project up-gradation have been separately assessed. A separate Resettlement Action Plan (RAP) has been prepared to compensate the project-affected persons who are likely to be impacted due to the development of the Project.

Other social impacts due to the project such as increased risk of HIV/AIDS etc have been dealt with in detail in the R&IPDP.

8.10 Induced impacts

8.10.1 ROAD SIDE DEVELOPMENT

Improving connectivity to areas not presently accessible is an objective of the project. Improving access can lead to 116olonization of the roadsides, if there are no controls on development simultaneously in place. This problem will be more pronounced along diversions km 0+000 to 3+000 , Km 7+640 to Km 9+200 and Km 17+050 to Km 24+300 stretch as some of the villages will be located away from the road .

8.10.2 JHUM CULTIVATION

With the New Landuse Policy in place, negative impacts associated with Jhum cultivation are likely to be offset. With the improved connectivity due to the road, local populace will be moving towards settled cultivation from the present Jhum cultivation. This phenomenon is observed along the national highway is applicable to this stretch also. Hence, the project is likely to contribute positively towards reduction in Jhum cultivation.

8.10.3 LAND SPECULATION

The Proposed project will induce development in its wake development along the improved roads. There is likelihood of land speculation at location of new realignments..

8.10.4 TOURISM

Influx of tourists and visitors may increase due to improved accessibility. This may increase the extraction of forest produce, if uncontrolled. If, on the other hand, eco-tourism can be promoted, the protection, measures to be provided can be made sustainable.

CHAPTER 9: AVOIDANCE AND MITIGATION OF IMPACTS

9.0 Introduction

The Mizoram State Roads Project II (MSRP II) is envisaged to alter (both beneficially and adversely) various environmental components within its area of influence. To minimize the adverse impacts of the project, avoidance and mitigation measures have been formulated and will be implemented during the tenure of the project. These Mitigation measures would be directed towards restoration of dynamic balance of nature.

The avoidance measure like not- to-allow construction activities such as excavation, cutting, blasting etc during rainy season (June to October) to avoid landslides/ erosion/ slips during construction and mitigation of negative impacts involves reduction in magnitude of the adverse impacts during various stages of the project through:

- Alterations during design, site clearance, construction and operation stages of the road project and
- Additional mitigation measures for unavoidable negative impacts on the environmental components.

These measures were incorporated into various stages of the project. Based on their applicability, both general and case specific measures were incorporated as follows:

- General measures: To avoid or mitigate impacts on environmental components, general mitigation measures were identified based on the characteristic features.
- Specific: At various sensitive locations site-specific designs have been formulated as mitigation / compensatory measures for addressing the negative impacts.

The following sections detail the mitigation measures adopted as part of the MSRP II-RTCP to minimize the adverse impacts envisaged due to the project.

9.1 NATURAL AND BIOPHYSICAL ENVIRONMENT

9.1.1 METEOROLOGICAL PARAMETERS

Since the impact on meteorological parameters is not expected to be significant, there is little by way of project actions that can effectively alter the overall temperature, rainfall, or

even wind speed patterns of the project area. Whatever localised impacts are anticipated, shall be offset over time by re-vegetation, taken up as part of the compensatory afforestation and additional tree plantation as part of the project along the existing and newly created slopes. However, there would be some lag of 2 to 3 years before the vegetation on the slopes is sufficiently developed.

9.1.2 AIR

Impacts on air quality are expected to be of far more serious concern during the construction period than during the operation phase. Several avoidance and mitigation measures have been considered and adopted as part of the environmental management plan to control pollution during the construction period.

9.1.22.1 Mitigation of dust generation and its impact. The asphalt plants, crushers and the batching plants will be sited in the downwind direction from human settlements. A distance of a minimum 500m to 1km from the nearest settlement should be maintained in order to ensure that the concentration of the pollutants from these emissions diffuse enough to be within acceptable limits at settlement locations. All precautions to reduce the dust emissions from the hot mix plants, crushers batching plants and other transportation of materials will be taken up including:

- Provision of wind breaking wall, bamboo screens around the sources of dust such as the vibrating screens, conveyors, etc. should be made and regularly checked for all stone crushers used to supply material for the project.
- Vehicles delivering loose and fine materials like crusher dust and soil/spoils shall be covered to reduce spills on existing roads
- Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.
- The hot mix plant will be fitted with dust extraction units.
- In addition, quarterly monitoring shall be conducted at locations where earthworks or slope cutting operations are taking place.

9.1.2.2 Generation of Exhaust gases. Generation of exhaust gases is a concern especially from hot mix plants. To ensure the control of exhaust gas emissions from various construction activities, the contractor shall take up the following mitigation measures.

- An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided. Other measures as planting of vegetation around periphery of the construction sites shall be taken up.
- To ensure efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month during the period the plant is in operation.
- Contractors also should be required to obtain regularly *Pollution under Control Certificate* from Mizoram Pollution Control Board for their equipments and machinery as per prevalent norms. If adequate measures are taken then impacts from generated gases can be effectively controlled.
- Use of firewood in construction camps/preparation of asphalt mix shall be banned and kerosene and LPG as alternate fuel shall be supplied.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the State Pollution Control Board norms. Also pollution monitoring shall be conducted monthly at all these locations to measure the levels of polluting gases.

9.1.3 MITIGATION OF IMPACT ON SURFACE WATER RESOURCES

The construction process is likely to have a significant adverse impact on water resources along the up-gradation road unless adequate measures are framed and executed for the same as part of the EMP. The following mitigation measures shall be adopted to minimize impacts

Silt Fencing at Rivers and Water Bodies. To prevent any degradation of water quality of various surface and ground water resources due to the proposed project, the contractor shall work out the following measures during the construction period:

- Construction work close to the streams or water bodies must be avoided during monsoon.

- Discharge standards promulgated under the Environmental Protection Act, 1986 for surface water bodies will be strictly adhered to.

Various measures that have been proposed for protection of water quality along the corridor have been detailed below. Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses at;

Vawmkaw Lui at km 22.400,
Dil Lui at km21.900,
Saisih at km 7.900 ,
Tuipui hnar at km 2.8000 ,
Verhpui lui at km 3.6 and
theiba lui at lm 23.700.

Silt fencing will be provided to prevent sediments from the construction site entering into the nearby ponds at;

chainages 0.3 km,
chainage 2.15 km,
chainage 2.22 km,
chainage 2.265 km,
chainage 3.00 km,
chainage 4.525 km and
chainage 4.685 km.

Silt fencing consists of geotextile (MIRAFI 140N or equivalent) with extremely small size supported by a wire-mesh mounted on a panel made up of angle frame. Modules of 625mm each are designed to allow ease of handling and construction.

It is expected that a single person will be able to drive the angles 300 mm into the ground by pressing from the top. The frame will be installed at the edge of stockpile of material at water body along which construction is in progress. The wire-mesh will provide structural stability and the 25x25x3 mm angle section will act as posts for the silt fencing. The number of such units to be installed will be decided depending upon the length of the water body along the side of the road construction.

Oil Interceptors at Fuel Storage areas/Construction Camps. Oil and Grease from road run-off is a concern during construction. During construction, discharge of Oil and Grease is

most likely from vehicle parking areas of the contractors' camps. Thus, the source is well defined and restricted.

Location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body.

In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided.

Oil and grease interceptors will be provided in the fuel storage and vehicle cleaning areas, as well as workshop, repair and parking areas. In the interceptor, oil from water is separated by gravity. Enough detention time is provided for run-off entering the chamber to allow oil to float on to the surface.

The slopes of embankments leading to water bodies will be modified and re-channelised to prevent entry of contaminants into the water body.

Mitigation of conflict with local community for construction water

Judicious use of existing water resources

Water for construction will have to be procured from river and hauled or pumped to the construction site. The contractor will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.

While working across or close to perennial water bodies, the Contractor will not impede or block any flow of water. If for any drainage work, containment of flow is required, the Contractor will seek approval of the Engineer appointed by Supervision Consultant. The Engineer will have the right to ask the Contractor to serve notice on all downstream users in advance of any closure.

Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over drainage channel should be carried out such that disruption to the flows is minimised and high quality of water is maintained. Construction will be undertaken with permission of the Department of Irrigation. The Contractor may use natural sources of water subject to the provision that any claim arising out of conflicts with other users of the said natural sources will be resolved by him.

Water harvesting on Hillside

Harvesting of natural runoff was observed at a few locations on the hillside. Water can be harvested on hillside by constructing small check dams along the natural contour of the hillside where space is available. Water can thus be harvested along the natural course of the stream at available levels along the hill slope (for details refer EMP).

Water Harvesting on the Valley Side

It was observed along the C-Z Road that small check dams (up to 1.5m high) can be constructed on the valley side to stop the outflow of natural water from culverts. Harvesting at valley sides would be especially manageable at sharp bends/curves of the Project Road (for detail refers EMP).

Water Harvesting at Locations of Realignment

It is also feasible to store water at locations (on valley side) where the road has been realigned at sharp bends to straighten out curves and improve road geometrics. Runoff from waterfalls/streams can be stored in the reservoir created by the natural curve of the road and the retaining wall of the proposed road. (for detail refer EMP).

Harvesting of water at Hill and Road Interface.

Along the up-gradation corridor at locations of waterfalls/streams ample flat land was available between the base of the hill and the carriageway. Such locations offer space to create underground water storage tank along the path of the runoff. (for detail refer EMP).

9.1.4 MITIGATION OF IMPACT ON GROUND WATER RESOURCES

Roadside 3 hand pumps in Zotlang Mualkawi, Melbuk village are likely to be affected by the proposed widening of the up-gradation corridor. These shall be replaced within the nearest settlement area in consultation with the local community and the village councils.

9.1.5 MITIGATION OF IMPACT ON DRAINAGE

To ensure that the project does not obstruct the existing course of the surface water flow and alter the hydrological setting by acting as an impediment to the natural drainage system of the region; detailed drainage surveys and hydrological investigations have been

undertaken and suitable design culverts proposed. All the existing cross-drainage structures will be replicated and additionally, cross-drainage structures will be provided at locations, where the natural drainage flow is obstructed at present.

Roadside drainage system has been provided for efficient and speedy flow of the surface water. V-shaped drains of 150 mm thick cement concrete and having top width of 600mm and depth of 300 mm has been provided on the hillside throughout the project road except where it is passing through inhabited areas.

9.1.6 Prevention of Local Flooding

The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during construction especially at locations of streams. In sections along watercourses, and close to cross-drainage channels, earth, stone or any other construction materials shall be disposed off such that the flow of water is not blocked. All necessary measures will be taken to prevent earthwork, stonework and other debris from impeding cross-drainage at rivers, streams, water canals and existing irrigation and drainage systems.

In addition to the design requirements, the contractor will take measures for the prevention of flooding shall include, no loss of access of any land or property thereon resulting from flowing or stagnant water as direct / indirect impact of construction.

9.1.7 Blasting and Cutting of the Hill faces

Cutting of the Hill faces is the most significant construction activity, and needs to be done in a highly controlled manner. The Explosives Act, 1884 and the Explosives Rules 1983 will be strictly followed during procurement transportation, handling, storage and use of explosive. Explosive will be used in accordance with the recommendations of the Indian Standard Code of practice and will be stored under proper security at a safe distance from the road and at least 300 m from any inhabited premises.

Blasting of hard rock will be required at following places (chainage): 7+050 to Km 7+150, Km 7+300 to Km 7+600, Km 10+100 to Km 10+740, Km 11+ 430 to Km 11+50, Km

12+800 to Km 13+200, Km 15+450 to Km 16+200, Km 18+500 to Km 19+000,Km 20+550 to Km 21+2400, Km 22+900 to Km 23+400.

Controlled blasting will be used to limit the volume and extent of rock throw, and to reduce the disturbances of local flora and fauna.

Regular monitoring studies shall be conducted for assessment of land stability and landslide occurrence as discussed in EMP.

9.1.8 MITIGATION MEASURES DURING QUARRYING OPERATIONS

Materials will be procured from quarries having NoC from mining and geology department of Mizoram or licensed as per the gazette notification, 2000 and regulations of the concerned State Government Departments. Redevelopment plans for quarry areas from which material is extracted and have exhausted in the construction period, shall be developed by the PWD and implemented in co-ordination with the Mining & Geology Department, Mizoram and the Forest Department, Mizoram.

Construction materials for GSB, WMM, DBM, BC, Cross drainage & Masonry R/Wall etc. works, will be available at Patea (Champhai) ,Pa Zualtea (Zotlang) , Zarzoliana , Tuichang and C.Malsawma Khawzawl quarry. Water Absorption and AIV of these quarries are within the limit of the Ministry's Specifications.

The existing stone quarries, from where materials may be sourced, may or may not have environment management plan. So it has been proposed that contractor will submit environmental due diligence report of the stone quarries, if materials will be sourced from those quarry for prior approval of the PIU/ consultant and environmental specialist.

