

Environmental Assessment Report

Initial Environmental Examination for Melli–Nayabazar (SK01)
Project Number: 37143
September 2006

India: North Eastern State Roads Project

Prepared by Ministry of Development of North Eastern Region for the Asian Development Bank (ADB).

The initial environmental examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

ABBREVIATIONS

ADB	-	Asian Development Bank
CPCB	-	Central Pollution Control Board
CRRRI	-	Central Road Research Institute
DoE	-	Department of Environment
EA	-	Executing Agency
EFRC	-	Environment Friendly Road Construction
EIA	-	Environmental Impact Assessment
EMMP	-	Environmental Mitigation and Monitoring Plan
GDP	-	Gross Domestic Product
GoI	-	Government of India
IEE	-	Initial Environmental Examination
IRC	-	Indian Road Congress
MDONER	-	Ministry of Development of North Eastern Region
MDRs	-	Major District Roads
MoEF	-	Ministry of Environment and Forests
MoRT&H	-	Ministry of Road Transport and Highways
MSL	-	Mean Sea Level
MW	-	Mega Watt
NEC	-	North Eastern Council
NER	-	North Eastern Region
NGO	-	Non Government Organization
NH	-	National Highway
NO _x	-	Oxides of Nitrogen
NSDP	-	Net State Domestic Product
PIU	-	Project Implementation Unit
PWD	-	Public Works Department
ROW	-	Right of Way
SPM	-	Suspended Particulate Matter
SO ₂	-	Sulphur Dioxide
SSI	-	Small Scale Industries
SPCB	-	State Pollution Control Board
TA	-	Technical Assistance
TOR	-	Terms of Reference
WHO	-	World Health Organisation

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1. INTRODUCTION

General

1. Sikkim, with a total area of about 7100 sq km is a landlocked state, criss-crossed by green valleys, high peaks and rippling rivers. It is decorated by an array of exotic and colourful orchids. About 45 percent of land area is covered by forest. It lies in the north-eastern Himalayas, bound on the north by China (Tibet plateau), on the east by Chumbi valley of Tibet and Bhutan, on the west by Nepal and on the south by Darjeeling district of West Bengal. Thus it is a gateway to Tibet and northern China. The population of the state stood at 0.54 million in 2001. Hills ranging from 300 m to 8500 m altitude result in a climate that varies from sub-tropical to alpine. The average annual rainfall is 5000 mm. The literacy rate is 70 percent (2001 census) which is well above the national average.

2. Roads are the only means of getting to and within the state. They are a critical input to the growth of all sectors. The length of roads is reported to be about 1840 km. Most of these roads are rural roads and other district roads amounting to more than 60 percent of total roads. All roads are single lane roads. Most of the roads have narrow carriageways, and are built along hillsides and are prone to landslides. The National Highway No. 31A is the only NH link serving the state and is under the jurisdiction of Border Roads Organisation for its development and maintenance. A few arterial roads in the north and north-western region of the state are also understood to be with the Border Roads Organisation.

3. The Public Works Department is the principal agency in the state responsible for development and maintenance of roads. The works on the national highway linking Gangtok (the state capital) with the rest of the country through Siliguri and a few arterial roads in northern and north-western part are looked after by Border Roads Organisation.

4. Settlements are scattered and many rural communities are still far from the nearest road. In these areas, goods are brought in, or taken out, either by animal or back loading. Gangtok is the only major commercial centre in the state.

5. The proposed "North Eastern State Roads Project" is a joint initiative of the Government of India and ADB. Funding for the technical assistance (TA) is provided jointly by GOI, through the Executing Agency (EA) for GOI, namely the Ministry of Development of North Eastern Region (MDONER), and ADB. For this purpose a Technical Assistance Agreement was signed on 20 December 2004 between GOI and ADB. The project is intended to assist the states of the north-eastern region of India to study the feasibility of developing the respective road networks and improving national and sub-regional connectivity with the objective of enhancing mobility and trade. The project will also assist the states to develop the capacity of road sector institutions to increase productivity of the road assets.

6. The primary focus of the assistance is on, but not be limited to: (i) prioritization of national highways, state highways, and major district roads to be improved; (ii) determination of the feasibility of an investment project for improvement of priority state roads and bridges; and (iii) preparation of an institutional strengthening action plan comprising immediate action to support implementation of the proposed project.

7. As part of the "Road Sector Investment Component" feasibility studies are being undertaken for the improvement of following roads in the State of Sikkim:

- Section SK-01: Nayabazar to Melli section in the district of South Sikkim is a state highway covering a total length of 27 km;
- Section SK-02: Nayabazar to Namchi section in the district of South Sikkim is a state highway covering a total length of 20 km; and

- Section SK-03: Rumtek to Sang in the district of West Sikkim is a state highway covering a total length of 25 km.

8. The main objectives of the road sector investment component are to improve the regional, as well as inter and intra state transport flows, and in doing so improving access to services, and making the NER attractive to developers and investors.

9. To fulfil the above objectives and due considerations to environmental feasibility of above road section, a sample road section (*SK-01: Nayabazar to Melli section in the district of South Sikkim covering a total length of 27 km*), which represent the typical environmental issues in the state is selected for the environmental study.

10. The IEE study was started in the month of September 2005 and continued till January 2006. The report has been prepared by national environmental expert, in coordination with project team based at project office in Shillong.

Purpose

11. The purpose of this Initial Environmental Examination (IEE) is to document a screening of the environmental consequences of this road section. This IEE is structured in accordance with the requirements of the ADB.

Scope

12. The Initial Environmental Examination of the proposed project road section has been undertaken to identify and to minimise the adverse environmental impacts, if any, associated with construction and operation. Environmental issues considered in this IEE are mainly macro-level and can have adverse or beneficial impacts. Initial Environmental Examination of the roads has four basic objectives, as stated below, to:

- determine the magnitude of potential environmental concerns and to ensure that environmental considerations are given adequate weight when carrying out the proposed road constructions/improvements;
- identify the environmental issues that should be taken into account when new links are constructed and/or existing links improved - such to include both adverse and beneficial impacts;
- identify any further needed environmental studies or Environmental Impact Assessment (EIA); and
- identify potentially required enhancement/mitigation measures, if any.

