

**BIODIVERSITY CONSERVATION  
AND  
MANAGEMENT PLAN  
FOR  
DOUBLE LANE ROAD AT MANGAN,  
NORTH SIKKIM UNDER BHARATMALA  
PROJECT**



**FOREST & ENVIRONMENT DEPARTMENT  
GOVERNMENT OF SIKKIM**

**PREPARED BY:  
NORTH TERRITORIAL DIVISION**

## SUMMARY

Sikkim, apart from being biodiversity rich is also diversified geo-morphologically with hill ranges traversing the length and breadth of this Eastern Himalaya State. Ministry of Road Transport & Highways, Government of India has taken up detailed review of National Highways network with a view to develop the road connectivity to Border areas including Sikkim under Bharatmala Pariyojana through maintenance, management and operation of National Highway No. 310A (widening/two lane with paved shoulder/four laning etc.) in the stretch of land from Km. 67 to Km. 95 (Mangan to Chungthang Section) in the district of NORTH DISTRICT in the state of SIKKIM

Under Bharatmala Project, the Border Roads Organisation (BRO) has floated tender for road works in Mangan-Chungthang section in Sikkim. As most of the border roads of Sikkim are being upgraded by BRO to double lane, so under this tender, the construction of 225 km double lane road to 'Mangan-Chungthang-Yumsemdong' and 'Chuganthang-Lachen-Zema-Muguthang-Nakula' is planned under the Bharatmala project in North Sikkim. These roads will be built with the latest techniques and will hugely benefit the people of North Sikkim and increase the military might of the region.

86 RCC GREF/BRO has proposed for diversion of 10.6759 Ha. of forest land under Mangan Territorial Range for construction/improvement of existing road to National Highways and Infrastructure Development Corporation (NHIDCL) specification with paved shoulder from existing 67.000 km (Mangan) to 95.000 km (Chungthang) of total design length 27.476 km (except perpetual landslides/sinking zone at Rafom khola Langtha khola, Manual and Ritchu) on road Gangtok-Mangan-Chungthang in Sikkim on Engineering, Procurement, and Construction (EPC) mode under project Swastik of BRO under North Territorial Division in North Sikkim. The proposed road alignment runs along the forest areas like Khasmal lands under Territorial jurisdiction of Mangan Territorial Range of North Territorial Division, Forest & Environment Department. The Khasmal forest consisting of sub-tropical, sub-temperate & temperate, is dense with rich floral and faunal biodiversity. The proposed road aligned on/along the ridge line of the hill range is 27.476 kms within Khasmal areas and involves diversion of 10.6759 Ha of forest land. Considering the present alignment, the road construction will impact the geography, biodiversity and water catchments in the affected region. To mitigate this impact, a Biodiversity Management Plan (BMP) has been proposed with the following components;

- Research, forest development, public awareness and training.
- Monitoring and Evaluation.

The proposed detail estimate is at page no 13 of the BMP with component wise brief as follows;

| SL. No. | Components  | Budget (Rs. In Cr.) |
|---------|---|---------------------|
| 1.      | Research, forest development, public awareness and training | 1.888               |
| 2.      | Monitoring and Evaluation                                   | 0.0377              |
| 3.      | Miscellaneous   | 0.2643              |
| 4.      | <b>Total</b>  | <b>2.190</b>        |



| <b>NO</b> | <b>CONTENT</b>   | <b>PAGES</b> |
|-----------|--|--------------|
| <b>1</b>  | INTRODUCTION   | <b>1</b>     |
| <b>2</b>  | THE NAME OF OFFICE ALONG PROJECT ROAD  | <b>2</b>     |
| <b>3</b>  | CHECKLIST OF MAMMALS DIVERSITY OF MANGAN<br>TERRITORIAL RANGE  | <b>2</b>     |
| <b>4</b>  | CHECKLIST OF FLORAL DIVERSITY OF MANGAN<br>TERRITORIAL RANGE   | <b>2-3</b>   |
| <b>5</b>  | CHECKLIST OF BIRDS OF MANGAN TERRITORIAL RANGE   | <b>3-4</b>   |
| <b>6</b>  | ENVIRONMENTAL IMPACT ASSESSMENT AND ITS MITIGATION<br>MEASURE  | <b>5-10</b>  |
| <b>7</b>  | PROPOSAL FOR DIFFERENT FORESTRY ACTIVITIES<br>1. RESEARCH, FOREST DEVELOPMENT, PUBLIC AWARENESS<br>& TRAINING<br>2. INFRASTRUCTURE DEVELOPMENT | <b>10-11</b> |
| <b>8</b>  | CLIMATE RESILIENCE MEASURE FOR MANGAN DOUBLE LANE<br>ROAD CONSTRUCTION   | <b>11-12</b> |
| <b>9</b>  | PROPOSED BUDGET REQUIREMENT FOR CONSERVATION AND<br>MANAGEMENT OF KHAMMAL FOREST UNDER MANGAN T<br>RANGE FOR BHARATMALA PROJECT                | <b>13</b>    |