New quarry, if needed during construction, can only be opened with prior approval of quarry management plan by the environmental specialist and supervision consultant as well as by State Pollution control Board

9.1.9 MEASURES FOR CONTROL OF EROSION /SLOPE STABILIZATION

Retaining walls. The road design incorporates appropriate type of treatments of slopes to reduce the potential for erosion of high embankments and bridge fills. Appropriate retaining structures like breast walls, revetment has been provided in the design at vulnerable locations to stabilize slopes. Details about the type and size of breast walls provided at different locations of the project are given in the Engineering Design volume of the report.

To prevent destabilization of slopes at locations where the road is to be widened by filling on the valley side retaining walls shall be provided. Three types of retaining walls have been designed for different locations of the Project Road.

Dry Random Rubble Masonry for heights<=2.0m

Composite Random Rubble masonry for Heights>=2.0m <=5.0m
Mortared Random Rubble Masonry for Heights>5.0m <=15.0m

Breast Walls. Breast walls shall be provided to protect the slope on the hillside at different locations of the project Road. To enhance the stability of the hillside, three types of designs have been proposed.

Dry Random Rubble Masonry for heights<=2.0m

Composite Random Rubble masonry for Heights>=2.0m <=4.0m
Mortared Random Rubble Masonry for Heights>4.0m <=6.0m

9.1.10 MITIGATION MEASURES FOR DISPOSAL OF DEBRIS/CONSTRUCTION SPOIL

The debris generated will be re-used/ utilized in construction works such as filling, construction of retaining walls, embankments, filling pedestrian foot-path in settlement area, creating parking spaces, etc. However, a large quantum of debris will still remain to be disposed off. Dumping sites have been identified to ensure environmentally safe disposal of the construction debris. The locations of dumping sites have to be selected such that -

- No residential areas are not located downwind side of these locations,
- Dumping sites are not located in bio diversity rich or sensitive locations,

- Dumping sites do not contaminate any water sources, rivers etc, and
- Dumping sites have adequate capacity equal to the amount of debris generated.

The cutting activities shall generate an earthwork of 1.05 million cu.m. The disposal of which is an issue of concern. Earth generated from cutting will be utilised as construction fill material and also for building road subgrade. Remaining debris needs to be disposed at dumping locations. 9 numbers of dumping areas have been suggested on the proposed road which has been reviewed by the environment team to assess the suitability of the sites as dumping sites. All the sites mentioned below are suitable as dumping sites.

Sl.No.	Chainage		Remarks	Sl.No.	Chainage		Remarks
	From	To			From	To	
1	1.280	1.310	LHS	10	22.950	23.400	LHS
2	1.860	1.950	RHS	11	24.370	24.470	LHS
3	2.960	3.035	RHS	1. Play ground at 800m from road alignment chainage km 17.50 2. Play ground at 70 m from road alignment chainage km 9.3 3. Play ground at 90m from road alignment chainage km 9.3 4. Play ground at km 2.6 to km 2.8 5. Zotlang football ground			
4	4.510	4.850	RHS				
5	14.100	14.160	LHS				
6	18.450	19.010	LHS				
7	20.180	20.450	RHS				
8	20.540	21.220	LHS				
9	21.450	21.510	LHS				

During consultations local NGO's and villagers suggested that some play grounds can be renovated by dumping excess earth in existing playgrounds located at the following locations:

800 m from the proposed alignment at chainage 17.5 km in Melbuk village
700 m from the proposed alignment at chainage 9.3 km in Mualkwai village 900m from the proposed alignment at chainage 9.3 km in Mualkwai village Km 2.6 to 2.8 along the road in Zotlang village

Proposed community market at km 3.6 in Zotlang village

Any new dumping site that may be proposed during construction will be screened by Environmental Specialist, site plan reviewed by environmental specialist, and based on the review approved by PWD.

Provision of Toe Walls to contain dumping spread. Toe Walls shall be provided to lend back support to the excavated rock/soil dumped on the valley side. Depending on the extent of dumped material the following types of designs are proposed to be used for constructing the Toe walls.

1. Dry Random Rubble Masonry for Heights<=2.0m
2. Bamboo/Gabion wire crates/bamboo crib walls for Heights, <=2.0m
3. Gabions for Heights >2.0m <=5.0m
4. Composite Random rubble masonry for Heights> 2.0m <=5.0m

The slope of the dumped material will be protected from erosion by grass plantation as well as by diverting surface water away.

In addition the contractor shall take the following precautions during disposal of debris:

i. During the site clearance and disposal of debris, contractor will take full care to ensure that public or private properties are not damaged/affected and that the traffic is not interrupted.

ii. Contractor will dispose off debris only to dumping locations having prior approval of PWD/ Engineer-in-Charge of works.

iii. Contractor will also dispose the debris for improvement of public utilities with the consent of villagers and approval of PWD/ Engineer-in-Charge of works.

iv. In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil/debris and restore the affected area to its original state to the satisfaction of the PWD/ Engineer-in-Charge of works.

v. The contractor will at all times ensure that the entire existing streams, watercourses and drains within and adjacent to the site are kept clean, safe and free from any debris.

vi. Contractor will utilize effectively, water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.

vii. Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.

viii. During cutting of hills and disposal of debris proper warning signs will be installed to the satisfaction of PWD/ Engineer-in-Charge of works.

ix. Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and permission of PWD/ Engineer-in-Charge of works.

x. During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.

During the debris disposal contractor will take care about wind direction and situation of the settlements, so that any dust problem will be avoided.

Debris disposal shall be monitored by the representatives of local people of habiting nearest to the dumping location. Reporting of the activity shall be done regularly by the NGO's village council presidents.

9.1.11 MITIGATION FOR NOISE AND VIBRATION

Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. Following mitigation measures need to be worked out by the contractor for the noise impacts associated with the various construction activities:

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB(A). If required, machinery producing high noise as concrete mixers, generators etc, must be provided with noise shields and their usage timings can be regulated.

- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.
- Workers in the vicinity of high noise levels must wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- No hot mix, batching and aggregate crushing plants shall be located within 500m of sensitive land uses as schools, hospitals etc.
- Blasting when required shall be restricted to daytime hours. All the statutory laws, regulations, rules etc, pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed. Blasting will be carried out only during fixed hours as permitted by the Engineer.
- During the operation stage, sensitive receptors will be clearly marked by providing regulatory signage. Enforcement of these will be the responsibility of the local authorities.

9.1.12 FLORA

Road Side Plantation. At the ratio of 10 trees shall be planted for every tree cut by the Forests Department. The project will transfer funds as per their estimate so that compensatory afforestation can be carried out for trees cut for the project. The project will involve the local NGOs to revegetate the slopes at space available on lands identified by the NGOs. While plantation is a one time cost to the project, there is provision for financial incentive to local NGOs for maintenance. PIU and supervision consultant/ environmental specialist will monitor and ensure the compensatory forestation and other plantation programes.

Indigenous species shall be used as far as practicable, strictly avoiding any exotic species like *Eucalyptus* that can have far-reaching adverse effects on the ecology and water regime of the area. Furthermore, thorny plants like *Zizypus* spp., etc., should not be ideally used in highway planting. Saplings should be planted in 2x2 ft. pits, wherever possible on small terraces created on the valley side, with adequate amount of cow-dung and dolomite added as organic and mineral nutrients.

Species to be used on road shoulders: *Cytisus* sp. (Broom grass), *Mikenia spp., Lycopodium spp., Selaginella spp., Polytrichum spp. And Sphagnum spp.* Besides bamboo clump could be planted on the upper side of the shoulder.

On Valley slope: Species recommended for afforestation on the Valley side are Thatch grass (*Imperata spp.*), *Cynodon* spp., *Mikenia* spp., *Hydrocotyl* spp., *Oxalis* spp., *Eupatorium* spp., various species of bamboo, etc.

Loss of Forest Cover/Green Cover

Various **Bio Engineering Measures** have been proposed to regenerate the cover lost due to the cutting of hill slopes. Such measures include transplantation / inoculation of soil-binding plant species on the exposed surfaces resulting from shoulder-cutting to widen the roads, as well as on the valley slope to further strengthen the soil-binding there. The following species need to be planted to reinforce the slopes.

Among the different species suggested, *Cytisus* and *Imperata* have laterally spreading adventitious roots and clump-forming tendency that results in effective soil-binding. *Mikenia* gives off roots from nodes while creeping that penetrates the exposed surface and clings to the soil. The bryophytes and pteridophytes, on the other hand, are provided with rhizoids that have a high cumulative soil-binding capacity. Besides, these plants, because of their habit of forming extensive spongy mats on exposed soil, protect the soil effectively against the bombardment of raindrops.

While shoulder-cutting, attempts should be made to create a slope of at least 80^0, avoiding totally vertical cuts, Small terraces about 4-6 ft. high may be carved out on the road shoulder and protected by planting grasses and other ground flora. These measures would go a long way in preventing soil erosion and landslides.

Besides serving the purpose of soil binding, plants like broom and thatch grasses could also benefit the local community, who could maintain these patches on a sustainable utilization basis, thus boosting the social welfare component of the road project.

Loss of Medicinal Plants

Medicinal plants identified in project influence area are wild plants found throughout the state. These are not of any special ecological interest. Although to enhance the environment it has been suggested that the contractor shall not set up construction camps, hot mix plants etc at the locations (or close to the place) where herbs and medicinal plants are available. Also dumping locations have been selected so that no material is tipped within 100m of such locations.

Regular monitoring of Biodiversity in the region is to be carried out to assess the effectiveness of the suggested mitigation measures.

9.2 SOCIO ECONOMIC ENVIRONMENT

9.2.1 LOSS OF ACCESS

The contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Construction activities that shall affect the use of side roads and existing access to individual properties shall not be undertaken without providing adequate provisions.

Construction works will not interfere with the convenience of the public or the access use and occupation of public or private roads, railways and any other access footpaths to or of properties, whether public or private.

9.2.2 SAFETY DURING CONSTRUCTION

The Contractor is responsible for ensuring road safety along stretches where construction is in progress. All the construction period road safety plans will be subject to scrutiny and approval by the Engineer. Due to the special nature of hill roads, special provisions will be incorporated in the plan. This includes stoppage of construction for two hours during peak periods in the morning and two hours in the evening to allow commuters to go through.

The contractor will provide and maintain barriers, fencing and lighting around the site and where necessary for the safety, security and convenience of the public including traffic on road and as otherwise needed to suit his working methods and timings.

The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic or closer of traffic on the state highway shall be drawn up in consultation with the PWD Engineer-in-Charge of works.

At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriageway) the lane width path for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device to the directions of the PWD Engineer-in-Charge of works. At night, the passage shall be delineated with lanterns or other suitable light source.

One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns / lights.

On both sides, suitable regulatory / warnings signs showing timings when road will be open for traffic as approved by the PWD Engineer-in-Charge of works, shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of specified design and of refectory type, if so directed by the PWD Engineer-in-Charge of works.

Provision of regulatory signage at sensitive receptor locations such as schools, hospitals and warning signs at known accident spots.

Stockpiling of material will be planned such that smooth traffic flow is ensured. Spills at accident sites will be cleared immediately. The left over spills will be scraped and reclaimed to small lined pits at identified sites.

In case of accidental spillage, immediate report to relevant departments will be made and instructions followed in taking up the corrective measures as soon as possible.

Worker’s Health and safety

Good practice guideline on safety, health and environment at work place as suggested in EMF (refer annexure -15 of EMF) will be implemented in the project during construction.

9.2.3 Maintenance of Temporary Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversion shall be maintained in a satisfactory condition till such time they are required as directed by the PWD/ Engineer-in-Charge of works. Temporary roads shall be kept free of dust by frequent applications of water, if necessary.

9.2.4 Impact on Community Resources

The community common resources located within the CIZ are listed in Annexure 5.1 (Table 9). During construction of the upgraded road following common property resources are likely to be impacted – Public Toilet- 1 no , Public Urinal 5 nos , Bazar Shed 5 nos , church boundary wall 1no and hand pump 3 nos (refer section 8.8)

All such will be relocated in consultation with the local people and will be reconstructed in suitable locations.

9.2.5 OTHER SOCIAL IMPACTS

Mitigation Measures for all social impacts have been detailed in the R&IPDP.

9.2.6 INDUCED DEVELOPMENTS

Road side development

The MPWD has acquired 5m reserve land on either side of the existing road, to curb roadside development outside the existing settlement areas. In the settlement area, village council is responsible for allotment of land other than agricultural purposes. During consultations with the village council presidents it was agreed that allotment of land abutting the road shall be avoided.

Trade and Tourism

Influx of tourists and visitors may increase due to improved accessibility. Eco-tourism can be promoted in the area for control of impacts associated with tourism. Awareness generation among tourists shall be taken up with the involvement of NGO/CBO and church.