Executing Agency

13. The executing agency of the proposed project is the Ministry of Development of North Eastern, Government of India in coordination with North Eastern Council. The work of the feasibility study has been assigned to "Technoconsult International Limited, Bangladesh in association with other consultancies DLA, DPM, DCPL and VisionRI. Initial Environmental Examination study has been undertaken by national consultant from VisionRI.

Study Methodology

14. The Initial Environmental Examination has been carried out using current ADB and Government of India guidelines, specifically:

- "Environmental Assessment Guidelines (ADB 2003)";
- "Environmental Guidelines for Selected Infrastructure Projects (ADB 1993b)";

- “Project Terms of Reference (TOR)”;
 - “Environmental guidelines for Road/Rail/Highway Projects”, Government of India, 1989
 - “Handbook of environmental procedures and guidelines”, 1994, Government of India
 - “Guidelines for Environmental Impact Assessment of Highway Projects” (IRC: 104-1988); and
 - The Environmental (Protection) Act, 1986
15. The IEE was carried out in four stages:
- reviews of literature, laws and guidelines and meetings with concerned agencies and organisations in NEC, Shillong, State Authorities (Environment & Forests, Pollution Control Board, PWD) in Gangtok and on-site;
 - reconnaissance survey along with public consultation was done in the month of July and October 2005 and processes of public consultation continued till the completion of study to inform the people about the project and collect the information / suggestions on environmental issues. The environmental data was collected within 100 meters of centre of road. The vegetation analysis was done by counting the number of trees within corridor and observing the vegetation density along the project road;
 - interaction with other members of the Project Team and PWD to ensure that environmental considerations were given adequate weight in project planning and design – data and other material from the Inception and Interim Reports have also been used for the preparation of this report; and
 - the preparation of the “Initial Environmental Examination” report.

2. DESCRIPTION OF THE PROJECT

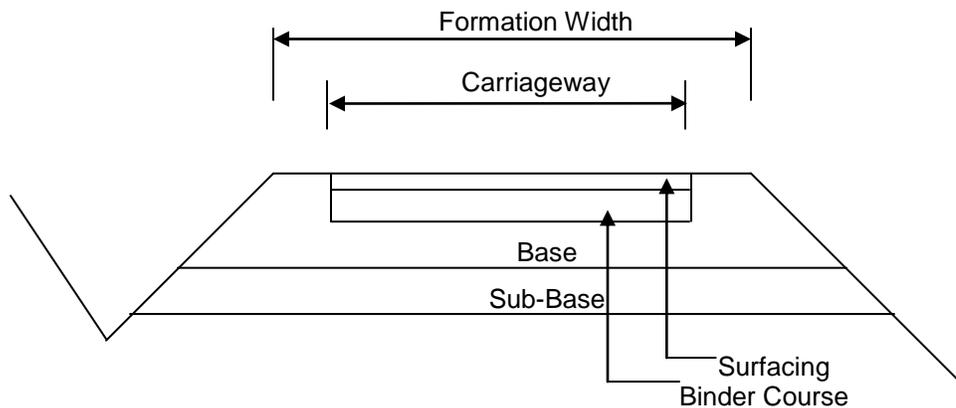
Project Type

16. The proposed road investment component has considered three core road sections in the state of Sikkim. The scope of work for these sections is:
- Road improvement work on 27 km long section SK-01 i.e. Melli to Nayabazar section. This includes widening of existing carriageway to double lane and improvement of shoulders.
 - Road improvement work on 20 km long section SK-02 i.e. Nayabazar to Namchi section. This includes widening of existing carriageway to intermediate lanes and improvement of shoulders.
 - Road improvement work on 25 km long section SK-03 i.e. Rumtek to Sang. This includes widening of existing carriageway to intermediate lanes and improvement of shoulders.
17. Initial Environmental Examination has been carried out for a sample road section i.e. SK-01: Melli to Nayabazar section, representing the typical environmental issues associated with road sector in the State. The existing road is a State Highway with single lane carriageway with shoulders. The average carriageway width is between 4.0 to 5.0m and formation width of 5.0 to 6.0 m. The road passes entirely through hilly terrain (about 96 % road length) with moderate to sharp curves. The road has bituminous surface with good riding condition. The earthen shoulders are deteriorated and hill side drains are damaged. The existing traffic is moderate and likely to go up in near future. The description of the proposed section is described in section 2.4

18. The scope of work for this section is the improvement work on 27 km long road section SK-01 i.e. Melli to Nayabazar section. This includes widening of existing carriageway to two lanes and improvement of shoulders and side drains. The various components for SK-01 road is:

- Widening of the carriageway width to 7.0 m with shoulders and side drains. Total formation width is 8.8m. The road more or less follows the existing alignment and profile. The widening will be accommodated within available land width and there will not be any land acquisition either forest land or private land.
- The total required pavement thickness will be 535 mm.
- Pavement layers consist of overlay with bituminous surfacing -25mm thickness.
- AC Base Course – 60mm thick,
- WBM Granular Base - 250mm thickness, and
- GSB sub-base -200mm thick.

The typical cross section of road is shown in figure below:



19. Besides, following aspects are adopted in the design.

- All construction works will be carried out by mechanized means, for adoption of the above.
- Pavement composition in reconstruction stretches will follow the existing adjoining pavement crust, subjected to the minimum requirements stated above.
- V-shaped drains are generally provided
- Usage of locally available suitable materials will be maximized.

Category of Project

20. Before the start of civil works for the any project roads the state PWD must obtain necessary clearances /permits from the regional office of Ministry of Environment and Forests and State pollution control board. The ADB categorises projects based on their potential environmental impacts. This project has been classified as Category B according to the ADB Fact-Finding Mission undertaken in the months of May and July 2004. The findings of the Consultants’ “Initial Environmental Examination” further confirm that this project falls under Category B. This category includes projects with adverse environmental impacts, which are of a lesser degree. As such, an Initial Environmental Examination (IEE) is required and an Environmental Impact Assessment (EIA) may not be required. Category B projects require the preparation of an Environmental Impact Assessment only if “significant” adverse environmental impacts have been forecast in the IEE. Significant impacts are those, which are comprehensive, broad and diverse and likely to be

irreversible. The Rapid Environment Assessment (REA) checklist for this section is appended as **Attachment 1**.