## **BIODIVERSITY MANAGEMENT PLAN FOR MANGAN-CHUNGTHANG DOUBLE LANE ROAD CONSTRUCTION UNDER BHARATMALA PROJECT.**

### **I. INTRODUCTION**

Nestled in the lap of the Eastern Himalayas, the picturesque village of Mangan serves as a gateway to North Sikkim while introducing you to the Lepchas and their unique culture. Primarily used as a halting place to Dzongu, Lachen and Lachung, the town was established in 1903 by Rinzing Namgyal, a local landlord. Mangan gets its name from the Lepcha word Maangan, meaning hidden place. The Nepalese inhabitants of the region changed its pronunciation to Mangan over the years. Mangan also serves the towns of Lachung, Chungthang and Lachen in the far north. Mangan is located at 27.52°N 88.53°E. It has an average elevation of 956 metres (3136 feet). The region has a cool temperate type of climate with a maximum temperature of 10°-22° and a mean annual rainfall of 162-200cm. Its entire area is covered by different altitudinal vegetation divided into various strata such as Upper Hill Forests (Between 1800m and 2400m), Rhododendron Forests (Between 2400m and above). The area is endowed with rich floral and faunal diversity. It contains a steep-sided valley and gorges with well-drained flaking slopes. Various species of Orchids, medicinal plant, Oak species, Acer species, Magnolia Species, tree fern, nettles, and different species of bamboo are the characteristic of the region. The forest is equally important for faunal components such as rare and threatened species. Species such as Himalayan black bear, Goral, Barking deer, Rhesus macaque, Fox, Grey mongoose, Orange-bellied Himalayan squirrel etc., are distributed in the higher region of Khasmal Forest. Similarly, the area is also categorized by different species of viz. Robin, Thrush, Warblers, Babblers, etc. Approx. 80 % of the land is under Khasmal Forest local inhabitants mainly depend on forest land for fodder, firewood collection, etc.



1. Table-1: The name of office along project road:

| SL. No. | Name of Office     | Location   | Remarks |
|---------|--------------------|--|---------|
| 01      | MANGAN             |  |         |
| 1       | Range Office       | Mangan   |         |
| 2       | Revenue Block      | Kazor, Pakshep, Singhik-Sentam, Singhchit, Meyong, Naga, Toong |         |
| 3       | G.P.U.             | Singhik-Sentam G.P.U., 14-Toong Naga G.P.U                     |         |
| 4       | Constituency       | Lachen-Mangan  |         |
| 5       | Sub-Divison Office | Chungthang   |         |
| 6       | B.A.C.             | Mangan   |         |

2. Table-2: Checklist of faunal diversity of Mangan Territorial Range

| SL. No | Common Name                       | Scientific Name          | IUCN Status          |
|--------|-----------------------------------|--------------------------|----------------------|
| 1      | Himalayan Black Bear              | <i>Ursus thibetanus</i>  | VU (Vulnerable)      |
| 2      | Rhesus Macaque                    | <i>Macaca mulatta</i>    | LC (Least Concern)   |
| 3      | Baring Deer                       | <i>Muntiacus muntjak</i> | LC                   |
| 4      | Grey Mongoose                     | <i>Urva edwardsii</i>    | LC                   |
| 5      | Orange-Bellied Himalayan Squirrel | <i>Dremomys lokriah</i>  | LC                   |
| 6      | Himalyan Jungle Cat               | <i>Felis sp</i>          | LC                   |
| 7      | Fox                               | <i>Vulpes sp.</i>        | LC                   |
| 8      | Wild Boar                         | <i>Sus scrofa</i>        | LC                   |
| 9      | Indian Porcupine                  | <i>Hystrix sp</i>        | LC                   |
| 10.    | Bhutan Giant Flying Squirrel      | <i>Petaurista nobili</i> | NT (Near Threatened) |

3. Table-3. Checklist of floral diversity of Mangan Territorial Range

| Sl. No | Common Name | Scientific Name             | Remarks |
|--------|-------------|-----------------------------|---------|
| 1      | Uttis       | <i>Alnus nepalensis</i>     |         |
| 2      | Saur        | <i>Betula alnoides</i>      |         |
| 3      | Kattus      | <i>Castanopsis hystrix</i>  |         |
| 4      | Tooni       | <i>Toona ciliate</i>        |         |
| 5      | Okhar       | <i>Juglans regia</i>        |         |
| 6      | Mawa        | <i>Engelhardtia spicata</i> |         |
| 8.     | Negara      | <i>Ficus sp.</i>            |         |