CHAPTER 10 – IMPLEMENTATION ARRANGEMENTS OF EMP

This chapter discusses the capacity assessment, implementation arrangements including the reporting, monitoring and training requirements for the project. The PWD has extensive experience in building and maintaining roads over the years. However, the traditional emphasis is now shifting with other concerns such as environmental and social impacts of the proposed development now becoming important for the successful implementation of major projects. As road and other works of PWD works expands, environmental work load will increase. The organisational set-up of the PWD and modifications required in order to meet these new challenges are discussed in the following sections.

10.1 Capacity Assessment

Environmental Management Framework prepared for the proposed MSRP II has assessed capacity of Mizoram PWD for environment management and proposed institutional set up for MSRP. The assessment suggests that there is need for various types of trainings to various stakeholders including PWD staff, contractor, and communities on environmental management and mitigations subjects. Besides, external human resources/ consultants are also necessary during implementation support PIU.

10.1 Proposed institutional set up

In line with the EMF for implementation of EMP for this road it has been proposed that Executive engineer (Environment) will be in charge for the implementation of EMP for this road. He will be assisted by Assistant engineer (Env.) Group-1 road, who will be assisted by two Junior Engineer and Environment Specialist of Supervision consultant and contractor. (Refer Figure 10.1)

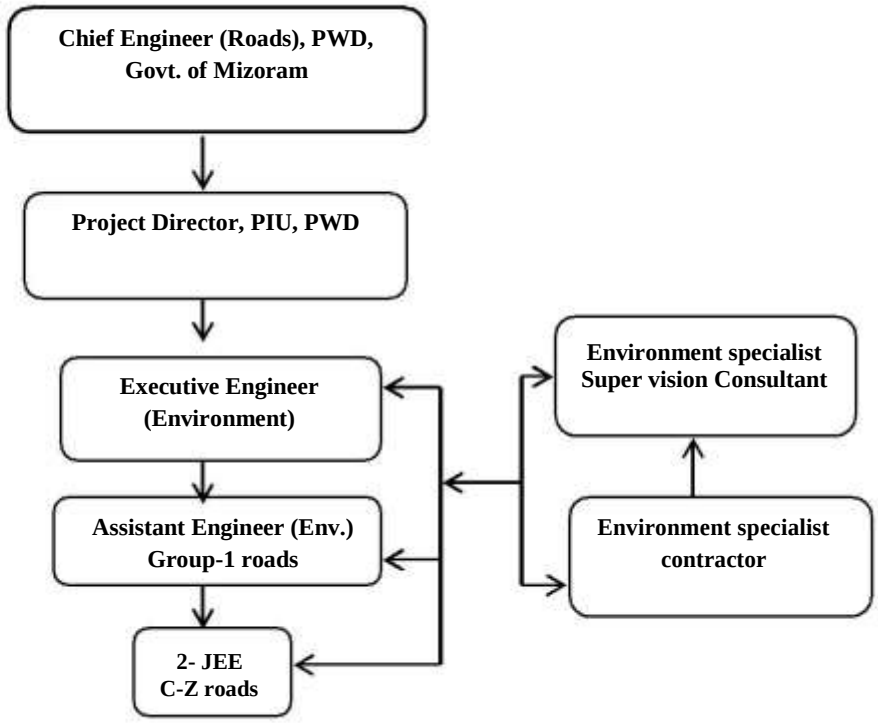

Fig 10.1 Proposed institutional set up for EMP implementation in C-Z road

Supervision Consultant. The construction supervision consultant are expected to have in-house capacity to advise on and supervise the implementation of the EMP including suggesting enhancement design options and nay modifications, if needed. For this purpose, the supervision consultant will employ a full-time environmental specialist.

10.3 Non-Governmental Organizations.

The C-Z Road requires undertaking plantation and maintenance and protection of vegetation in addition to compensatory plantation as part of environmental mitigation and enhancement works. Similarly, spoils will be used, where possible, to crate community assets on demand/ request of the community. In these types of works, C-Z Road project may engage NGO or CBO.

10.4 Training for Capacity enhancement

To enable the PWD in integrating the social and environmental issues in its day-to-day operation and in internalising the environmental and social issues in the existing and future road development projects training is conceived. To achieve this goal, the MPWD, needs training on road development and environment management and the effective implementation of the environmental issues.

Training proposed for capacity development in EMF document of MSRP-II (Refer section 7.4 of EMF) will also be applicable for this project because this project is a component of MSRP II. The training to be undertaken need to be of relevance to the specific context of the roads in Mizoram, focusing on the following issues:

- Conservation of biodiversity
- Slope stability and vulnerability to landslides
- Siting criteria for identification of dumping sites
- Harnessing water resources, including rain water harvesting
- Concepts of bio-engineering and application of bio-engineering techniques for slope protection

Type of training envisaged are summarized in the table below.

S. No.	Training Recipients	Content of the module
Module – I	Environmental staff of "Environmental and Social Management Cell". Associated NGOs in implementation and staff associated with construction supervision	Environmental overview:Key issues, Methodology, Public Consultation, Value Addition
Module – II	Members of PWD staff involved in supervising up-gradation corridor, NGO representatives;	Mizoram State Road Project: Environmental Impact Assessment Social Impact Assessment, Environmental Management Plan, Slope protection

S. No.	Training Recipients	Content of the module
Module - III	Contractors' representatives; NGO representatives; Supervision Consultants' representatives; Members of PWD staff involved in supervising up-gradation corridor,	Institutional Framework for Implementation of MSRP: The role of the PWD, The responsibilities of the Supervision Consultant and the NGO Reporting requirements, Contractual Obligations and Environmental Protection.
Module – IV	Members of PWD staff involved in supervising Major Maintenance, Upgradation; NGO staff implementing the R&IPDP; District Officials & Members of special committees – MVAC and GRC	Special Issues in MSRP-2: Bio-Diversity Assessment and Conservation, Geo-morphological Assessment and Slope Protection Consultation and Counselling, Income generation and Economic Rehabilitation Preparation of Micro-plans
Module – V	Members of the PWD; Selected Officers of the line Departments such as Forests, Officials of the Pollution Control Board, Mining and Geology department	Improved Co-ordination with other departments: Overview of the MSRP Environmental & Social Impacts of the proposed improvements Statutory permissions – procedural requirements, Co-operation with the Forests Department, Co-operation with the Revenue Department
Module – VI	Members of PWD involved in MSRP	Long-term issues in Planning Roads development in Mizoram Environmental & Social Assessment Methodology, Preparation of EMP & RAP, Stability of Hill Roads and mitigation measures, Conserving bio-diversity along roadside, Highway related diseases and AIDS Consultation tools and techniques.

10.5 Institutional arrangement for monitoring

In order to ensure that the proposed mitigation measures have the intended results and comply with GoI and World Bank requirements, an environmental performance monitoring arrangement for Monitoring of Environmental Issues has been proposed as described in table 10.1. Details of the monitoring and reporting requirements has been discussed in EMP in detail

Table 10.1 Monitoring of Environmental Issues

SN	Issue	Procedure	Timing	Responsibility
A. Pre-Construction				

1	Incorporation of mitigation measures and environmental guidelines	Review detail design/drawings of the project	During project approval	PIU, PWD
2.	Location of camp sites and location of plants	Review of camp location Approval of layout of camp and plants	Prior to Contractor mobilization	PIU, PWD,
3.	Statutory clearances from different agencies like- Pollution control board, mining department, Revenue department etc.	Review of documents and clearance certificates.	Prior to Contractor mobilization	PIU, PWD
B. During Construction				
4	Construction and location of drainage facilities.	Site inspections at places where such drains are required.	During active	PIU, Contractor, Local NGOs.
5.	Proper use of explosives for	Site observation and discussion with local people and workers	Whenever blasting takes	PIU, Contractor,
6	Care and safe storage of top soil for later use.	Inspection of site clearance practices, top soil storage sites	Monthly during construction.	PIU, Contractor,
7.	Care for vegetation in the RoW and immediate vicinity	Inspection of site clearance Activities.	Bi-Weekly during construction.	PIU, Local NGOs, Contractor
8.	Safeguarding of drinking water sources.	Site observation	During and immediately after construction in the water source vicinity.	PIU, Local NGOs, Contractor
SN	**Issue**	**Procedure**	**Timing**	**Responsibility**
9.	Disposal of spoil materials and other construction wastes	Disposal site observation and disposal practice	Weekly.	PIU, Local NGOs, Contractor

10.	Impacts on agricultural land due to spoil disposal/soil erosion/water-logging due to construction	Site observation and discussion with local people	Weekly	PIU, Local NGOs, Contractor
11.	Reclamation of disposal sites	Observation of reclaimed disposal sites	Periodically	PIU, Local NGOs, Contractor
12	Plantation of vegetation in the cut slope	Observation of sites	Periodically	PIU, Local NGOs, Contractor
13	Timely construction of other slope protection measures, such as, retaining walls.	Observation of sites	Immediately after construction	PIU, Local NGOs, Contractor
14	Quality of surface water.	Water testing	Construction site near a water body	PIU, Local NGOs, Contractor
15	Operation and closure of quarries and borrow pits confirmed to the requirements related to location, vegetation protection, soil conservation, erosion control, siltation and stability concerns.	Site inspection, discussion with workers and local people.	During quarry operation or bi-weekly	PIU, Local NGOs, Contractor
16	Air pollution near settlements	Observation of construction practices and consultation with local residents and workers	Periodically	PIU, Local NGOs, Contractor

ANNEXURE 2.1

ROAD GEOMETRY:

The project corridor passes through steep and mountainous terrain. The design speed adopted is 30km/hour (IRC SP: 48). Along the proposed alignment, there will be no hair-pin bend. However minimum design speed has been considered on technical grounds. The vertical and horizontal alignments of the proposed road have been summarized as shown in table below:

Project road length	No. of curves with design speed in km/h				No. of curves with radius (m)		
	<30	30-40	40-50	>50	<30	30-50	>50
41.53 km	96	320	42	9	0	264	203

Project road length	Length Distribution (km) and Gradient Class				
	<4%	4%-5%	5%-6%	6%-7%	7%-8%
41.53 km	20.98 Km	2.77 Km	7.50 Km	10.00Km	0.28 Km

PAVEMENT COMPOSITION

BC	:	30 mm
DBM	:	55 mm
WBM in 3-layers	:	250mm
GSB in 2-layers Gr.I& V	:	250 mm
Total	:	585 mm

SHOULDER DESIGN:

Surface dressing	:	20 mm
WBM in 1-layers Gr. II	:	55 mm
Excavated rock	:	330mm
GSB in 1-layers Gr. V	:	150 mm

Surface dressing	:	20 mm
WBM in 1-layers Gr. II	:	55 mm
Total	:	585 mm

ANNEXURE –2 .2

DRAINAGE DESIGN

Length of drain					
Sr. No.	**Chainage in m**		**Length**	**Type**	**Remarks**
	From	**To**			
1	0.0	600.0	600.0	Type-1	Village portion
2	600.0	4850.0	4250.0	Type-2	Soil Mixed Boulder Stretch
3	4850.0	5980.0	1130.0	Type-1	Village portion
4	5980.0	18855.0	12875.0	Type-2	Soil Mixed Boulder Stretch
5	18855.0	19675.0	820.0	Type-1	Village portion
6	19675.0	23870.0	4195.0	Type-2	Soil Mixed Boulder Stretch
7	23870.0	25565.0	1695.0	Type-1	Village portion
8	25565.0	32445.0	6880.0	Type-2	Soil Mixed Boulder Stretch
9	32445.0	33100.0	655.0	Type-1	Village portion
10	33100.0	35400.0	2300.0	Type-1	Village portion
11	35400.0	36900.0	1500.0	Type-2	Rocky & Steep Stretch
12	36900.0	40320.0	3420.0	Type-1	Soil Mixed Boulder Stretch
13	40320.0	41225.0	905.0	Type-2	Soil Mixed Boulder Stretch
14	41225.0	41529.0	304.0	Type-1	Village portion
		Total	**41529.00**		

Sr.No.	**Type**	**Length**	**Remarks**
1	Type-1	10924.00	Built up area & Ordinary Soil stretch
2	Type-2	37041.00	Rocky & Steep Stretch & Catch water drain at box cutting portion
3	Transverse Trench drain within the sub-grade	7295.00	300 mm wide transverse trench drain within the sub-grade filled up with drainage material @ 50m interval on straight portion road & curve having center at valley side as per the specification along the road alignment & gradient The bottom of the trench shall be slope to valley, including providing and laying of drainage material ,excavation of trench as per drawing or technical specification (MORT&H 309.3.7 ,TABLE-300-4,GR.-CLASS-A)
4	Rain Cut Drain	1245.00	1 m wide & 0.15 m deep flat V shape at an interval of 50m to 150 m as per site condition ,drain beyond the shoulder edge at valley with coating of bitumen @ 1.0 Kg per sqm over the compacted surface

5	Sub Surface Drains with Perforated Pipe	3500.00	Subsurface drain with perforated pipe of 100 mm internal diameter of PVC, closely jointed, perforations ranging from 3 mm to 6 mm depending upon size of material surrounding the pipe, with 150 mm bedding below the pipe and 300 mm cushion above the pipe, cross section of excavation 450 x 550 mm. Excavated material to be utilised in roadway at site

Chutes of the culverts form part of the culvert structure to lead the discharge to the catch-pit or to natural drainage channel.