21. The project road passes through the hilly terrain with river valley on other side. The project road between Malli to Nayabazar passes through the reserve forest area of the South Sikkim Forest Division. However, the improvement work will be done along the existing alignment and the available land width is sufficient to accommodate the proposed improvement work. Therefore, there will be no acquisition of forest land and impacts of the proposed work will be minor and short duration. There are no environmentally critical areas in the project road.

22. During detailed engineering (not part of this project) an “Environmental Management and Monitoring Plan” will be also required. Amongst other things, this plan should address issues associated with “Environmentally Friendly Road Construction”, which approach is now a requirement of all feeder road construction.

Need for Project

23. Sikkim is the smallest state in the north eastern region having a total area of 7100 sq.km with an estimated population of 0.54 million (2001). The state has 4 districts, 8 subdivisions and 92 blocks. In the study area most of the rural population is concentrated in the valleys and mountain shoulders often in remote scattered settlements. Travel by road is the only mechanised mode of transport. Because of the mountainous terrain, the area of land suitable for agriculture is limited. This situation makes the construction and improvement of roads extremely difficult and expensive.

24. Presently, there is no railway line in the state. Nearest railhead is Siliguri in West Bengal. Similarly, there is no airport also in the state. Nearest airport is at Bagdogra in West Bengal. There is a skeleton helicopter service between Bagdogra and Gangtok (Sikkim). Two major rivers Teesta and Rangit flow through the state but are not navigable and as such inland water transport has practically no role. Roads are the only means of getting to and within the state. They are a critical input to the growth of all sectors. The length of roads is reported to be about 1840 km.

25. The National Highway No. 31A is the only NH link serving the state and is under the jurisdiction of Border Roads Organisation for its development and maintenance. A few arterial roads in the north and north-western region of the state are also understood to be with the Border Roads Organisation. The stock of registered motorized vehicles in the state is around 12000 (year 1999-2000) including about 4000 two wheelers. Population of trucks is around 1000. Traffic is bound to grow to meet the state objectives of economic and industrial growth. Many areas are prone to landslides. Many roads become difficult to use during the winter months and rainy season. Improvement and maintenance of the existing road network is urgent. Roads are considered to be key to the facilitation of economic development in the remote rural areas. To achieve the development objectives, it will be necessary to improve the road sector. The existing road infrastructure urgently needs repair and improvement.

26. The implementation of various project items is envisaged to have the following direct benefits:

- improved quality of life for the rural population in the project influence area (state highway section between Melli and Nayabazar): this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;
- a more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- the facilitation of tourism;
- interstate connectivity to Sikkim South and Sikkim West Districts.

Location

27. The geographical features of the project road are described in **Table 2.1. Figure 2.1** shows the locations of the project roads.

28. The proposed road section (Nayabazar to Malli) is a State Highway measuring 27 km in length and located in Sikkim South District. The topography of the project area is hilly. It passes entirely through hillock in one side and river valley (perennial river Rangit) on other side. The land use is completely forest type. It is situated within the reserved forest area of Sikkim South Forest Division. Project area is covered with greenery having a vegetation density of about 0.4 to 0.5. During the field investigation, local forest department and village communities were consulted to know the presence of flora and fauna in the forests along the road. Local communities and forest official indicated that the reserve forest of the region has some species which are endangered. Some of the endangered mammals reported in forest records are Bharal, Chouded Leopard, Fidhing Cat, Golden Cat, Himalayan Thar, Leopard Cat, Red Panda, Marbled Cat, Musk Deer, Nayan or Great Tibetan Sheep, Pangolin, Serow, Snow Leopard, Spotted Lingsand, Tibetan Antelope, Tibetan Fox, Tibetan Gazzelle, Tibetan Wild Ass, Tiger, Tibetan Wolf. Among the endangered birds are Black Naked Crane (migratory), Blod Pheasant, Peafowl, Tibetan Snow Partridge, and Siberian Crane (migratory). However, during the field surveys, no such species were encountered.

29. The existing condition of the road is moterable with average carriageway width of 3.5 m. The project area is high rainfall zone. The soil is poor and unstable which leads to frequent landslides and soil erosion mainly in rainy season. Cases of landslide were observed during site visits. There are no historical places in the project area; however, two temples exist near to existing carriageway. Temple of goddess Durga at chainage Km 10 i.e. Rolu village has the great cultural significance for local residents of hillocks and the travellers. There is no major settlement in between the project road. Santhang (Nayabazar is the only town at the start of the project road. There is no encroachment on the road and available ROW is 27 ft either side of road.

Proposed Schedule for Implementation

30. Various activities of the project are estimated to take between two and three years to complete. This excludes the pre-construction detailed design period. The proposed schedule should be provided after formulation of detailed engineering design.

Figure 2.1 – Location Map



Table 2.1: Description of road sections between Melli to Nayabazar

Road Section	Distance (km)	Districts	Summary of General Road Condition	Likely Scope of Road Improvement Works
Melli to Nayabazar	27	Sikkim South District	<p>The proposed road section (Nayabazar to Melli) is a State Highway measuring 27 km in length located at Sikkim South District. The topography of the project area is hilly. It passes entirely through hillock in one side and river valley (perennial river Rangit) on other side. The land use is completely forest type. It is situated within the Reserved Forest area of Sikkim South Forest Division. Project area is covered with greenery having a vegetation density of about 0.4 to 0.5. The existing condition of the road is moterable with average carriageway width of 4.0 to 5.0m. The project area is high rainfall zone. The soil is poor and unstable which leads to frequent landslides and soil erosion mainly in rainy season. Cases of landslide were observed during site visits. There are no historical places in the project area; however, two temples exist near to existing carriageway. Temple of goddess Durga at chainage Km 10 i.e. Rolu village has the great cultural significance for local residents of hillocks and the travellers. There is no major settlement in between the project road. Santhang (Nayabazar) is the only town at the start of the project road. There is no encroachment on the road and available ROW is 27 ft either side of road.</p>	<p>The improvement work includes widening of the carriageway to double lane with 7.0 m pavement and 8.8 m formation width and 0.5 m drain on hill side. Carriageway will be asphalt pavement followed by periodic maintenance (patching, crack repairs and sealing)</p> <p>Gabion boxes, check dams, diversion drains, toe walls, benches and chute structures will be required to avoid landslides and enhance proper drainage. Numbers of culverts need to be reconstructed. Few bridges need strengthen and replacing. While the radii of curves less than 25 metres will be increased.</p>

3. DESCRIPTION OF THE ENVIRONMENT

31. A brief description of the existing environment, including its physical and ecological resources, economic development of the region, and issues relating to quality of life are presented in this section. Broad aspects on various environmental parameters (geology, soil, topography, climate, land use, water resources, water quality, air quality, noise quality, tourism, cultural resources etc.) which are likely to be affected (direct or indirect) by the proposed road improvement project are covered. These aspects are covered in broader geographic extent to present the entire region.