| Sl. No | Common Name    | Scientific Name                  | Remarks              |
|--------|----------------|----------------------------------|----------------------|
| 9.     | Bojho          | <i>Acorus calamus</i>            | High Medicinal Value |
| 11     | Titaypati      | <i>Artemisia vulgaris</i>        |                      |
| 12     | Thotne         | <i>Aconogonum molle</i>          | Medicinal Value      |
| 13     | Banmara        | <i>Eupatorium cannabinum</i>     | Medicinal Value      |
| 16     | Argaily        | <i>Edgeworthia gardener</i>      |                      |
| 17     | Satwa          | <i>Paris polyphylla</i>          | High Medicinal Value |
| 18     | Rani Chanmp    | <i>Maichila excelsa</i>          |                      |
| 19     | Siris          | <i>Albizia lebbek</i>            |                      |
| 20     | Chilauney      | <i>Schima wallichii</i>          |                      |
| 21     | Panisaj        | <i>Terminalia myriocarpa</i>     |                      |
| 27     | Pipli          | <i>Symingtonia populnea</i>      |                      |
| 28     | Bhalayo        | <i>Rhus insignis</i>             |                      |
| 29     | Payun (Cherry) | <i>Prunus puddum/ cerasoides</i> |                      |
| 30     | Pompsi         | <i>Persea edulis</i>             |                      |
| 31     | Bangi          | <i>Hovenia dulcis</i>            |                      |
| 32     | Totola         | <i>Heteroporax fragoans</i>      |                      |
| 33     | Ber            | <i>Ziziphus sp.</i>              |                      |

4. Table-4. Checklist of Birds of Mangan Territorial Range

| Sl. No | Family        | Local Name                 | Scientific Name                 | IUCN status |
|--------|---------------|----------------------------|---------------------------------|-------------|
| 1      | Columbidae    | Oriental Turtle Dove       | <i>Streptopelia orientalis</i>  | I.C         |
| 2      | Columbidae    | Barred Cuckoo Dove         | <i>Macropygia unchall</i>       | I.C         |
| 3      | Nectariniidae | Green-tailed Sunbird       | <i>Aethopyga nipalensis</i>     | I.C         |
| 4      | Nectariniidae | Fire-breasted Flowerpecker | <i>Dicaeum ignipectus</i>       | I.C         |
| 5      | Nectariniidae | Streaked Spiderhunter      | <i>Arachnothera magna</i>       | I.C         |
| 6      | Nectariniidae | Fire-tailed Sunbird        | <i>Aethopyga ignicauda</i>      | I.C         |
| 7      | Pycnonotidae  | Black Bulbul               | <i>Hypsipetes leucocephalus</i> | I.C         |
| 8      | Pycnonotidae  | Striated Bulbul            | <i>Pycnonotus striatus</i>      | I.C         |
| 9      | Pycnonotidae  | Himalayan Bulbul           | <i>Pycnonotus leucogenys</i>    | I.C         |
| 10     | Passeridae    | Old World sparrow          | <i>Passer domesticus</i>        | I.C         |
| 11     | Picidae       | Bay Woodpecker             | <i>Blythipicus pyrrhotis</i>    | I.C         |
| 12     | Picidae       | Darjeeling Woodpecker      | <i>Dendrocopos darjellensis</i> | I.C         |
| 13     | Muscicapidae  | Blue Whistling Thrush      | <i>Myophonus caeruleus</i>      | I.C         |



| Sl. No | Family       | Local Name                  | Scientific Name              | IUCN status |
|--------|--------------|-----------------------------|------------------------------|-------------|
| 14     | Phasianidae  | Indian peafowl              | <i>Pavo cristatus</i>        | I.C         |
| 15     | Phasianidae  | Junglefowl                  | <i>Gallus gallus</i>         | I.C         |
| 16     | Strigidae    | Asian Barred Owlet          | <i>Glaucidium cuculoides</i> | I.C         |
| 17     | Strigidae    | Collared Owlet              | <i>Glaucidium brodiei</i>    | I.C         |
| 18     | Paridae      | Green-backed tit            | <i>Parus monticolus</i>      | I.C         |
| 19     | Accipitridae | Crested Serpent Eagle       | <i>Spilornis cheela</i>      | I.C         |
| 20     | Accipitridae | Black Eagle                 | <i>Ictinaetus malayensis</i> | I.C         |
| 21     | Sylviidae    | Chestnut-crowned Warbler    | <i>Seicercus castaniceps</i> | I.C         |
| 22     | Sylviidae    | Scaly-breasted Wren Babbler | <i>Pnoepyga albiventer</i>   | I.C         |
| 23     | Sylviidae    | Pygmy Wren Babbler          | <i>Pnoepyga pusilla</i>      | I.C         |
| 24     | Sylviidae    | Golden Babbler              | <i>Stachyris chrysaea</i>    | I.C         |
| 25     | Corvidae     | Black Drongo                | <i>Dicrurus macrocercus</i>  | I.C         |
| 26     | Corvidae     | Lesser Racket-tailed Drongo | <i>Dicrurus remifer</i>      | I.C         |
| 27     | Corvidae     | Ashy Drongo                 | <i>Dicrurus leucophaeus</i>  | I.C         |
| 28     | Corvidae     | Common Green Magpie         | <i>Cissa chinensis</i>       | I.C         |
| 29     | Corvidae     | Yellow-billed Blue Magpie   | <i>Urocissa flavirostris</i> | I.C         |
| 30     | Corvidae     | Spangled Drongo             | <i>Dicrurus hottentottus</i> | I.C         |
| 31     | Muscicapidae | White tailed Robin          | <i>Myiomela leucura</i>      | I.C         |