GEO-TEXTILE

Geo-textile for drainage & separation with physical requirement as per MORT&H-702.2.2.3.2 .TABLE 700-4 after preparation of sub-grade as per the specification along the road alignment, geo-textile shall be rolled as indicated in the drawing .The entire rolled shall be placed on the sub-grade and unrolled as smoothly as possible .Wrinkles and folds in the fabric shall be removed by stretching as required.

TABLE – 1: Distribution of Tree Species (Size of Quadrat :10m x 10m)

	Name of the species	Local Name	Family	Total no of Quadrat studied	No.of Quadrats Occurrence	Tt no.of Individuals of species	Mean Girth (MG)cm	Basal Area (BA)cm^2	Dominance or Basal Area (BA)m	Frequency %	Density	Relative Frequency
1	*Albizzia chinensis*	Vang	Mimosaceae	20	7	8	65	336.38	0.0336	35	0.4	5
2	*Albizzia procera*	Kangtek	Mimosaceae	20	5	5	35	97.53	0.0097	25	0.25	3.57
3	*Bischofia javanica*	Khuangthli	Euphorbiaceae	20	3	3	45	161.23	0.0161	15	0.15	2.14
4	*Bombax insigne*	Pang	Bombacaceae	20	5	5	56	249.68	0.0249	25	0.25	3.57
5	*Callicarpa arborea*	Hnahkiah	Verbenaceae	20	9	10	47	175.87	0.0175	45	0.5	6.43
6	*Derris robusta*	Thingkha	Fabaceae	20	8	8	34	92.04	0.0092	40	0.4	5.71
7	*Duabanga grandiflora*	Zuang	Lythraceae	20	15	17	52	215.29	0.0215	75	0.85	10.71
8	*Erythrina variegata*	Fartuah	Fabaceae	20	12	15	49	191.16	0.0191	60	0.75	8.57
9	*Ficus semicordata*	Thei-pui	Moraceae	20	9	11	37	108.99	0.0109	45	0.55	6.43
10	*Gmelina arborea*	Thlanvawng	Verbenaceae	20	7	8	57	258.68	0.0259	35	0.4	5
11	*Lithocarpus xylocarpus*	Then	Fagaceae	20	8	10	51	207.09	0.0207	40	0.5	5.71

	Name of the species	Local Name	Family	Total no of Quadrat studied	No.of Quadrats Occurrence	Tt no.of Individuals of species	Mean Girth (MG)cm	Basal Area (BA)cm^2	Dominance or Basal Area (BA)m^2	Frequency %	Density	Relative Frequency
12	*Macaranga denticulata*	Hnah-khar	Euphorbiaceae	20	7	7	54	232.17	0.0232	35	0.35	5
13	*Ostodes paniculata*	Beltur	Euphorbiaceae	20	3	3	56	249.68	0.0249	15	0.15	2.14
14	*Rhus semialata*	Khawm-hma	Anacardiaceae	20	8	9	42	140.45	0.014	40	0.45	5.71
15	*Schima wallichii*	Khiang	Theaceae	20	7	10	55	240.84	0.024	35	0.5	5
16	*Sterculia villosa*	Khaupui	Sterculiaceae	20	6	8	34	92.04	0.0092	30	0.4	4.28
17	*Terminalia myriocarpa*	Char	Combretaceae	20	4	5	61	296.26	0.0296	20	0.25	2.86
18	*Toona ciliata*	Teipui	Meliaceae	20	5	8	67	357.4	0.0357	25	0.4	3.57
19	*Anogeissus acuminata*	Zairum	Combretaceae	20	4	6	58	267.83	0.0268	20	0.3	2.86
20	*Bauhinia variegata*	Vaube	Ceasapiniaceae	20	8	10	46	168.47	0.0168	40	0.5	5.71

TABLE – 2: Distribution of Shrub Species (Size of Quadrat :5m x 5m)

Sl.no	Name of the species	Local Name	Family	Total no of Occurrence	No. of Quadrats	Total no. of Individuals of	Frequency %	Density	Abundance	Relative Frequency	
1	*Antidesma acidium*	*Thur-te-an*	Euphorbiaceae	20	7	9	35	0.45	1.29	5.93	2.8
2	*Bambusa longispiculata*	*Rawthing*	Poaceae	20	5	35	25	1.75	7	4.24	11.
3	*Bridelia monoica*	*Phak tel*	Euphorbiaceae	20	10	23	50	1.15	2.3	8.47	
4	*Clerodendrum viscosum*	*Phuihnamchhia*	Verbenaceae	20	9	17	45	0.85	1.89	7.63	5.
5	*Dendrocalamus longispathus*	*Rawnal*	Poaceae	20	11	31	55	1.55	2.82	9.32	9.8
6	*Eurya japonica*	*Sihneh*	Theaceae	20	3	5	15	0.25	1.67	2.54	1.
7	*Lantana camara*	*Shillong-tlangsam*	Verbenaceae	20	4	9	20	0.45	2.25	3.39	2.
8	*Morinda angustifolia*	*Lum*	Rubiaceae	20	5	7	25	0.35	1.4	4.24	2.2

Sl.no	Name of the species	Local Name	Family	Total no of	No. of Quadrats Occurrence	Total no. of Individuals of	Frequency %	Density	Abundance	Relative Frequency
9	*Musa sylvestris*	*Changel*	*Musaceae*	20	3	9	15	0.45	3	2.54
10	*Mussaenda macrophylla*	*Vakep*	Rubiaceae	20	9	27	45	1.35	3	7.63
11	*Pandanus fascicularis*	*Ramlakhuih*	Pandanaceae	20	3	5	15	0.25	1.67	2.54
12	*Polygonum chinense*	*Ta-ham*	Polygonaceae	20	4	5	20	0.25	1.25	3.39
13	*Ricinus communis*	*Mutih*	Euphorbiaceae	20	2	3	10	0.15	1.5	1.69
14	*Rubus birmanicus*	*Siali-nu-theihmu*	Rosaceae	20	4	5	20	0.25	1.25	3.39
15	*Saccharum longisetosum*	*Luang*	Poaceae	20		55	75	2.75	3.67	12.71
16	*Solanum torvum*	*Tawkpui*	Solanaceae	20		29	55	1.45	2.64	9.32
17	*Thysanolaena maxima*	*Hmunphiah*	Poaceae	20		41	65	2.05	3.15	11.02

TABLE –3 : Distribution of Herb species (Size of Quadrat :1m x 1m)

Sl.no	Name of the species	Local Name	Family	Total no of Quadrat studied	No. of Quadrats Occurrence	Total no. of Individuals of spp	Frequency %	Density	Abundance	
1	*Ageratum conyzoides*	*Vaihlenhlo*	Asteraceae	20	6	23	30	1.15	3.83	3
2	*Amomum dealbatum*	*Aidu*	Zingiberaceae	20	2	2	10	0.1	1	1
3	*Biden pilosa*	*Vawkpuithal*	Asteraceae	20	11	24	55	1.25	2.18	5
4	*Bytttneria pilosa*	*Sazuknghawng hhlap*	Sterculiaceae	20	7	11	35	0.55	1.57	3
5	*Chromolaena odorata*	*Tlangsam*	Asteraceae	20	11	26	55	1.3	2.36	5
6	*Cissampelos pareira*	*Hnahbial hrui*	Menispermaceae	20	5	8	25	0.4	1.6	2
7	*Curculigo crassiflora*	*Phaiphak*	Amarryllidaceae	20	9	12	45	0.6	1.33	4
8	*Desmodium heterocarpon*	*Berbek*	Fabaceae	20	9	15	55	0.75	1.67	5
9	*Desmodium sequax*	*Cha-bet-ban*	Fabaceae	20	7	15	35	0.75	2.14	3

Sl.no	Name of the species	Local Name	Family	Total no of Quadrat studied	No. of Quadrats Occurrence	Total no. of Individuals of spp	Frequency %	Density	Abundance	
10	*Desmodium gangeticum*	*Hlah tha*	Papilionaceae	20	3	9	15	0.45	3	
11	*Dioscorea alata*	*Bachhim*	Dioscoreaceae	20	8	12	40	0.6	1.5	4
12	*Dioscorea bellophylla*	*Hra-kai*	Dioscoreaceae	20	9	17	45	0.85	1.89	4
13	*Gleichenia linearis*	*Ar-thla-dawn*	Gleicheniaceae	20	3	11	15	0.55	3.67	
14	*Hedyotis scandens*	*Kel-hnam-tur*	Rubiaceae	20	5	7	25	0.35	1.4	2
15	*Imperata cylindrica*	*Di*	Poaceae	20	9	25	45	1.25	2.78	4
16	*Merremia vitifolia*	*Thian-nu*	Convolvulaceae	20	4	18	20	0.9	4.5	2
17	*Mimosa pudica*	*Hlo-nuar*	Mimosaceae	20	5	25	25	1.25	5	2
18	*Mikania micrantha*	*Japanhlo*	Asteraceae	20	12	38	60	1.9	3.17	6
19	*Mucuna exserta*	*Hruiduk*	Leguminosae	20	3	8	15	0.4	2.67	
20	*Phyllanthus urinaria*	*Mit-thi-sunhlu*	Euphorbiaceae	20	8	15	40	0.75	1.87	4

Sl.no	Name of the species	Local Name	Family	Total no of Quadrat studied	No. of Quadrats Occurrence	Total no. of Individuals of spp	Frequency %	Density	Abundance	
21	*Polygala arvensis*	*Diktawn*	Polygonaceae	20	2	5	10	0.25	2.5	1
22	*Polygonum chinensis*	*Ta-ham*	Polygonaceae	20	3	5	15	0.25	1.67	
23	*Setaria pumilla*	*Thangchikhat*	Poaceae	20	7	9	35	0.45	1.28	3
24	*Scleria levis*	*Thip*	Cyperaceae	20	9	17	45	0.85	1.89	4
25	*Smilax perfolia*	*Kai-ha*	Liliaceae	20	4	9	20	0.45	2.25	2
26	*Spilanthes acmella*	*Ankasate*	*Asteraceae*	20	5	16	25	0.8	3.2	2
27	*Stephania glandulifera*	*Chaih-chun*	Menispermaceae	20	5	11	25	0.55	2.2	2
28	*Thladiantha calcarata*	*Kang-mang*	Cucurbitaceae	20	8	15	40	0.75	1.87	4
29	*Urena lobata*	*Se-hnap*	Malvaceae	20	6	14	30	0.7	1.56	3

OTHER INFORMATION RELATED TO PROJECT INFLUENCE AREA

Mizoram is one of the biodiversity hotspots in the eastern Himalayan region (north east India) with about 94% tribal people living in the state. Majority of the people practice shifting cultivation and livelihood of the rural masses depend largely on forestry products. The people begin to realize the value and importance of conservation of biodiversity and the genetic resources.