Physical Environment

Topography, Geology, and Soil

32. Sikkim is a small hilly State in the eastern himalayas with formidable physical features. Topographically the state is divided according to land elevations (lower hills – altitude ranging from 270 to 1500 meters, mid hills – 1500 to 2000 meters, higher hills – 2000 to 3000 meters, alpine zone - above 3900 meters with vegetation and snow bound land – very high without vegetation upto 8580 meters). The state is separated from the neighbouring countries by three hill ranges i.e. Singalila range – separates Sikkim from Nepal in the west, Chola range – separates Sikkim from Tibet and Bhutan in the east and Pangolia range- separates Sikkim from Bhutan. Tista and Rangit, which originates respectively, from Cholu Lake and Rathong glacier, are the two major rivers of the state. The state receives an annual rainfall of 2000mm to 4000mm. The project road running parallel to the Rangit river on one side throughout its length. The state has the highest peak in the north eastern region with an altitude of 8586 at Mount Kanchendzonga (third highest mountain of the world). Fig 3.1 shows the typical terrain of project road.

33. Geographically the state lies in the North-Eastern Himalayas between 27°00'46" to 28°07'48" North latitude and 88°00'55" to 88°55'25" East longitude, and sprawling over 7096sq.km. The state is bounded by vast stretches of Tibetan Plateaus in the north, the Chunbi valley of Tibet and the Kingdom of Bhutan in the east, the Kingdom of Nepal in the West and Darjeeling district of West Bengal in the south. The state account about 3 percent of the total area of the north eastern region and 1 percent in terms of population. About 10 per cent of the land resource is available for economic utilization in terms of agriculture. Figure 3.2 shows the physical map of the Sikkim State.



Fig 3.1: Typical Hilly Terrain through Project Road

34. The geological formation is of recent origin resulted by nine repetitive successions of Neocene argillaceous and argillaceous sediments gradually thrown into series of North-South trending longitudinal, plunging anti-clines and synclines. In the higher elevations argillaceous formations occur while the low-lying areas and depressions are represented by argillaceous rocks. The common rocks found are sandstone, shale, silt, stone, clay stones and slates. The rock system is weak and unstable prone to frequent seismic influence. The local geology is highly important for the success of road projects. Unstable rock formations and high precipitation combine to make many areas landslide prone. Such areas need to be approached cautiously – measures must be taken to select alignments that minimise the likelihood of land-slides and/or damage from land-slides.

35. Soils of the State are loamy sand to silty clay loam. Soil depth varied from few inches and in some places practically nil to several feet deep depending on weathering processes. Soils are acidic in nature with high organic matter content (0.36 to 5.61%). Soils are porous with poor water holding capacity deficit in potash, phosphorous, nitrogen and even humus.

Climate

36. Sikkim's climate is sub tropical in the lower valleys, but changing fast to temperate and alpine with increase in elevation. For most of the year, it is cold and humid as rainfall occurs right through the year. The area experiences heavy rainfall due to its proximity to the Bay of Bengal. The rainfall in the north district is comparatively less than the other districts. The general trend of decrease in temperature with increase in altitude holds good everywhere. Pre-monsoon rain occurs in April-May and the south-west monsoon operates normally from the month of May and continues up to early October. Climatically, state can be divided into five ranges i.e. Tropical, Sub-tropical Temperate, Sub-alpine, and alpine. These zones are further divided into three zones in describing the aspects of vegetation and based on the altitude i.e.

- Tropical climate - From MSL to 1700 m above MSL
- Temperate climate - From 1700 m to 4300 m above MSL, and
- Alpine climate - From 4300 to 5000 m above MSL

37. Based on temperature, rainfall attributes and wind directions, three main seasons may clearly be recognised in the State. These are –

- Winter extending from November to February
- Summer from March to May, and
- Rainy season from May to October.

38. The mean temperature in the lower altitudinal zone varies from 1.5 to 9.5 degree centigrade. Temperature varies with altitude and slope. The maximum temperature is recorded usually during July and August and minimum during December and January. Fog is a common feature in the entire state from May to September. The summer temperature varies from Max 20.7⁰C to Min. 13.1⁰C and winter temperature varies from Max. 14.9⁰C to Min. 7.7⁰C. The state receives an annual rainfall of 2000 mm to 4000 mm. Available rainfall data shows that the mean annual rainfall is minimum at Thangu and maximum at Gangtok.

39. North-West Sikkim gets very little rainfall (even less than 4.9 mm.). This area has mainly snow -covered mountains. Rainfall is heavy and well distributed during the months from May to early October. July is the wettest month in most of the places. The intensity of rainfall during the south-west monsoon season decreases from south to north, while the distribution of winter rainfall is in the reverse order. The salient climatic features of the state are as follow:

- Average Annual Rainfall - 2000 mm to 4000 mm
- Concentration of precipitation - April to September
- Humidity - 79 to 96%
- Cloudiness - Heavily clouded
- Wind - Generally light except rainy season
- Temperature - Summer 16.9 to 26.30C
Winter 5.80C to 17.50C

Water Resources and Water Quality

40. The state has vast water resources in the form of lakes, snow-fed rivers and streams, some with marshy area. It has abundant of water potential both ground as well as surface water. The State has two major rivers, Teesta and Rangeet, with a total length of 900 km.

These rivers originate from the glaciers of North and West Sikkim. The project area is drained by Rangeet River which joins Teesta River at Melli. Besides river network, the state has 13 lakes, 9 hot springs and glaciers. The State has minor irrigation potential of 13000 hectares. Specific data on surface and ground water potential for the state is not available. However, it can be seen from the figures available for the entire north east region i.e. total surface water potential of the region is 928,873 Mm³ and the total ground water potential of 855 Mm³.

41. The ground water aquifers in the region occur in sediments and fractured rocks. Springs are either seasonal or perennial and are often used for irrigation and drinking purposes. There are number of hot springs in the region which are being used by the local communities for domestic and agricultural purposes and also being used by the visiting tourists.