## **\* ENVIRONMENTAL IMPACT ASSESSMENT**

### **INDIAN FOREST ACT, 1927**

The Indian Forest Act 1927 was enacted after repealing the Indian Forest Act, 1878 for the purpose of consolidating the law relating to forests, the transit of forest produce and the duty applicable on timber and other forest produce. The Act is an important piece of the Central Legislation and various state enactments have made amendments to suit their local requirements and some states enacted their own full scale Forest Acts. The Indian Forest Act was enacted to preserve and safeguard the forests generally in India. The act makes various provisions for such conservation of forests and in the scheme it provides for a state government to constitute any forest lands or waste lands, which are property of Government or which the Governments have proprietary rights, a reserved forests. All though the Indian Forest Act specifically speaks with (i) Reserved forests (ii) Village forests and (iii) Protected forests. The preamble and other provisions of the Forest Act are wide enough to cover all categories of forests.

#### **1. IMPACTS ON THE WILDLIFE:**

Disturbance to Wildlife the wildlife population often decline due to the cumulative impacts of the linear projects. The impacts are quite substantial are severe and more detrimental. The major impacts are listed below:

- **Wildlife mortality**
- **Habitat loss and degradation**
- **Habitat fragmentation**
- **Landslides and soil erosion.**
- **Effect on arboreal animals**
- **Impact on the flora and fauna components**
- **Impacts on aquatic ecosystem.**
- **Change in animal behavior**
- **Pollution from construction activity and due to construction equipment.**

There is a direct loss of habitat during establishment and maintenance of linear project. This may happen due to clearing of vegetation, dumping of excavated earth and material movement of heavy vehicles and earth movers, creation of labour camps etc. the effect of these disturbances may persist in the landscape for years to decades. The effect of infrastructure on bird populations extended over distances up to 1 km and for mammal's population up to about 5 km. Mammals and birds areas should be avoided for infrastructure developmental activities except in open areas over larger distances compared to forested areas. The construction work gives raise to landslides and other forms of erosion in steep forested landscapes. During the construction period, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife population in the vicinity of project area. The operation of equipment will generate significant noise, especially during blasting which will have adverse impact on fauna of the area. The noise may scare the fauna and force them to migrate to other areas. Likewise shifting of construction plants, workshops, stores, labour camps etc. could also lead to adverse impact on the fauna of the area. During the construction phase, accessibility to area will lead to influx of workers and the people associated



with the allied activities from outside will also increase. Increase in human interference could have an impact on terrestrial ecosystem. The other major impact could be the blasting to be carried out during construction phase. This impact needs to be mitigated by adopting controlled blasting and strict surveillance regime and the same is proposed to be used in the project. This will reduce the noise level and vibrations due to blasting to a great extent. The impacts caused by the construction activity can be easily mitigated.

**Suggested biodiversity management measures:**

- Delineation of critical wildlife zones in the project area based on presence of major species i.e., Himalayan Black Bear, Bhutan giant flying squirrel, Rhesus Macaque etc
- No collection of green bamboo should be allowed
- Strict compliance for measures to control forest fires including dousing of all fires at project site
- Segregation of solid waste into bio-degradable and non-biodegradable at project site and strict compliance against dumping of waste in open spaces. There should be a mechanism for transporting inorganic waste out of the project site to the nearest recycling facility on a regular basis
- Strict compliance against dumping of road construction debris near water sources and inside critical wildlife zones
- Strict compliance to ensure that vehicular effluents and fuel are not dumped near /inside water sources
- Strict monitoring for detection of any illegal activities against wildlife by the labour/ project staff engaged at the site
- Sensitization for all engaged project staff and construction labour regarding biodiversity and illegal wildlife activities
- Strict compliance against deployment of generators/ noise inducing equipment after evening.
- Enough speed breakers/ rumble strips should be constructed at regular intervals.
- Installation of signages signifying the code of conduct and important biodiversity of the areas, at strategic locations.
- No damage should be done to any natural wetland or water body during the construction.