Checklist of Threatened Plants of Mizoram

scientific name	s.no	family	rdb status
Begonia lusshaiensis	1	Begoniaceae	Rare
Begonia wengeri	2	Begoniaceae	Indeterminate
Coelogyne rossiana	3	Orchidaceae	Vulnerable
Paphiopedilum hirsutissimum	4	Orchidaceae	Rare
Paphiopedilum villosum	5	Orchidaceae	Vulnerable
Renanthera imschootiana	6	Orchidaceae	Endangered

Source: Red Data Book Plants of India (Nayar & Sastry 1987-88) - Checklist of Threatened Plants of Mizoram, Observed on June 4, 2013

Checklist of Endemic Plants of project influence area of Chumkhum Chowngte Road

	Scientific name	Family
1.	*Arundinaria phar*	Poaceae
2.	*Begonia lushaiensis*	Begoniaceae
3.	*Bulbophyllum parryae*	Orchidaceae
4.	*Chasalia lushaiensis*	Rubiaceae
5.	*Derris lushaiensis*	Fabaceae
6.	*Dichrocephala minutifolia*	Asteraceae
7.	*Didymocarpus adenocarpus*	Gesneriaceae

	Scientific name	**Family**
8.	*Didymocarpus parryorum*	Gesneriaceae
9.	*Didymocarpus rodgeri*	Gesneriaceae
10.	*Didymocarpus wengeri*	Gesneriaceae
11.	*Eria lacei*	Orchidaceae
12.	*Glycosmis cyanocarpa*	Rutaceae
13.	*Jasminum wengeri*	Oleaceae
14.	*Mahonia borealis*	Berberidaceae
15.	*Mantisia wengeri*	Zingiberaceae
16.	*Mussaenda parryorum*	Rubiaceae
17.	*Mussaenda pentasemia*	Rubiaceae
18.	*Orthosiphon glandulosus*	Lamiaceae
19.	*Petrocosmea parryorum*	Gesneriaceae
20.	*Rhododendron witchianum*	Ericaceae
21.	*Senecio lushaiensis*	Asteraceae
22.	*Sinarundinaria longispiculata*	Poaceae
23.	*Sonerila villosa*	Melastomataceae
24.	*Stereogyne lushaiensis*	Orchidaceae
25.	*Strobilanthes parryorum*	Acanthaceae

	Scientific name	Family
26.	*Trisepalum lineicapsa*	Gesneriaceae
27.	*Vernonia parryae*	Asteraceae

Source: Red Data Book Plants of India (Nayar & Sastry 1987-88) - Checklist of Endemic Plants of Mizoram, Observed on June 4, 2013

List of medicinal plants in project influence area

1. Adhatoda vasika	*20. Dryopteris*
2. Agave americanna	*21. Terminalia arjuna*
3. Alpinia malacensis	*22. Crataeva sp.*
4. Anogessus acuminate	*23. Dillenia sp*
5. Begonia rex	*24. Phyllanthus emblica*
6. Datura metal	*25. Tamarindus indica*
7. Homonoia riparia	*26. Saraca indica*
8. Linostoma decandrum	*27. Bauhinia purpuria*
9. Orthosiphon aristatus	*28. Bauhinia variagala*
10. Bergendia lingulata	*29. Cassia fistula*
11. Anthocephalus cadamba	*30. Azadirachta indica*
12. Bergenia ligulata	*31. Eugenia jambelona*
13. Hedychium acuminaturm	*32. Anthocephalus indica*
14. Lonicera macranda	*33. Artocarpus chaplasha*
15. Bergendia lingulata	*34. Gmelina arborea*
16. Marchantia sp	*35. Ziziphus maurtiana*
17. Sphagnum sp.	*36. Ficus religiosa*
18. Polytrichum sp	*37. Ageratum conyzoides*

19. Lycopodium *20.Selaginella*	*38. Lantana commara* *39. Euphorbia hirta* *40. Argemone maxicana*

List of Floral Species identified in the project area

	Local name	Botanical name	Character
1	Bahra	*Dioscoera spp.*	Climber
2	Hruichun	*Dysolobium grande*	Climber
3	Hruiduk	*Mucuna exserta*	Climber
4	Japanhlo	*Mikania micrantha*	Climber
5	Sazuknghawnghlap	*Byttneria pilosa*	Climber
6	Tling	*Embelia vestita*	Climber
7	Vako	*Thunbergia grandiflora*	Climber
8	Vawihuihhrui	*Paederia foetida*	Climber
9	Vawkpuibahra	*Diocorea bulbifera*	Climber
10	Vawkpuiruangruh	*Acacia caesia*	Climber
11	Di	*Imperata cylindrica*	Grass
12	Hmunphiah	*Thysalomina maxima*	Grass
13	Luang	*Saccharum longisetosum*	Grass
14	Phaitualhnim	*Cynodon dactylon*	Grass
15	Rairuang	*Saccharum arundinaceum*	Grass
16	Aichhia	*Hedychium villosum*	Herb
17	Aidu	*Amomum dealbatum*	Herb
18	Ailaidum	*Curcuma petiolata*	Herb
19	Aithur	*Curcumorpha longiflora*	Herb
20	Ansate	*Spilanthes calva*	Herb
21	Baibing	*Alocasia fornicata*	Herb
22	Dawl	*Colocasia sesculenta*	Herb
23	Hnahthial	*Phrynium capitatum*	Herb
24	Katchat/Chakawk	*Pteridophytes spp.*	Herb
25	Phaiphak	*Curculigo crassifolia*	Herb
26	Sumbul	*Costus speciosus*	Herb
27	Thip	*Scleria levis*	Herb
28	Tlangsam	*Eupatorium odaratum*	Herb
29	Vailenhlo	*Ageratum conyzoides*	Herb
30	Arngeng	*Maesa indica*	Shrub
31	Builukham	*Melastoma malabathricum*	Shrub

32	Changel	*Musa spp.*	Shrub
33	Chhura-sa-um	*Unknown*	Shrub
34	Hmarcha	*Campsicum annum*	Shrub
35	Kawlkar	*Leea indica*	Shrub
36	Lehngo	*Debregeasia longifolia*	Shrub
37	Leihruisen	*Calycopterius floribunda*	Shrub
38	Lem	*Arenga nana*	Shrub
39	Nghardai	*Toddalia asiatica*	Shrub
40	Pangbal	*Manihot esculenta*	Shrub
41	Phuihnamchhia	*Clerodendrum viscosum*	Shrub
42	Raichhawk	*Daemonorops jenkinsianus*	Shrub
	Local name	**Botanical name**	**Character**
43	Rulei	*Millettia pachycarpa*	Shrub
44	Tuipuisuthlah	*Rotura aquatica*	Shrub
45	Uifawmaring	*Flemingia stricta*	Shrub
46	Zawngtenawhlung	*Mallotus roxburghianus*	Shrub
47	Laisua	*Licuala teltata*	Palm
48	Mitperh	*Calamus acanthospathus*	Palm
49	Raichhawk	*Daemonorops jenkinsianus*	Palm
50	Tairua	*Calamus guruba*	Palm
51	Tum	*Caryota urens*	Palm
52	Archangkawm	*Oroxylum indicum*	Tree
53	Banphar	*Anthocephalus chinensis*	Tree
54	Belphuar	*Trema orientalis*	Tree
55	Beltur	*Ostodes paniculata*	Tree
56	Bil	*Protium serratum*	Tree
57	Bungbutuairam	*Garunga pinnata*	Tree
58	Chhawntual	*Aporusa octandra*	Tree
59	Dangkha	*Garcinia anomala*	Tree
60	Fartuah	*Erythrina variegata*	Tree
61	Hmuifarial	*Syzygium claviflorum*	Tree
62	Hnahkhar	*Macaranga indica*	Tree
63	Hnahkiah	*Calicarpa arborea*	Tree
64	Hnahthap	*Ficus spp.*	Tree
65	Kangtek	*Albizzia procera*	Tree
66	Khaupui	*Sterculia villosa*	Tree
67	Khiangzo	*Schima khasiana*	Tree
68	Lungkhup	*Haldina cardifolia*	Tree
69	Mautak	*Melocanna baccifera*	Tree
70	Muk	*Cordia dichotoma*	Tree

71	Nauthak	*Litsea monopetala*	Tree
72	Nganawm	*Desmous dumosus*	Tree
73	Paitemaian	*Ficus hispida*	Tree
74	Pang	*Bombax insigne*	Tree
75	Phaktel	*Bridelia monoica*	Tree
76	Phunchawng	*Bombax ceiba*	Tree
77	Rawnal	*Dendrocalamuslongispathus*	Tree
78	Rawthing	*Bambusa tulda*	Tree
79	Sahatah	*Aglaia hiernii*	Tree
80	Sazutheipui	*Ficus hirta*	Tree
81	Sehsen	*Ficus rigida*	Tree
82	Sihneh	*Eurya cerasifolia*	Tree
83	Siksil	*Pterospermum acerifolium*	Tree
84	Tatkawng	*Artocarpus chaplasha*	Tree
	Local name	**Botanical name**	**Character**
85	Teak	*Tectona gradis*	Tree
86	Teipui	*Toona ciliata*	Tree
87	Thakthingsuak	*Cinnamomum bejolghota*	Tree
88	Theibal	*Ficus auriculata*	Tree
89	Theibate	*Ficus variegata*	Tree
90	Theihai	*Mangifera indica*	Tree
91	Theipui	*Ficus semicordata*	Tree
92	Theitit	*Ficus prostrate*	Tree
93	Thingkha	*Deris robusta*	Tree
94	Thingkhawilu	*Vitex peduncularis*	Tree
95	Thingthiang	*Olea salicifolia*	Tree
96	Thlado	*Lagerstroemia speciosa*	Tree
97	Thlanvawng	*Gmelina arborea*	Tree
98	Thlengreng	*Vitex heterophylla*	Tree
99	Tiar	*Saurauia punduana*	Tree
100	Tuiaram	*Garuga floribunda*	Tree
101	Tuaitit	Bengawng *Antidesma spp.*	Tree
102	Vaiza	*Hibiscus macrophyllus*	Tree
103	Vang	*Albizzia chinensis*	Tree
104	Vawmbal	*Drimycarpus racemosus*	Tree
105	Zairum	*Anogeisus accuminata*	Tree
106	Zihnghal	*Stereospernum colais*	Tree
107	Zuang	*Duabanga grandiflora*	Tree
108	Nganbawm,	*Acrocarpus fraxinifolius*	Tree
109	Thingpawnchhia,	*Glochidion khasicum*	Tree

110	Sunhlu,	*Emblica officinalis*	Tree
111	Vaube,	*Bauhinia variegata*	Tree
112	Phunchawng,	*Bombax ceiba*	Tree
113	Sihneh,	*Eurya cerasifolia*	Tree
114	Khiang,	*Schima wallichii*	Tree
115	Char,	*Terminalia myaocarpa*	Tree