42. The surface water quality in the region is reported to be well within the permissible limits and also found by visual identifications. There are no reports of any water born disease in the region. People are using this water for drinking purpose without any treatment. In case of ground water quality, it is generally good in entire north east region. People use ground water for domestic purposes within any treatment. Overall ground water quality is acceptable.

Air Quality

43. The ambient air quality in the state is quite pure compared to other neighbouring states. Except few urban centres like Gangtok and Nayabazar, the ambient air quality is good. There are no major industrial activities in the State. Dust arising from unpaved surfaces, forest fire, smoke created by burning of fire woods for producing charcoal and domestic heating, and vehicular pollution are sources of pollution in the region. Firewood burning is major contributor in the ambient pollution load. Industrial & vehicular pollution is mainly concentrated in the major commercial areas in State capital. Lack of technology and state of the art equipments are some of the factors responsible for industrial pollution.

44. Vehicular pollution is a secondary source of pollution in the state as the traffic density in the entire state is very less. Pollution from vehicles is mainly due to use of low-grade fuel, low maintenance of vehicles, and also the poor conditions of the roads. The level of pollution in rural areas is much lower than that of the urban areas. Also the traffic flow in rural areas much less than that of the urban locations. The traffic density in the state is very low. In the entire north eastern region, Sikkim has only 1 percent of total registered vehicles of 10232. About 25 % of the vehicles consist of two wheelers followed by cars and trucks.

45. The air quality data obtained from the Sikkim State Pollution Control Board indicates that the ambient air quality in the state is well within permissible standards. Table 3.1 below presents the air quality in the Sikkim State.

Table 3.1: Ambient Air Quality in and around Gangtok (Yearly Average) in µg/m³

Sl.No.	Location	Category	SPM	SO ₂	NO _x
1	Tadong	Residential	108 (140)	16.2 (60)	15.7 (60)
2	Indra bye-pass	Commercial	137 (360)	17.4 (80)	22.6 (80)
3	Deorali	Residential	118 (140)	18.6 (60)	16.1 (60)
4	Bazar Area (Near metro point)	Commercial	145 (360)	22.3 (80)	20.4 (80)
5	Hospital Point	Sensitive	122 (70)	19.6 (15)	18.6 (15)
6	Zero Point	Sensitive	98 (70)	10.2 (15)	12.3 (15)

Source: Sikkim State Pollution Control Board

Note: Figures in () indicates the permissible standards

Noise Quality

46. Noise pollution is not a problem in the state. Also in future there will not be any rise in the noise levels due to proposed activities as also there are no major settlements along the proposed road. Since the traffic flow is expected to be very low in the project roads, there will not be any rise in the noise levels. However, few commercial locations i.e. Nayabazar and busy junctions i.e. Melli, small contribution to the noise levels are expected, but still the ambient noise quality is expected to be well within the permissible limits.

47. During the construction period, temporary increase in the noise levels are expected due to movement of construction machineries and construction activities associated with proposed road development. Suitable barriers in the form of noise barriers and timely scheduling of construction activities will minimize these affects to the greater extent.

48. The ambient noise quality in various locations in the Gangtok city in the State of Sikkim is presented herewith in Table 3.2. It can be seen that the noise levels are well within the permissible limits for all categories off the areas.

Table 3.2: Ambient Noise Level in decibel (A) at Residential Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	College Valley, Tadong	Morning	74.2	34.3	51.6
		Afternoon	78.4	42.2	60.8
		Night	76.3	39.5	58.4
2	Deorali Government Quarter	Morning	71.5	35.1	55.3
		Afternoon	76.3	39.9	61.4
		Night	73.4	36.2	57.2

Ambient Noise Level in decibel (A) at Commercial Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	Bazar Area (M.G. Marg)	Morning	97.1	58.4	70.4
		Afternoon	105.2	61.0	74.3
		Night	-	56.2	62.1
2	Indra Bypass	Morning	93.0	52.0	68.5
		Afternoon	97.0	57.4	73.2
		Night	88.0	43.8	69.4

Ambient Noise Level in decibel (A) at Sensitive Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	Hospital Point	Morning	74.3	38.2	50.1
		Afternoon	84.2	40.8	62.5
		Night	85.1	41.6	63.2
2	District Court	Morning	68.1	34.2	47.1
		Afternoon	72.5	38.6	49.2
		Night	64.2	34.6	44.6

Source: Sikkim: A Statistical Profile, 2004-05, Directorate of Economics, Statistics, Monitoring & Evaluation, Government of Sikkim

Ecological Environment

Vegetation

49. The state is divided into three zones in describing the aspects of vegetation. These are tropical, temperate and alpine respectively in increasing order of altitude. The favourable rainfall, temperature and high humidity existing in the area, have caused the vegetation to acquire the general characteristics of the Northern Tropical Semi-Evergreen Forest.

50. The territorial area under region extends from the forest hills of Eastern Himalayas (Bhutan hills) to the flood plain area of Brahmaputra valley. Because of diversified configuration pattern of the ground and varied rainfall pattern throughout the region different types of forest associations are found in the region. Based on the classification pattern envisaged by Champion and Seth (Revised Survey of Forests types of India) the different type of forests occurring (or approximated to be occurring) in the region under study are indicated as follows:

Sl. No.	Forest Types	Classification code	Remarks
1.	Eastern Sub-mountain Semi-Evergreen Forest	2B/C1b	**
2.	Sub-Himalayan light alluvial Semi-Evergreen Forest	2B/1S1	**
3.	Eastern Alluvial secondary Semi-Evergreen Forest	2B/2S2	**
4.	Sub-Himalayan secondary wet mixed Forest	2B/2S3	**
5.	Moist Sal Savannah Forest	3C/DS1	**
6.	East Himalayan moist mixed deciduous Forest	3C/CS3b	*
7.	Low alluvial Savannah wood land	3/1S1	**
8.	Eastern Hollock Forest (Terminelia-lagers tremia)	3/1S2(a)	*
9.	Eastern Hollock Forest (Terminelia-Duabanga)	3/1S2(b)	*
10.	Eastern wet alluvial grass land	4D/1S2(b)	**
11.	Khair Sissu Forest	5/1S2	*

Source: Working Plan Office, Department of Forest, Government of Assam

* A revised survey of the forest types of India by Champion and Seth

** Not described by Champion and Seth. Approximated to be grouped under the mentioned code

51. The vegetation of the state is fairly well known. About 5841 sq.km area is under recorded forest area (reserved forest and protected forests), which is 82.32 % of total geographical area of the state. Percentage of tree cover and forest cover account to 45.55 percent of the total area. The State holds about 5000 species of flowering plants. Out of 315 families of Angiosperms in India, more than 200 are represented in Northeast India and the state accounts for nearly 50% of the total number of plant species in India as a whole. Though the flora of this region exhibits an Indo-Malayan affinity, the floral elements of other parts of India, and of neighbouring and far off countries, have also contributed to its richness and diversity. It is of interest to note that about one third of the flora of Northeast India is endemic to this region.