**2. MITIGATION MEASURES:**

- Scheduling construction activities to avoid disturbances to bird populations during feeding and reproduction periods.
- Keeping an inventory of all large trees to be removed in order to identify bird eggs and nests and minimize impacts.
- The contractors to establish environmental units and implement public awareness programs during construction regarding the impacts caused by the construction activity.
  - All wood building material for worker's housing should be brought from outside the project area it should not be procured from the same project site.
  - Workers should be supplied with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract

- All contract equipment and plants should be cleaned to the satisfaction of the project engineer prior to their relocation to project sites.
- During site clearance, care should be taken to ensure that the minimum area of vegetation area is affected
- The water sprinkling of trucks used, as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation is minimized.
- Clearing only necessary amount of vegetation from the forest area.
- Project staff and workers should not be allowed to have fire-arms and animal traps etc.
- Employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading all other ancillary works should also agree not to participate in such activities;
- If any of the hunting activity is observed then the worker will be removed from the employment with immediate effect.
- There should be speed limit for the material carrying trucks/dumpers while traversing through the forest areas if at all. It is always better not to travel in the forest areas that would disturb the animal behavior.
- Honking should be strictly prohibited in the forest area by the trucks and dumper used for the construction activity.
- No construction yard will be established at the forest area.
- No disposal of construction waste in the forest premises
- No earthen material or water from the springs present in the forest area will be used for the construction activity.
- Hunting will be strictly prohibited for the workers.

### **3. IMPACTS DUE TO MOVEMENT OF VEHICLES:**

Sprinkle water on the road surface in settled areas when dust levels rise, particularly in the dry season.

Maintain all construction vehicles to minimize toxic vehicle emissions.

Set and enforce speed limits, especially near schools and populated areas.

Install appropriate signs warning drivers to slow down in settlement areas.

Arrange flagmen to control the traffic at the muck disposal areas.

Proper training imparted to the workers involved in the construction activity.

The wind breaks well and fully maintained.

### **4. IMPACTS DUE TO MUCK DISPOSAL**

Waste will be generated due to construction of double lane road from Mangan to Chungthang. Waste generated by excavation and by the construction activity will be dumped in proper dumping ground designated by the Forest Department. There are several measures suggested to prevent polluting the environments.

### **5. MITIGATION MEASURES:**

- The waste material generated during the excavation of rock will be reused during the site development to some extent. The material will be used after testing its quality.



- Construction debris will be disposed of in suitable pre identified dumping location, suggested by the Pollution Control Board. A prior approval from the Forest & Environment Department, Govt. of Sikkim will be required before disposal of muck.
- Construction labour camp should be more organized with adequate facilities and should be away from the muck disposal yard as suggested by the Concern Department.
- Required a regular inspection for the debris disposal site from Forest Department.
- A waste disposal site should be away from human settlement, to prevent incidence of health hazards.
- Generally suitable barren lands are preferable for this purpose.
- Ideally speaking a disposal site should be away from the ecologically sensitive areas such as water streams/scared areas/wetlands/Petlands.
- It should be easily accessible from the main roads.
- No dumping allowed on private property without written consent of the owner.
- The truck and dumpers used should be spill proof as they move through settlements.
- There should be direction showing boards to the disposal site.
- The worker working at this area should be given proper training regarding the health hazards associated with the work.

#### **6. IMPACTS ON WATER QUALITY**

The major sources of water pollution during project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Effluent from Construction Plants and Workshops
- Disposal of solid waste
- The sewage will be treated appropriately.
- The effluents will be suitably treated before letting out
- No disposal of cut spoils into gullies or watercourses.
- A waste disposal site should be away from human settlement, because of incidence of health hazards. Generally barren lands are preferable for this purpose.
- A disposal site should be away from water streams sources.

#### **7. SEWAGE FROM CONSTRUCTION WORKER CAMPS**

The project construction is likely to last for a period of 3 years. Most of the employees/workers during construction phase are likely to be employed from outside the project area. The construction phase, also leads to mushrooming of various allied activities to meet the demand of immigrant Construction Worker population in the project area. Additionally drivers and labour associated with transportation of material will also stay in the area on temporary basis. There will be increased quantum of wastewater and sewage is generated, which requires immediate treatment.

#### **8. MITIGATION MEASURES**

The construction wastewater and kitchen waste water will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. The settled material will be either used as fertilizer.

## **9. IMPACT ON NOISE ENVIRONMENT**

As discussed earlier, two major construction plants viz. aggregate processing and concrete mixing and major repair workshops will be established, apart from minor workshops and other construction equipment. Water is used and in these construction plants and wastewater generated contains suspended solids. Similarly from workshops, major pollutant will be oil and grease. Discharge of untreated wastewater will have serious impact on water quality of receiving water body. Turbidity and oil & grease levels will increase substantially in small tributaries, especially, in lean season

## **10. MITIGATION MEASURES**

- Treatment in settling tanks before discharge to any water body or for land application.

Sources of noise will be the vehicles and equipment for excavation and stationary equipment, including concrete batch plant located at the construction sites. Other sources of noise will be the use of explosives for blasting purposes for construction activities, drilling machines and quarrying and crushing activities.

## **11. NOISE DUE TO CONSTRUCTION EQUIPMENT**

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all these equipment generate noise from a common point. The increase in noise levels due to operation of the different construction equipment has been worked out. However, such noise levels will only affect the operators and construction workers who will be in the vicinity of the noise generating equipment and they should always be using PPEs to ward off any negative impact due to exposure to high noise levels. As the distance from the source increases the noise levels decrease considerably. By erecting a noise barrier would additionally reduce the noise level as the sound wave passes through a barrier.