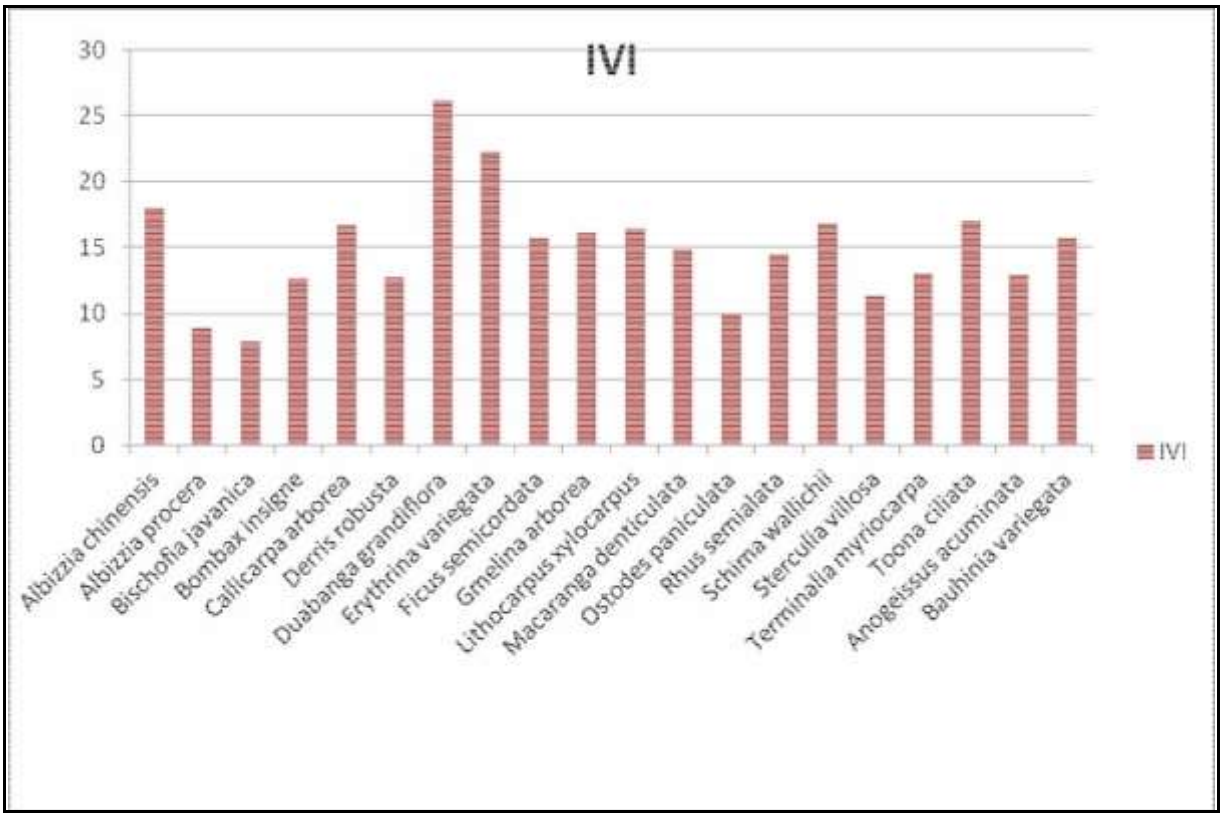

Figure-1 : IVI of tree species along the road

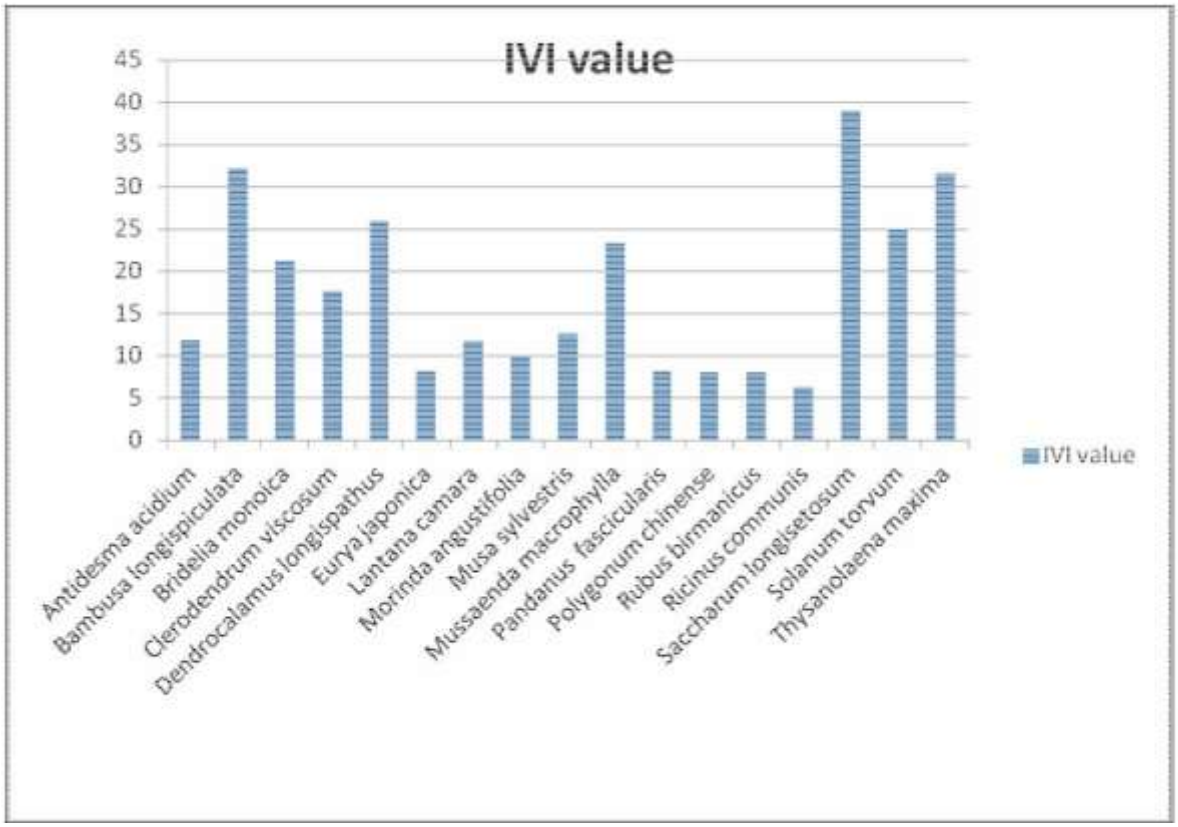

Figure-2: IVI of shrub species along the road

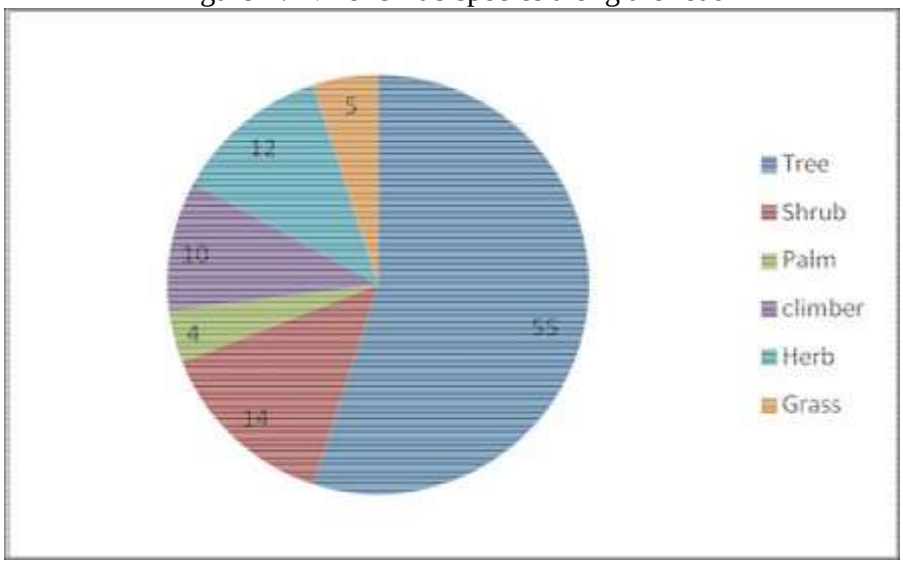

Figure 3: Distribution of vegetation type in the project area.

List Faunal species

Fauna : There is no unique faunal community within the core and buffer zone of the project area, except most common ones like toad, frog, crow, sparrow and myna, Loris, etc. *Loris t.*

tardigradus is found in wet lowland forests (Schulze and Meier 1995), tropical rain, swampy coastal and evergreen forests, and wet zone lowland forest up to 470 m (Molur *et al.* 2003). *Loris t. tardigradus* has only been observed to eat animal prey. Although they will eat fruit in a captive setting, they will always choose animal prey first. In addition to insects (including moths, stick insects, dragonflies, beetles, cockroaches, grasshoppers), they lizards .

Stream and River Marsh: The following organisms were observed to inhabit and use the marshy ecosystem as breeding place at marsh:

Faunal Species			
Sl No	Common Name	Scientific Name	Identifying Character/Colour
1	Algae	Rodophyceae sp.	brown
2	Green Algae	Chlorphyceae sp.	Dark Green
3	Dragon fly	*Macromia sp*	purple
4	Damsefly	*Enallagma sp.*	fluorescent blue
5	Dragon fly	*Macromia sp.*),	scarlet
6	Dragon fly	*Macromia sp.*	red small
7	Dragon fly	*Sympetrum corruptum*	Yellow
8	Tadpoles	*Rana sp*	Dark brown
9	Planktons	Nektons, Neuston	Dark green
10	Surface swimmers	*Brachionus s., etc*	Swimmers

Community of Roadside water fall and streams : The following are observed:

Sl no.	Common name	local name)
1	Daphnia sp.	Tuitifiminu
2	Crab	Chakai

3	*Limnea sp.*	chengkawl,
4	fresh water fish	*Nghahrah*
5	fresh water fish	*Nghadawl*
6	fresh water fish	*Dawntial*
7	*Cyclop*	*Tuitifiminu*
8	Rana limnocharis	*Chungu*
9	Blue Green algae (Common)	*Patek*
10	*Paleamon sp*	*Kaikuang*
11	Water bug	*Tui Chukchu*
12	Rotifers *(Brachionus sp.)*	*tuitifiminu*

Spottings of birds made during the monitoring are listed below (Zoological names and local names given):

Sl No	**Zoological Name**	**Common./Local Name**	**Location**
1	*Pycnonotidae sp*	Bulbul – Tlaiberh	At various spot
2	*Falco peregrinus*	falcon –Mute	at Mualkawi forest
3	*Pisttacula krameri* -	family of	at Mualkawi
		tropical parrots, Vaki	riverine forest
4	Drongo sp	Vakul	at various spots
5	*Megalaima virens* –	Tawllawt	at Zotlang biodiversity
6	*Pycnonocus cafer*	*Bulbul*- Tlaiberh	throughout the corridor
7	*Megalaima franklinii*	Zo-tuklo	Melbuk and various spots
8	*Charcophaps indica*	Ram parva	at various spots
9	- Various small birds feeding	*Vate*	throughout the corridor

Some of the birds and animals reported to be spotted by visual observation during the visit, and through local informants are (local names given in parenthesis):

Sl No	Common/Local Name	Zoological name
1	Wild cat (Sanghar) -	*Felis spp.*
2	Partridges (Ram parva) -	C*olumba sp.*
3	Lizard - Laiking	Caleotes vesicular
4	Squirrels (Thehlei)	*Callos ciurus macclellandi*
5	Sazaw type	*Felis sp.*

Annexure 5.2 : Ground water quality in the project area

No.	Parameters	GW1 Zothlang	GW2 Melbuk	GW3 Zokhawthar
1	Odour (TON)	Odourless	Odourless	Odourless
2	Colour (Hazen)	1	1	1
3	Taste	Acceptable	Acceptable	Acceptable
4	Turbidity (NTU)	1.8	2.1	1.58
5	Total Dissolved Solid (mg/l)	445	380	352
6	pH	7.2	7.1	7.1
7	Alkalinity (mg/l)	225	200.0	45.0
8	Total Hardness (mg/l)	120	180	110
9	Residual Chlorine (mg/l)	<0.01	<0.01	<0.01
10	Nitrate (mg/l)	58.2	40	25
11	Fluoride (mg/l)	<0.02	<0.02	<0.02
12	Phenol (mg/l)	<0.001	<0.001	<0.001
13	Total Nitrogen (mg/l)	60	41.8	26.8
14	Boron (mg/l)	<0.1	<0.1	<0.1
15	Chloride (mg/l)	159.1	28.93	38.57
16	Sulphate (mg/l)	63.33	20	16
17	Bi Carbonate (mg/l)	274.5	244	54.9
18	Cyanide (mg/l)	<0.05	<0.05	<0.05
19	Calcium (mg/l)	88.18	84.17	24.05
20	Magnesium (mg/l)	91.2	40.8	12
21	Manganese (mg/l)	<0.03	<0.03	<0.03

No.	Parameters	GW1 Zothlang	GW2 Melbuk	GW3 Zokhawthar
22	Zinc (mg/l)	0.12	0.34	0.03
23	Aluminium (mg/l)	<0.006	<0.006	<0.006
24	Iron (mg/L)	0.35	0.58	0.57
25	Chromium (VI) (mg/l)	<0.05	<0.05	<0.05
26	Copper (mg/l)	0.08	0.06	0.05
27	Mercury (mg/l)	<0.001	<0.001	<0.001
28	Cadmium (mg/l)	<0.01	<0.01	<0.01
29	Sodium (mg/l)	112.5	71.38	52.46
30	Arsenic (mg/l)	<0.01	<0.01	<0.01
31	Lead (mg/l)	<0.03	<0.03	<0.03
32	Total Coliform / 100 ml.	<1,<10,<100	<1,<10,<100	<1,<10,<100
33	Fecal Coliform /100 ml.	<1,<10,<100	<1,<10,<100	<1,<10,<100

<1 indicate No Colony developed in 1 ml. Sample. <10 ; <10 indicate No Colony developed in 0.1 ml. Sample ; <100 indicate No Colony developed in 0.01 ml. Sample

Annexure – 6.1

STAKE HOLDER CONSULTATIONON ENVIRONMENTAL & SOCIAL SCREENING ON 30.8.2013 AT PIU, CONFERENCE HALL. PWD, MIZORAM

PWD, Mizoram delivered the presentation on Environmental screening of Champai – Zokhwatar road. They explained about the project and findings based on screening exercise.

During presentation salient feature of the existing road and proposed alignment was discussed. Environmental issues related to proposed road improvement, anticipated impacts on environment were discussed.

Suggestion on environmental issues was discussed with the representatives of the different department participated in the consultation

Discussion on screening presentation

1. PD informed that construction of bridge over river Tiau on Myanmar border is cancelled due to non-cooperation of Govt. of Myanmar.
2. Ms. P.C Lalmuanpui, AEE , Mizoram Pollution controlr Board inquired aboud the technical criteria of proposing re-alignments at different stretches. She also asked about the possibility of constructing elevated corridors in villages instead of realignment. She expressed her concern about the disposal of huge spoils and suggested to consult with villagers for identifying disposal sites.
3. Mr. Lalduhthlana, ACF, Environment and Forest Department , Govt. of Mizoram informed about the existence of a wild life sanctuary in Champai district . He suggested that PWD should write a letter to DFO to inform about the notified forest land.
4. The design consultant Mr. Dhananjoy Kumar informed that 24m width corridor is not possible in some areas.
5. Mr. Drona of World Bank suggested for due-diligence report of the suggested stone quarries during implementation of the project .

The meeting ended with vote of thanks by PD, MSRP-II, PWD Mizoram.

Stake holder Consultation on Environmental & Soci
Sceening on 30/8/2013.

ATTENDANCE SHEET

venue :- PIU Conferance hall, PWD, Mizoram.

Name	Designation	NGO/Department	Signature
LALDUHTHLANA	Asst PCCF Office	E&F Dept	
P.C. Lalmuanpuii	AEE	Mizoram Pollution Control Board	
Vanlalzuala Chenchual	EE	Highways PWD	
P. Bhattacharjee	Env. Advisor STUP, Kolkata	STUP Kolkata	
RUMJHUM	Soc. Expert STUP Kolkata	STUP	
Lalsiamkima Hnamte	P.D (PIU)	PWD	29/8/13
Lalthanthangi Ralte	Assistant PIU Engineer PWD	PWD	
Dhruba Raj Ghimire	Env. Sp., Kolkata	World Bank	
Neeraj Kumar Singh	Social Development Specialist	World Bank	
Dhananjay K	Consultant	CMES	
Dr. Samar Kr. Banerjee.	Env. Consultant the World Bank	World Bank	
Chuanhnuna	Special Land Acquisition Officer	PWD, Mizoram	

Annexure 6.2

MINUTES OF MEETING ON WORKSHOP OF STAKEHOLDERS' CONSULTATION ON ENVIRONMENT AND SOCIAL MANAGEMENT FRAMEWORK OF MSRP – II

Venue : Conference Hall, Aijal club, Aizawl.