52. The state is home of 550 species of Orchids, 36 species of Rhododendron, over 4000 species of flowering plants, 300 species of ferns & allies, 9 conifers and plenty of medicinal plants and herbs.

53. The major flora found in the temperate zone includes Oak, Cherry, Alurel, Chestnut, Maple, Birch, and Rhododendron – found in alpine region. Besides this the most popular orchids found in state are Cymbidiums, Vanda, Cattaleya, Hookeriana, Farmeri, Dendrobiun amoenum, Nobile orchid –which is state flower of Sikkim. The restricted trees in State are Dar, Khamari, Tooni, Panisaj, Sisum, Junifer, Mel, Bahumi Kath, Rani Chap and Jat Katus. List of protected trees include Malgiri, Yew tree, Chemal, Gurans, Chewri, Tamala, Kimbu, Sinkauli, Amala, Harra, Barra, Bar, Pipal, Labar, and Siltimbur. Important medicinal plants found in Sikkim include Nardostachys Grandiflora (Jatamasi), Aconites (Bikhma), Artemisia Vulgaris (Titeypati), Piper Longum (Pipla) and Picrorhiza Kurrooa. The names in brackets are local name of the plant. Dominant species of flowering plants in State are Orchidaceae, Asteraceae, Poaceae, Leguminosea, Cyperaceae, Rosaceae, Scrophulariaceae, Rubiaceae, Lamiaceae and Euphorbiaceae. Besides this Sikkim Himalaya harbours as many as 190 wild plants that are suitable for human consumption.

54. The state is exceedingly rich in lichens, mosses and liverworts. These seemingly unimportant plants need to be investigated, studied, appreciated and above all, protected, as they serve vital ecological roles as soil protectors; contribute to the recycling of nutrients and water, offer food and shelter to an assemblage of invertebrates and take a part in air purification and carbon sequestration.

55. The proposed project road i.e. SK-01 passes most of the road length through reserve forests on one side of road. Except at starting from 0.0 to 1.0 near Melli and ending point of project road i.e. from km 26.2 to 27.3, where land use is built up, the remaining portion of project road from km 1.0 to km 26.0, project road passes through Reserve forests area of Sikkim South Forest Division. The vegetation density in these forests varies from 0.4 to 0.5.

Wildlife and Protected Area Network

56. The State has rich wildlife and has long network of protected area. In order to protect the rich flora and fauna of Sikkim from the poacher, the Government has established parks and sanctuaries. The largest of these is the Khangchendzonga National Park which encompasses an area covering 1784 sq km. It is bounded in the north by the Tent Peak and the ridge of the Zemu glacier. The eastern boundary of this park comprises of the ridge of the mountain

57. The state's protected area network comprises of four wildlife sanctuaries and one national park. Recognizing the importance of this region as one of the hot spots, majority of the biodiversity rich areas of the state has been placed inside the protected area network system comprising mainly of the National Park and Sanctuary. The total area under the protected area network is 22.5 percent and that of under national parks is 19.6 percent. The details on the forest area, forest cover and area under protected areas is presented in Table 3.3.

Table 3.3: Detail of Protected Areas in Sikkim

A	National Parks	Area in Sq. km.
	Khangchendzonga National Park	1784
B	Wildlife Sanctuaries	
	Fambonglho Wildlife Sanctuary	51.76
	Maenam Wildlife Sanctuary	35.34
	Kyongnosla Alpine Sanctuary	31
	Singba Rhododendrone Sanctuary	43
	Barsey Rhododendrone	104
	Pangolakha Wildlife Sanctuary	128
C	Reserved Forest	5452.4
D	Protected Forests	389

58. The entire north eastern region has been the home of a great variety of wildlife species which has a significant influence on the tradition and culture of communities' including tribal. But due to indiscriminate killing of animals by all walks of life in the region before and after enactment of Wildlife (Protection) Act, 1972, the animal population has gone down to a great extent. However, the Department of Environment and Forests has taken up wildlife protection schemes with a great enthusiasm by constituting protected areas for wildlife protection and preservation. Awareness in wildlife protection is still the need of the hour in the region. New development has been initiated in the wildlife wing of the Department of Environment and Forest since a couple of years ago with centrally sponsored schemes.

59. The State is home for large number of wild fauna. It is reported that the state has 144 species of mammals, 550 species of birds, 650 species of butterflies & moths, 33 species of reptiles and 16 species of frogs. Some of the endangered mammals are Bharal, Chouded Leopard, Fidhing Cat, Golden Cat, Himalayan Thar, Leopard Cat, Red Panda, Marbled Cat, Musk Deer, Nayan or Great Tibetan Sheep, Pangolin, Serow, Snow Leopard, Spotted Lingsand, Tibetan Antelope, Tibetan Fox, Tibetan Gazzelle, Tibetan Wild Ass, Tiger, Tibetan Wolf.

60. Among the endangered birds are Black Nacked Crane (migratory), Blod Pheasant, Peafowl, Tibetan Snow Partridge, and Siberian Crane (migratory).

Socio Economic Environment

61. This section presents the demographic and socio-economic conditions of the State and North Eastern Region. The information relevant to the socio-economic indicators i.e. demographic, poverty, agriculture, fisheries, industries, energy, transport etc. has been included.