## **12. NOISE MITIGATION MEASURES**

- Site the quarries away from communities and livestock grazing areas.
  - Inform people of the possible vibration before using Vibrating Rollers near settled areas.
  - Machinery and vehicles will be maintained regularly, with particular attention paid to silencers and mufflers, to keep construction noise levels to minimum.
  - Construction yards will be located away from settlement areas. Aggregate crushing plants shall be located on the down wind direction of sensitive areas such as schools, hospitals or human settlement etc. In unavoidable circumstances, the time of the operation of the plant shall be limited. The necessary permission should be obtained from the local government officials.
  - A vegetative barrier will be suitably less expensive for a construction yard. The native species is always preferable.
  - Operations will be scheduled to coincide with period when people would least likely to be affected.
- Construction activities will be strictly prohibited between 6 A.M. and 6 P.M.

## **13. THE FOLLOWING IMPACTS ARE ENVISAGED ON AIR QUALITY:**

- Pollution due to fuel combustion in various equipment
- Emissions from various crushers and other construction plants
- Fugitive Emissions from material handling and transportation



#### **14. MITIGATION MEASURES**

- Maintain all construction vehicles to minimize toxic vehicle emissions.
- Placing of dust arresters surrounding the crusher and the construction yards will prevent the dispersion of the dust to a great extent.
- Spray water on the stones while unloading from the truck/dumper.
- Spray water at the primary crusher feeder chute.
- Spray water at the transfer points from one belt conveyor to another.
- Payload area of trucks will be covered by tarpaulins when transporting crush to prevent fall out of fines and emissions of dust
- Facility for regular cleaning and wetting of the ground should be provided.
- Trees of native species should be planted to develop a green belt within and along the boundary of the premises of construction yards and the labor camps
- Vegetation of the pile is an excellent option whenever soil is likely to be exposed for a long period of time (greater than four weeks), or whenever works are completed in an area. Note there is also a requirement by the Department of Planning for dust control measures to be left in place until at least 70% vegetative cover has been established.
- Alternatively mulched green wastes can be temporarily laid over the stockpile and removed when required, and retained for later landscaping purposes.

#### **15. IMPACTS DUE TO QUARRYING OPERATIONS**

Opening of the quarries will cause visual impacts. Other impacts will be the noise generated during crushing activity, which could affect wildlife in the area, dust produced during the crushing operation to get the aggregates to the appropriate size and transport of the aggregates, and transport of materials. The quarry sites would lead to disturbance to forest area and rural areas surrounding the project site.

#### **16. MITIGATION MEASURES**

- Paving road surfaces within the quarry site to prevent the dust emissions.
- Water spraying of conveyors/conveyor transfer points, stockpiles and roads, appropriate maintenance of vehicles and machinery; landscaped mounds on the periphery of the site and around storage areas. The quarries should be sited away from the sensitive locations like the schools and health Centers.
- The quarries should not be very near to human settlements; at least 500 meters away from the human settlement.

#### **\* PROPOSAL FOR DIFFERENT FORESTRY ACTIVITIES UNDER BELOW:-**

##### **\* RESEARCH, FOREST DEVELOPMENT, PUBLIC AWARENESS & TRAINING:**

The pristine forest area of this Mangan-Chungthang holds an array of biodiversity. So far, no serious research work has been conducted in the area and there is a need to develop, encourage, allow, support positive research programmed. The information obtained from the research could be used further for better administrative and planning as well as better management of this fragile ecological forest area.

### **1. FOREST PROTECTION MEASURES WITH BOULDER SAUSAGE WALL FENCING:**

Boulder sausage works: Upper reaches are treated with this work where bigger boulders are used to construct sausage works to stabilize the slopes of forest areas which will be acquired for the double lane road construction.

### **2. FOREST PROTECTION MEASURES WITH DRY STONE WALL FENCING:**

Dry stone wall fencings would be required at various locations within the Reserve/Khasmal forest to protect the forest and its allied afforestation from cattle grazing, discourage encroachment, and prevent soil slippage.

### **3. INFRASTRUCTURE DEVELOPMENT**

#### **I. REPAIRING OF RANGE OFFICER & BLOCK OFFICER QUARTER UNDER MANGAN RANGE:**

The present Range Officer & Block Officer quarters under Mangan Range is in dire need of up-gradation for efficient working at the Range Level.

#### **II. FOREST FIRE MANAGEMENT:**

While Sikkim has made great strides in the use of technology for detecting forest fires, there is still a need to strengthen fire prevention practices and to develop a well-equipped and trained workforce to fight fires.

#### **III. PURCHASE OF SIGNAGES:**

It's important to be aware of the types of forest area and the vegetation to make sure forests can be enjoyed in a good way for which installation of signages is important.