Date & Time : Dt. 18.11.2013 at 0:00 PM to 3:00 PM

Part –A: EMF meeting minute:

Lalram Thanga, Principal Secretary, Chairman of the meeting welcomed all participants of stakeholders and thanked them for attending the meeting in spite of their busy schedules giving due importance to the meeting. He further emphasized his desire for open, frank and fruitful discussion with open mind to clear all doubts and problems arising for implementation of the proposed project. He highlighted briefly the background and importance of the proposed road under MSRP –II for improvement of Socio-Economic profile of Mizoram. He further stated the history of global issues of sustainable development of environment and worldwide World Bank's achievement.

Ms. Er. Laltlanthangi Ralte Assistant Engineer (Env) PIU gave PowerPoint Presentation of Draft Environmental Management Framework. This was followed by discussion of the topic. The summing of discussions is given below:

Ms. Ethel Rothangpuii Dy. Director, Transport Department: asked on what scenario the proposed road was selected and name of the selected road.

Engineer in Chief, PWD answered the queries.

Ms. P.C. Lalmuanpuii, Assistant Executive Engineer, Mizoram Pollution Control Board:

said that in the MSRP –I, there were many complaints about dust pollution. She asked how it is going to suppress dust generation during construction period in the MSRP –II

Er. Samar Banerjee World Bank Consultant answered that generated dust will be suppressed by mixure of 2% NaCl with water through sprinkler.

Lalmalsawma Jt. Secy, Finance Department: asked Chhumkhum – Chawngte road was already accorded Administrative Approval under NABARD funding, how it was going to do with this.

Engineer in Chief, PWD answered that the proposal of Chhumkhum – Chawngte road under NABARD funding was only for single lane. However the proposal under World Bank is double

lane national Highway, if the proposal is going to be success, the proposal under NABARD funding will be cancelled.

Dr. Alfred Malsawmsanga S.A, Mizoram Pollution Control Board: said about study of bio-diversity in Mizoram. It is very important to give prior important for preservation of wild animals living in Mizoram. He again mentioned that rehabilitation of dumping areas and road site plantation.

Dr. Chawngsailova, General Secy. Mizoram Consumer Union: said that the road width of road, MSRP –I was not 7.0m and whether there is provision of crash barrier along the proposed road or not, as crash barrier is very important for road users.

Engineer in Chief answered that the previous road constructed under World Bank funding was not conformed the National Highway Standard. However, the proposed road under MSRP –II was designed for Double Lane, National Highway. There is provision of crash barrier along the road in MRSP –II.

Er. Lalzawmthanga, Executive Engineer, PIU said that in the Champhai to Zokhawthar road, there was Forest plantation area owned by Mualkawi village YMA of about 0.28 Hac. He asked that whether the village YMA is entitled to receive the compensatory fees of the area in spite of their wantedness. **Duhthlana Assistant Conservator of Forest Department** replied that the issue will be settled in Part –II.

Samar Banerjee, World Bank Consultant: mentioned that National and state regulatory Laws and Acts should be followed during pre- construction, construction and post-construction. Framework of implementation arrangement should be made and this should be revised by the PWD official.

Er. Lalramthanga Assistant Engineer PIU said that villagers of Phairuangkai village have LSC for their land but the area is within riverine forest area.

Principal Secy. MPWD said that the riverine reserve forest area does not need to have LSC.
The workshop was concluded by Engineer in Chief, Mizoram PWD with a vote of thanks.

Part –B: SMF meeting minute:

Lalram Thanga, Principal Secretary, PWD, Mizoram : Welcome the participants and highlighted basic importance of Social Management Framework then call upon Chuauhnuna, MCS, SLAO, PIU, PWD to give presentation on social Management Framework.

Chuauhnuna. SLAO, PIU : Delivered presentation on social Management Framework.

Lalram Thanga, Principal Secretary, PWD, Mizoram : Thanks Chuauhnuna, MCS, SLAO, PIU, PWD for his presentation on social Management Framework. He request the participants to share any idea if they have for better SMF. He highlighted the importance of Special Development for Primitive Tribal Group where PAP are Tribal. He also suggested that BPL family and widows may be treated as Vulnerable Group if they are among the PAP.

Zonunmawia CEP : Said that where land is acquired by relevant LA process, it is always the Vulnerable Group who suffer the most. He suggested that care should be taken to make accurate assessment of the property losses by this group.

Lalramthanga, Principal Secretary, PWD, Mizoram : Most of these Vulnerable Group are always the one who want their land to be acquired by the government because of compensation money.

Chuauhnuna. SLAO, PIU : stated that in most of the case the land owner are not the victim but the beneficiary of LA process.

Duhthlana, Assistant Conservator of Forest, E&F Dept : Said that in Table 3 – Entitlement Matrix (b) stated that " If the compensation amount fixed by Special Committee is higher than that amount calculated from the rate fixed by the Collector, the amount fixed by the collector shall be paid by the collector as compensation and the remaining amount as assistance" , then if reverse is the case, what would be the solution ?.

Chuauhnuna. SLAO, PIU: Assured that there should not be such case.

Dr. Chawngsailova, General Secy. Mizoram Consumer Union: Mentioned that this is a high time for everybody to abstained from indulging in corruption in compensation and also request to formulate a method or system that appropriated compensation are paid to the rightful owner. And this should be the practice in World Bank Project.

Chuauhnuna. , MCS, SLAO, PIU, PWD : Stated that to make assessment of compensation more accurate and to make the process more transparent, NGO like YMA, MUP etc are engaged to witness the measurement at site and also assured to all the participant that corrupt practice shall not be practice in LA process.

Duhthlana, E&F Dept : From the Entitlement Matrix it appear that land holder by way of Periodic Patta also have to be compensated, will this have adverse effect on future Land

Acquisition Process as this entitlement is not according to LA Act 1894. This can make precedence in the case of compensation.

Chuauhnuna. , MCS, SLAO, PIU : mentioned that the poor villagers can't always came to district headquarter to have their land pass issued or to engaged surveyor from revenue department, and that why most of villagers don't have LSC. Assistance will be paid to them not the compensation. And caution will be taken not to make any precedence that could have adversely affected on future LA Process.

Niraj World Bank Consultant: Social Management Framework should assured minimum social impact, resettlement and development of Indigenous People, Best alternatives alignment, Studies of best alternatives.

Chuauhnuna. , MCS, SLAO, PIU : Asked the participant if they felt if the rate of compensation is too poor eg Rate for Fruit bearing Zawngtah is Rs 1000/- while the fruit it yield in a year can be up to Rs 10000/- .

Lalram Thanga, Principal Secretary, PWD, Mizoram : This issue could be very controversial case. It is better that the rate adopt may be accepted as it is today.

Lianchungnunga E in C, PWD : The classification of fruit bearing and non fruit bearing is too wide ranges. Compensated base on girth size for plant may be more appropriated.

The workshop was concluded by Engineer in Chief, Mizoram PWD with a vote of thanks.

LIST OF INVITEES.

Government Departments.

1. Finance Department.
2. Land Revenue & Settlement.
3. Department of Urban Development & Poverty Alleiation.
4. Mizoram State Aids Control Society (MSACS).
5. Mizoram State Pollution Control Board – Chairman –
6. Department of Environment and Forests.
7. Deputy Commissioners/District Administration of Lunglei and Champhai, Chakma Autonomous District Council (CADC), Mamit and Lawngtlai.
8. State Rural Livelihood Mission
9. Office of NLUP
10. Social Welfare Department
11. Transport Department.
12. Police Department

The World Bank

13. Ms Diep, Team Leader, Mizoram State Roads Project II
14. Mr. Ashok Kumar, Co-Team Leader, Mizoram State Roads Project II
15. Ms. Sangeeta Kumari, Social Development Specialist.
16. Mr. A.S.Ramakrishna, Senior Environmental Specialist
17. Mr. Drona Raj Ghimire, Environmental Specialist
18. Mr. Sa,ar Banerjee, Environmental Consultant
19. Mr. Neeraj Kumar Singh, Social Development Consultant
20. Mr. G.Srihari, Social Development Consultant
21. Mr. Ranjan B. Verma, Social Development Consultant/Livelihood Expert

Educational Institution, NGOs/Civil Society and Religious Institutions.

22. Environment Department,Mizoram University.
23. Central Young Mizo Association (YMA)
24. Mizo Hmeichhe Insuihkhawm Pawl (MHIP)
25. Zoram Upa Pawl (MUP)
26. Mizoram Truck Owners Association
27. Mizoram Maxicab Owners Association.
28. Mizoram Social Defense and Rehabilitation Board (MSD&RRB)– Axis Bank Zarl
29. Mizoram Kohhran Hruaitu Committee –
30. Save Environment Association (SENVA)
31. Village Council Presidents

Consultants

32. Mr. Dhananjay Kumar, C.M. Engineering and Solution
33. Social and Environmental Expert of M/S STUP – Social and Environment Consultant.

LIST OF INVITEES

1. Chief Secretary
2. Finance Commissioner
3. Planning Commissioner
4. Commissioner Taxation Department
5. Secretary, Finance Department
6. Secretary, State Planning Board
7. Secretary, Transport Department
8. Secretary, Trade & Commerce Department
9. Secretary, Urban Development & Poverty Alleviation
10. Secretary, Rural Development Department
11. Secretary, NLUP Implementing Board
12. Secretary, Social Welfare Department
13. Principal Chief Conservator of Forest
14. Engineer-in-Chief, Public Works Department
15. Director General of Police
16. Deputy Commissioner, Aizawl District
17. Deputy Commissioner, Lunglei District
18. Deputy Commissioner, Champhai District
19. Deputy Commissioner, Mamit District
20. Deputy Commissioner, Lawngtlai District
21. Director, Transport Department
22. Director, Land Revenue & Settlement Department
23. Director, Social Welfare Department
24. Chairman, Mizoram State Pollution Control Board
25. Director, State Aids Control Society
26. Chairman, Mizoram Chamber of Commerce
27. President, Mizoram Truck Owners Association
28. Secretary, Truck Owners Association
29. President, Mizoram Consumer Union
30. President (SENWA)
31. Secretary, Mizoram Road Transport Union
32. President, Mizoram Bus Owners Association
33. Secretary, Mizoram Bus Owners Association
34. President, Mizoram Taxi Owners Association
35. Secretary, Mizoram Taxi Owners Association
36. President, Maxi-cab Owners Association
37. Secretary, Maxi-cab Owners Association
38. President, Central Young Mizo Association
39. Secretary, Central Young Mizo Association
40. President, Mizoram Upa Pawl
41. Secretary, Mizoram Upa Pawl
42. Chairman, Mizoram Kohhran Hruaitu Committee
43. President, Mizoram Hmeichhe Insuihkhawm Pawl
44. Secretary, Mizoram Hmeichhe Insuihkhawm Pawl
45. Director, Mizoram Social Defence & Rehabilitation Board
46. President, Centre for Environment Protection
47. Secretary, Centre for Environment Protection
48. President, Aizawl City Local Council Association
49. Secretary, Aizawl City Local Council Association
50. Mr. Dhananjay, C M Engineering & Statistics

V.

WORKSHOP ON STAKEHOLDERS' CONSULTATION MEETING FOR ENVIRONMENT AND SOCIAL MANAGEMENT FRAMEWORK(ESMF) OF WORLD BANK FUNDED MSRP – II

[redacted]

ATTENDANCE SHEET on 18th November, 2013.

Sl No	Name and Designation	Address	Contact No	Signature
1	2	3	4	5
1.	LION CHUNGNUNGA	E-in-C (PWD)	9436140776	
2.	R. VANLALTLUANGA	CE(R), PWD	9436142857	
3.	LALRINKIMA HNAMTE	P.D (PIU)	9436140569	
4.	LAL ZAWM THANGA.	EE (ENV) PIU	9436151012	
5	Chuankaina	SLAO, PWD	9856600320	
6.	Ethel Rothangpui	Dy. Dir. Transport	9436142676	
7.	K. Lalhmangaihi	STO	9612325831	
8.	Lalhanliani	Asst Archi (UDEPA)	9436360229	
9.	Latrinchhani	Asst. Engg. (UDEPA)	8974169235	
10.	Laham Thanga	Principal Secy, PWD	—	
11.	S.R. Lalsawmthanga	AE PW	9436197444	

WORKSHOP ON STAKEHOLDERS' CONSULTATION MEETING FOR ENVIRONMENT AND SOCIAL MANAGEMENT FRAMEWORK(ESMF) OF WORLD BANK FUNDED MSRP – II (GR I ROADS)

ATTENDANCE SHEET on 18th November, 2013.