Demography

62. Sikkim is the smallest state of the north eastern region with a population of 0.54 million with about more than 80 percent of the population living in the rural areas. The human population density is very less i.e. only 78 persons/km² compared to 149 persons/km² for the north eastern region. Sex ratio is also less i.e. 875 against the 936 in the region. The demographic feature of north eastern states is unique in that there are more than 100 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and

traditional knowledge systems. The major three minority groups in the state namely Bhutias, Lepchas and Nepalis. The Nepalis owned roughly 60 percent of the total cultivated land in 1981. Bhutias and Lepchas share was 20 percent each. The majority of the people survive on subsistence economy based mainly on the agriculture, supplemented with limited horticulture, animal husbandry, crafts/handloom, etc. Table 3.4 below presents the demographic features of the North eastern region.

Table 3.4: Demographic Features of Sikkim and North Eastern Region as per 2001 census (p)

State	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
Sikkim	7096	480488	60005	540493	76	875
NE Region	262179	33008703	5809395	39041167	149	936
All India	3287263	741660293	285354954	1027015247	312	933

Source: 1) Census of India, 2001 (Provisional), 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, 3) Where do we stand in 2003, Meghalaya & North East and India & The World, Directorate of Economics & Statistics, Government of Meghalaya

63. The Gross State Domestic Product of the state was Rs.8169 million in 1999-2000. The incidence of poverty continues to be high. A stagnant agriculture sector combined with poor industrial activity has severely limited employment opportunities outside the government. This has also put the government under fiscal stress as expenditure on wages and salaries, including pensions and interest payments consuming almost half of the total government expenditure.

64. The progress on industrial front has been constrained by many factors particularly the lack of appropriate infrastructure, lack of raw materials and trained manpower

Land Resources

65. The area available for land utilization in the state is about 6317 sq.km out of the total geographical area of 7096 sq.km. This means about 89 percent of the area in the state is available under various land uses. Major portion of the land use is under forest cover covering about 77 percent of the land use area. About 9 percent area is under gross cropped area. Agriculture is the second major land use in area. The area under various land uses in the region is presented in the table 3.5 below:

Table 3.5: Land use pattern in North East Region (Figure in thousand hectare)

State	Reporting area for land utilization	Forest area	Not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Gross cropped area	Net area sown	Area sown more than once	Total
Sikkim	631.7	619.9	12.4	9.8	14.5	72	62	10	800.6
NE Region	21754.5	13379	3296.8	1624	913.6	5448.6	3891.1	1557.5	30110.6

Source: www.neportal.org (Directorate of Economics and Statistics, NE states and NEC, Shillong).

Statistical Abstract (2001-02), Sikkim, Directorate of Economics and Statistics, NE States.

Agriculture and Forestry

66. The state remains dependent upon agriculture, contributing to about 40 percent of the Gross Domestic Product. The state has only 64,000 hectares of net sown area. Production of foodgrains was 103,000 tonnes in 1997-98 of which rice share was 20 percent. Horticulture and floriculture has a very good potential for development provided proper transport facilities and successful markets can be created. Between 1975 and 1995, for example, for which data are available showed that horticulture production including fruits, vegetables, potato, cardamom, ginger and turmeric increased by nearly six times (increasing from 16000 tonnes in 1975 to 93000 tonnes in 1995). Promotional activity in floriculture is also another area needing attention. Efforts are being made to improve production of cut flowers and bulbs. Being perishable, special arrangements for transport and good road connectivity are equally critical.

67. Forest area constitutes about 45 percent of the total area of the state. While deciduous and ever-green forests are more commonly found in eastern and western Sikkim, northern part is dominated by coniferous forests. The Sikkim Himalayas show tremendous biological diversity and this contributes to the country's natural heritage and to the national ecological balance. Forests are an important source of livelihood for the people. Apart from timber, forests are also a source of herbs and plants for use as medicines. This is a potential growth area for the state. However, forests cannot be a major source of revenue because of government policy of implementing conservation measures and regulated price of forest and allied produce. The state is also seismically active and characterized by frequent land slides. Hill slopes are steep and even a small geo-environmental change and sudden rainfall can destabilize the soil-rock balance and cause landslides.

Fisheries

68. The state has great potential for the development of fisheries. The state abounds in perennial and seasonal water bodies which hold high promise for the growth of fishery. In the absence of properly organized fishery production and marketing system, the fishery potential has also not been adequately developed and exploited.

69. The state has vast potential for fisheries by enhancement of rivers, streams, floodplain, wetlands, reservoirs, lakes, ponds and paddy-cumfish culture. About 7 hectares of water are available for nursery and 38 hectare under rearing. Inland fish production for the year 2003-2004 was 160 tonnes. The total fish production for the year 2003-2004 was 2.8 millions fries and 0.6 millions fingerlings.

70. The important fishes commonly found in the region's plain and river basins are Catla catla, Labeo rohita, Labeo calbase, Cirrihinus mirigale, Clarius, batrachus, Rita rita, Heteropneustus fonilis, Notopterus nontopterus, N. Chitala, Macrobrachum rosenbergii, M. malconsoni, M. Chapral, Channa punetatus C. gaehua, C. striatus.

Transportation

71. Transportation system is a key factor in the socio-economic development of any state. Currently there is no railway line in the state. Nearest railhead is Siliguri in West Bengal. Similarly, there is no airport also in the state. Nearest airport is at Bagdogra in West Bengal. There is a skeleton helicopter service between Bagdogra and Gangtok (Sikkim). The Eleventh Finance Commission had recommended a grant of Rs. 500 million for the construction of an airport near Pakyong (East District). However, this is yet to materialize. Two major rivers Teesta and Rangit flow through the state but are not navigable and as such inland water transport has practically no role. Roads are the only means of getting to and within the state. They are a critical input to the growth of all sectors. The length of roads is reported to be about 1840 km. Major district roads and other district roads covers the major portion of the total road network. The National Highway No. 31A (about 40 km) is the only NH link serving the state

and is under the jurisdiction of Border Roads Organisation for its development and maintenance.

Mineral Resources

72. The north eastern region is also endowed with reasonable resources of mineral and oil and gas. However, Sikkim state has very limited resources i.e. 1200 tonnes of copper, zinc and lead deposits. For exploiting the mineral resources, it is important to provide a good road and rail infrastructure.

Industrial Situation

73. There are no major industries in the state. It has 2 industrial estates and 5 large and medium industries giving employment to only 280 persons. In addition, there are about 349 small scale industries (SSIs) giving employment to 1815 persons. Table 3.6 gives a broad picture of the states and north eastern region's industrial statistics.