#### **IV. PUBLIC AWARENESS AND EDUCATION:**

The intensity of disturbances caused is due to ignorance or lack of proper education of understanding of the ecosystem of the Khasmal Forest and other forest land. The proper awareness and dissemination of information to the local residents is very essential and should be made mandatory in the project. The important floral and faunal resources of the proposed Mangan-Chungthang double lane road construction with a stretch of 27.476 kms area highlighting the local sentiments should be printed in handouts or pamphlets in language which can be read and understood by the local community. Several meeting with the local community and the stakeholders and people residing at the fringes of the Forest area may be organized constantly asking them to Preservation and conservation of Forest area. Audio visual aids should be provided to the local community to understand and educate themselves through the media. A film on successful conservation of Forest Land may be screened to the public especially on the festivals and other community meeting to benefit more involvement. The local schools may be taken to the entire reserve forest to educate the value and significance of conservation. Radio talks in local language are very effective means of communication and it reaches to all the area on earth and is affordable by many. Workshop on conservation of Forest land may be organized with the participation of local community and tour operators. Colorful signage informing about the reserve forest area and other forest land and their significance with Do's and Don'ts may be displayed at the vantage points. The information about the Forest area and religious and cultural values may be written. During the tourist peak season cultural shows may be organized with emphasis on the conservation of Forest Land and to spread the message for conservation.



1) **MONITORING AND EVALUATION:** Monitoring and evaluation is an integral part of the project.

2) **OVERHEAD EXPENDITURE:** 2% of the proposed work amount.

3) **CLIMATE RESILIENCE MEASURE FOR MANGAN-CHUNGTHANG DOUBLE LANE ROAD:**

The forest of Sikkim, a Himalayan State in north-east India, is vulnerable to the impacts of climate change. The Sikkim landscape comes under the Eastern Himalayan Biodiversity Hotspot, one of the global biodiversity hotspots, due to its floral and faunal biodiversity. Climate change is basically driven by anthropogenic activities and other natural calamities such as landslide, earthquake etc. The State of Sikkim has one of the highest percentages of land under forest and tree covers among the states of India. These forests provide opportunities towards climate change mitigation and adaptation.

1. Plantation of degraded forest land to increase the green cover.
2. Encouraging participation of JFMCs and EDCs towards conservation of Forest which is important watersheds and for habitat wildlife species.
3. Establish and plantation of climatic resilience indigenous species such as Oak species.
4. Provision of climate-resilient alternate livelihoods option such as ecotourism, bird watching and Home-stay training.
5. Promoting responsible solid-waste management program.
6. Capacity building programs to forest department personal as well as local communities.
7. Support the development of community forest management plans.



*Flowering Species found in Mangan Territorial Range, North Sikkim*

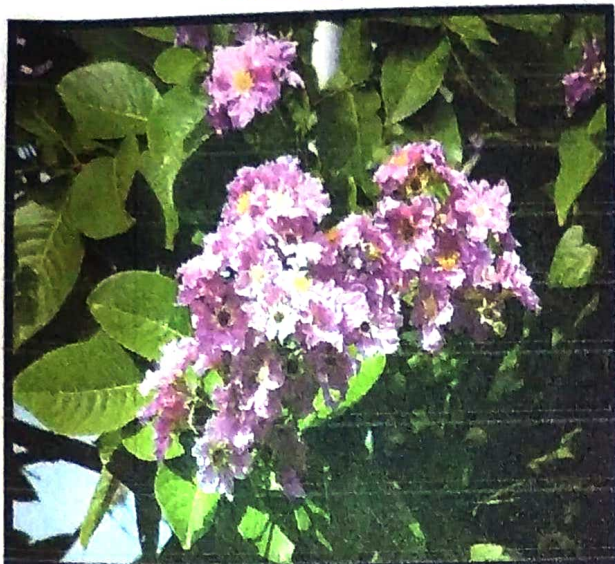


Fig. 1). Jarul (*Lagerstroemia speciosa*)



Fig. 2). Eight Stamen Osbeckia (*Osbeckia octandra*)



Fig. 3) Dhobi phool (*Mussaenda frondosa*)



Fig. 4). Neelkamal (*Hydrangea macrophylla*)



Fig. 5). Ban Fanda (*Lantana camara*)