Sl No	Name and Designation	Address	Contact No	Signature
1	2	3	4	5
12	R. Lalrinmawia.	AE PIU PWD	9862500854	
13	Lalremmawia	J.E	9862056213	
14	Lalmakzauva	J.S., Ruama	9436170310	
15	LALDINSANGA HNAMTE	AE, UDAPA	9615715579	
16.	C. LALCHHUANA	JE PWD	9436141765	
17.	Dr. CHAUNGSAILOVA.	G.S., MCH	9862419157	
18.	P.C. Lalmuanpuii	AEE, MPCB.	9436151809	
19	Dr. Alfred Malsawmzuala	SA, MPCB	9436366099	
20.	Lalhanpuia.	President. MTOA.	9436141963.	
21.	H. Zokunghaya.	GS MTOA.	9436365985.	
22.	C Lalthlamuani	EE PIU	9436157618	

WORKSHOP ON STAKEHOLDERS' CONSULTATION MEETING FOR ENVIRONMENT AND SOCIAL MANAGEMENT FRAMEWORK(ESMF) OF WORLD BANK FUNDED MSRP – II (GR I ROADS)

ATTENDANCE SHEET on 18th November, 2013.

Sl No	Name and Designation	Address	Contact No	Signature
1	2	3	4	5
23.	Lalthanthangi Ralte	A.E P.I.U		
24.	Lalduhthara	DFO Protection Ed P Deptt	9436352064	
25.	Dhananjay KV	Consultant	9811406386	
26.	A.C. Zonunsanga	CEP	9612082472	
27.	G. Lalrinchina	CEP	9436381785	
28.				
29.				
30.				

Annexure 6.3

CONSULTATION IN VILLAGES FOR IDENTIFICATION OF POTENTIAL DISPOSAL SITES FOR DUMPING OF SPOIL IN CHAMPHAI – ZOKHAWTHAR ROAD

Public consultations – Melbuk Village

Date	Place of consultation	Environmental Issues raised by people	Response of PIU
27.12.2013	**Melbuk**	The village council members still mentioned their desire that the proposed alignment of C – Z should pass through their village.	The PIU team explained to the villagers about design criteria of the proposed project and the corresponding compensation involved. They seem to have understood the situation.

The proposed disposal site for dumping of construction debris was visited with the village VC members and NGOs. The local NGOs indicated that they want to renovate the existing playground by dumping excess earth to the playground. The existing football ground is located about 800 Km from the proposed alignment of 17.50 km. Permanent side-drain of the playground is about 225 m along the peripheral of the playground. For protection work, Gabion wall of 148.00m and retaining wall of 40 m length. The community market shed is proposed to construct along the alignment at 16.80 Km. the quantity of earth that can be dumped at the existing playgrounds is estimated at about **20126.00 m^3.**

As per the local peoples' suggestion, the water required for construction of road and labour camp will be harvested from the water point located at 16.900 Km which is 200 m from Melbuk village. It will be needed to construct one water tank closed to the camp site. Since the village NGOs does not have their own village land, a private land, owned by Mr T. Lalliana was proposed for the camp site. He who was briefing clearly no land acquisition will be acquired for use of workers' camp site. The camp site was proposed at 100m away from the proposed alignment. The proposed camp site can accommodate the space for installation of construction equipments such as crushers, hot mix plants etc.

Public consultations – Mualkawi Village

Date	Place of consultation	Environmental Issues raised by people	Response of PIU
28.12.2013	**Mualkawi**	The village council members still mentioned their desire that the proposed alignment of C – Z should pass through their village.	The PIU team explained to the villagers about design criteria of the proposed project and the corresponding compensation involved. They seem to have understood the situation.

The proposed disposal site for dumping of construction debris was visited with the village NGOs. The local NGOs indicated that they want to renovate the existing two playgrounds by dumping excess earth to the playgrounds. The existing football grounds are located about **0.70 Km (Playground 1) and 0.90 Km (Playground 2) from 9.3 Km of the proposed alignment**. Permanent side-drain of Playground 1 is about 125 m along the peripheral of the two playgrounds. For protection work, for the two playgrounds Gabion wall of 528 m and retaining wall of 45.00 m length. The site for community market shed is proposed at 7.6 Km was also finalised. The quantity of earth that can be dumped at the two playgrounds is estimated at about **32692 m^3.**

As per the local peoples' suggestion, the water required for construction of road and labour camp will be harvested from *Dam Tuikhur* which is 0.8 Km from the camp site. It was proposed to construct of one reservoir and a site for the same was also chosen from which water can be drawn by gravity to the work site and labour camp. The reservoir will be an asset to the villagers after the construction is over. Labour camp site was also finalised in consultation with the local people. The camp site was proposed at 0.9 Km from the proposed alignment. The proposed camp site can accommodate the space for installation of construction equipments such as crushers, hot mix plants etc.

Public consultations : Zotlang Village

Date	Place of consultation	Environmental Issues raised by people	Response of PIU
28.12.2013	Zotlang	The village people wanted to maintain the existing approach road to the camp site in good condition during and after project construction is over.	The PIU Team made a commitment that the approach road will be maintained as good as the existing condition during and after construction work is over.

The proposed disposal site for dumping of construction debris was visited with the village NGOs. From the local NGOs' information, the existing playground was under renovation contract of NBCC Company. The NBCC people will need a huge quantity of earth debris for renovation of the playground. It may be necessary to have a discussion with the NBCC official for dumping of earth spoil. The existing football grounds are located along the alignment in between 2.6 to 2.8 Km. The site for community market shed is proposed along the alignment of 3.6 Km was also finalised. The quantity of earth that can be dumped at the playground is estimated at about **17640 m^3.**

As per the local peoples' suggestion, the camp site proposed was located at 1.2 Km from 3.6 Km chainage of the alignment. The water requirement for the camping may be harvested from the natural spring located in the vicinity of the camp site area. The proposed camp site can accommodate the space for installation of construction equipments such as crushers, hot mix plants etc.

Since adequate dumping site was not found within premises of the villages located along the proposed alignment, the PIU team also had a discussion with the local NGOs of Ruantlang village. Ruantlang village is located adjacent to Zotlang village. As per the suggestion of the local NGOs, **8692.00 cu.m** of the earth debris can be dumped at the existing playground with protection wall provision of retaining wall 20 m length and 138 m length of gabion wall.

Public consultations : Zokhawthar Village

Date	Place of consultation	Environmental Issues raised by people	Response of PIU
28.12.2013	**Zokhawthar**	**Nil**	**Nil**

The Zokhawthar village didnot has the village land. Their existing playground does not need renovation. They don't have appropriate place for dumping of the earth debris.

For labours'camp site, the NGOs of Zokhawthar suggested a site located within Nwe Hruaikawn village, which is 2.5 Km from Zokhawthar village. The PIU team visited recommended site with the local representatives of Zokhawthar and New Hruaikawn. Water requirement for the camp will be harvested from Lunglohtui, which is located at 0.7 Km from the camp site proposed.

List of participants in Melbuk

List of Participants

SN	Name	Occupation	Sex	Age	Social Category	Signature
1	= Vanlalawa.		M	52		
2	[illegible]		M	45		
3	Lawmsangzuala		M	34		
4	Sangthuama		M	52		
5	Lalmuanawa		M	48		
6	F Lalhaozela		M	51		
7	R. Lalnunsanga		M	40		
8	Lalrinawthanga		M	40		
9	Lalhmunsiama Pachuau		M	30		
10	Saivanthang -		M	58		
11	Ramchullova		M	41		
12	MS Sangzuela		M	28		
13	Ramngina		M	63		
14	C Lalzoliana		M	34		
15	TBC Lalnunthanga		M	70		
16	C. Hmuthanga		M	59		
17	C. Vanlalvela		M	36		
18	Lalruatsanga		M	34		
19	C Lalnunthuaga		M	27		
20	Lalramenga		M	31		
21	Lalremmawia		M	28		
22	Thangvela			50		
23	Lalbiakthangi		F	18		
24	Lalthlamuanpuia		M	18		
25	Vanlalfeli		F	18		
26	Lallawmthanga		M	30		
27	Malsawma		M	40		
28	Lalengkimi		F	43		
29	T. Lalhmangaiha		M	33		
30	Hauliali		F	70		
31	Vanramthangi		F	42		
32	Hranghluna Sailo		F	32		
33	Thanchullovi		F	28		
34	Pianmawii		F	70		
35	Lalmuanpuri		F	47		

Format for Public Consultations and Focus Group Discussions

	Name	Age (Years)	Sign
36	T. Lalhrain	48	[illegible]
37	Rohmingthanga	70	[illegible]
38	Zalianlungi	45	[illegible]
39	Mangpungi	35	[illegible]
40	Sangea	75	[illegible]
41	T. KOCHHAWNGKIMA	40	[illegible]
42	Hangdimchiari	57	[illegible]
43	Hmungkhanchhung		[illegible]
44	Lalhmat Sailo	40	[illegible]
45		39	[illegible]
46			[illegible]
47			
48			
49			
50			

List of participants in Mualkwai

List of Participants

SN	Name	Occupation	Sex	Age	Social Category	Signature
1	F. Rohmingpuiana		M	36		[illegible]
2	Changzuala		M	70		[illegible]
3	K. Lalkhumliana		M	34		[illegible]
4	H. Chhunthanuma		M	42		[illegible]
5	Vanlalauva		M			[illegible]
6	Lalmuanauia		M	31		[illegible]
7	Lalrawnghaki		F	30		Lalz.
8	Lalthanlawmna		M	20		Nghaki
9	Lallawmthangi		F	43		[illegible]
10	Lalvuanchhungi		F	40		Lawmi
11	Lalhmangaihthanga		M	38		Vuani
12	Lalthuani		F	80		Hanga
13	Ramthanga		M	75		Thuani
14	Thanghuta		M	72		Rama.
15	Valnunchhani		F	35		Thanga
16	C. Lalrawnmawii		M	50		Rini
17	Lalvenkimi		F	34		Chhun S.
18	Vantharzoli		F	25		Vani
19	H. Rochhunga		M	69		Vani
20	Lalbiaki		F	65		Biaki

List of participants in Zotlang

List of Participants

SN	Name	Occupation	Sex	Age	Social Category	Signature
1	C Lalduna	Farmer	M	51		
2	F Lalbeakthuluya	Business	M	40		
3	Vanlalthuanga	Farmer	M	52		
4	Lalbeakchhunga	Farmer	M	48		
5	Lalchhawlina	Farmer	M	60		
6	Lalramhanla	"	M	32		
7	Lalhmunsaina	"	M	38		
8	F. Kapzama	"	M	53		
9	Thanpuii	"	FM	40		
10	Nuntei	"	FM	42		
11	Hmai	"	FM	43		
12	Mawii	"	FM	50		
13	Biakzami.	"	FM	50		
14	Mawi	"	FM	45		
15	C Thanu	"	FM	42		
16	Hermoni	"	FM	45		
17	Engi	"	FM	42		
18	Vanrovi	"	FM	40		
19	Hauthuam	"	FM	35		
20	Ikaruni	"	FM	32		

21.	Biaknii	Farmer	fm	30	[signature]
22.	Thangpuii	"	fm	32	Thangpuii
23.	Dingpuii	"	fm	33	Dingpuii
24.	Kaungi	"	fm	36	[signature]
25.	Chhungi	"	fm	30	Chhingte
26.	Seni	"	fm	28	Seni
27.	Tei	"	fm	27	Tei
28.	Chhungi	"	fm	32	[signature]
29.	Nghaktei	"	fm	30	Nghakti
30	Helbai	"	fm	28	[signature]
31	Lalnunmawii	"	fm	30	[signature]

List of participants in Zokhawthar

List of Participants

SN	Name	Occupation	Sex	Age	Social Category	Signature
1	C. Lalzivunga	Farmer	M	50		
2	M.S. Duongzela	—do—	M	34		
3	C. Kuagliana	Tailoring	M	59		
4	Zoramuana	Farmer	M	37		
5	Lalroanhaha	—do—	M	37		
6	B. Lawmawma	—do—	M	50		
7	Lalhmangkimi	Farmer	F	32		
8	H. Vanlalpeka	~~Farmer~~	M	32		
9	Lalthlamuani	Business	F	34		
10	Zaihniangkunga	Govt Servant	M	50		
11	V. Lalrinthanga	Farmer	M	51		
12	Lalnunmawia	Govt Servant	M	62		
13	R. Sangkhuma	Pensioner	M	64		
14	Kapliancheugu	Farmer	M	37		
15	Ramparseli	—do—	F	30		
16	Saphniangthangi	Student	F	19		
17	Lalhmaithangi	Farmer	F	23		
18	Thanthuami	Bussiness	F	61		
19	Lalchhanhima	Student	M	28		
20	Bethlehema	Student	M	34		
21	Zothlanlo	farmer	M	56		
22	Lallianzuala	Farmer	M	28		
23	Lalnunthangi	Farmer	F	58		
24	~~Lianthanmawi~~	~~Farmer~~	~~F~~	~~60~~		
24.	Lawmuanthangi		F	35		