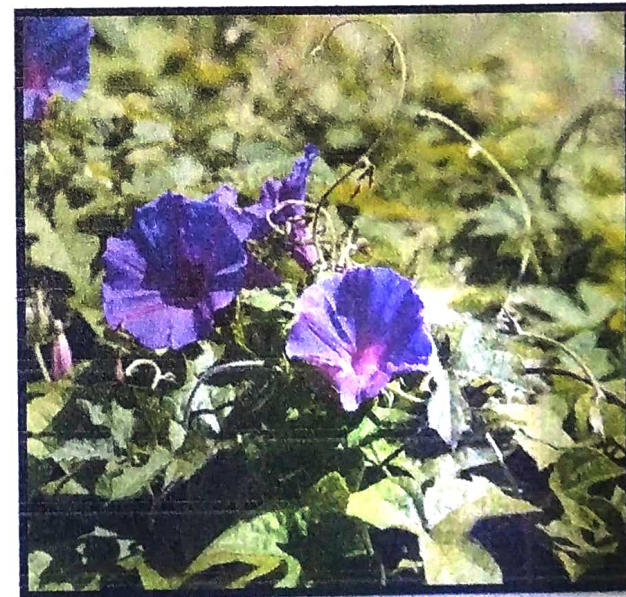


Fig. 6). Morning Glory (*Ipomoea purpurea*)



*Fruit Bearing Species found in Mangan Territorial Range, North Sikkim*



Fig. 1). Vui Aiselu (*Fragaria vesca*)

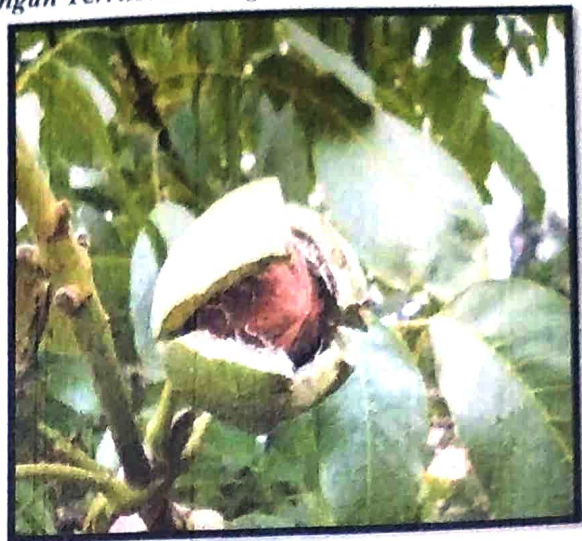


Fig. 2). Okhar (*Juglans regia*)



Fig. 3). Kattus (*Castanopsis indica*)



Fig. 4). Pompsi (*Persea edulis*)



Fig. 5). Bokey Timbur (*Zanthoxylum armatum*)



Fig. 6). Nebara (*Pyrus pashia*)



*Birds Diversity of Mangan Territorial Range, North Sikkim*



Fig. 1). Blue Whistling Thrush (*Myophonus caeruleus*)



Fig. 2). Barred Cuckoo Dove (*Macropygia unchall*)



Fig. 3). Black Drongo (*Dicrurus macrocercus*)



Fig.4). Indian Myna (*Acridotheres tristis*)



Fig. 4). White tailed Robin (*Myiomela leucura*)



Fig. 5). Himalayan Bulbul (*Pycnonotus leucogenys*)



*Faunal Diversity of Mangan Territorial Range, North Sikkim*



Fig. 1). Giant Flying Squirrel(*Petaurista nobili*)



Fig. 2). Wild Boar (*Sus scrofa*)



Fig.3). Orange-bellied Himalayan squirrel (*Dremomys lokriah*)



Fig. 4). Rhesus Macaque (*Macaca mulatta*)



Fig. 5). Barking Deer (*Muntiacus muntjak*)



Fig. 6). Himalayan Black Bear (*Ursus thibetanus*)



## CONCLUSIONS

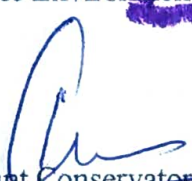
The proposed road construction from 67.000 km (Mangan) to 95.000 km (Chungthang) of total design length 27.476 km in North Sikkim, involves the degradation of the Khasmal Forest, however the construction of these roads will hugely benefit the people of North Sikkim and increase the military might of the region. To compensate and mitigate the environmental damage due to the proposed project, the Biodiversity Management Plan has been prepared under North Territorial Division, Forest & Environment Department, Government of Sikkim.

Block Officer  
Mangan Territorial Block  
Mangan Territorial Range  
North Territorial Division  
Forest & Environment Department

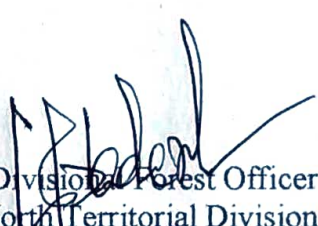

Block Officer  
Naga Territorial Block  
Mangan Territorial Range  
North Territorial Division  
Forest & Environment Department



Range Officer  
Mangan Territorial Range  
North Territorial Division  
Forest & Environment Department



Assistant Conservator of Forest  
North Territorial Division  
Forest & Environment Department  
ASSISTANT CONSERVATOR OF FOREST  
SUB DIVISION MANGAN  
NORTH TERRITORIAL DIVISION  
FOREST & ENV. DEPARTMENT



Divisional Forest Officer  
North Territorial Division  
Forest & Environment Department  
Divisional Forest Officer  
North Territorial Division  
Forest & Environment Department