Table 3.6: Number of Industries and Employment Generated

States	No. of industrial estates	No. of large and medium industries	Employment generated	No. of SSIs	Employment generated
Sikkim	2	5	280	349	1815
NE Region	52	202	47501	59548	313524
Per capita employment	-	-	109	-	5
India	-	133345	16425592	3300000	18600000
Per capita employment (national)	-	-	123	-	5.6

Source: www.databank.nedfi.com, www.nic.in

Statistical Abstract (2001-02) of Arunachal Pradesh, Assam, Manipur, Nagaland, Directorate of Economics and Statistics, NE states.

Aesthetic and Tourism

74. The state is characterized by beautiful series of mountainous hills and valleys. The state is endowed with several features such as trekking, scenic spots, pilgrim centres/monastery, national parks which can be utilised for a systematic growth of the tourism industry. In the year 2002, the total international tourist arrival was 8539 and domestic tourist were 160789. Gangtok is the major destination of tourists. Of the domestic tourists, about one-third is from West Bengal alone. The state offers unique opportunity for eco-tourism development.

Cultural Resources

75. The state has great cultural value. Festivals and cultural activities are being celebrated throughout the year in the state. The department of cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The state has great cultural value for Buddhism. There are 11 monasteries in the state. However, project road does not affect these places. There is a temple of Goddess Durga at Rolu village in the project road which has great sentiments of local people and traveller. Besides this there are number of cultural / pilgrim centers in the state.

Energy and Electric Power Potential

76. Firewood is still a major source of energy in the state which is available in abundance. The state is generating mostly hydro power which contributes to about 70 percent of installed capacity in the state and rest is by other means. The total installed capacity in Sikkim is 36.5 MW with an average peak load of 34 MW. The available hydro power potential in the State is huge and actions being taken to capture it.

International Trade & Commerce

77. There are number of agreements between India and neighbouring country to enhance the border trade across the countries. Indo-Myanmar border trade agreement in 1994, border trade agreement between India and Bangladesh in 1972 is some of the agreements signed to develop the trade relations.

78. The north eastern region has the potential to emerge as a strategic base for domestic and foreign investors to tap the potential of the contiguous markets of China, Myanmar, Lao PDR, Nepal, Bhutan and Tibet. This calls for converting the unauthorised trade into authorised trade, at the policy level as well as at the ground level. The BIMST-EC (Bangladesh-India-Myanmar-Sri Lanka-Thailand Economic Cooperation) initiative is creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry, technology, human resource development, tourism, agriculture, energy, infrastructure and transportation. Various physical features along the project road is described in table 3.7 below.

Table 3.7: Physical Features along the project road

Location / Chainage (Km)	Features
0 -1	Major bridge across Rangit river at starting point i.e. Nayabazar junction and commercial area
1-2	Right Rangit river flowing parallel to road and left hillocks, Left temple at km 1.5 adjacent to existing carriageway
2-4	Left hillock with forest area and right river valley of Rangit river
4-5	Small steel bridge at km 4.5, hillocks with forest and valley on right
5 – 8	Dense forest on hillock left side with density of vegetation is 0.4 to 0.5
8-9	Few residential houses along the road, hillock and valley
9-19	Hillock with forests on left and river valley on right
9-10	Small steel bridge
12-13	Y - junction to Ravangla village
14-15	Small steel bridge
17-18	Small settlement, hillock & valley section
19-20	Forest on hillocks and valley continues, Small steel bridge, Temple right on sharp curve near village Rolu (big temple with cultural importance) Rolu village with few residential structures
20-25	Forest area with hillocks and valley
22-23	Small steel bridge
25-26	Hillock and valley
25-26	Forest check post
26-27	Major bridge over river Teesta Settlement with commercial shops at Melli (end point)

Policy, Legal and Administrative Framework for Environmental Management in India

Policy

79. As a sequel to the UN Conference on the Human Environment (1972), Indian parliament in 1976 amended the Constitution of India by introducing articles 48A and 51A. These articles incorporated environmental concerns into the Directive Principles of state policy and postulated as a fundamental duty of all citizens to preserve and protect the environment. As per the constitutional provisions:

80. The state shall endeavour to protect and to improve the environment and safeguard forests and wildlife of the country (Article 48A) and

81. Every citizen is bound to protect and improve the natural environment and to have compassion for living creatures (Articles 51A(g)).

Legislation

82. Government of India has enacted more than thirty environment conservation laws and Acts. Some of these are: The Environment (Protection) Act 1986, The Wildlife (Protection) Act 1972; The Forest (Conservation) Act 1980; The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981; 1988 amendment of The Motor Vehicle Act (M.V.) Act, 1939. The Water and The Air Acts entrusted the task of their implementation and regulation to pollution control boards set up for such purpose at State and Central levels.

83. Even prior to the 1970's and 80's flurry of environmental legislation, there existed numerous statutory provisions for safeguarding environment, though in a highly limited way as some of these dated back to the colonial period. Some of these were Section 277 of IPC dealing with water pollution, Section 278 of IPC dealing with atmospheric pollution and Statutes like the Factories Act, 1948; the Mines Act, 1952, Insecticides Act, 1968 and Motor Vehicle Act (M.V.) 1939.

84. Some of the important acts applicable to the present project are described herewith:

The Environment (Protection) Act, 1986

85. The Environment (Protection) Act, 1986 is widely regarded as a comprehensive or umbrella legislation for environment in its entirety. The responsibility for implementation of the provisions of the EPA has to a large extent been entrusted to the regulatory agencies created under the Air and Water Acts. Department of Environment (DoE) was created in 1981 in the Central Government to act as a nodal agency for environmental protection and development in a co-ordinated manner.

86. The principal environmental regulatory agency in India is the Ministry of Environment and Forests (MoEF) of the Government of India. MoEF formulates environmental policies and accords environment clearances for the large projects (sector-wise listing done by MoEF). In the North Eastern Region, the State Department of Environment and State Pollution Control Boards are enforcing authorities at the State level to resolve environmental issues arising due to any infrastructure project. MoEF has a regional office at Shillong to look after the matters related to environment in the region.

The Environmental Impact Assessment Notification (1994) and Amended Notification 1997

87. The Environmental (Protection) Act, 1986 provided for Environment (Protection) Rules, which are formulated since then. As one of these rules, the Environmental Impact Assessment Notification 1994 has identified highways (item 21 of Schedule-I) as one of the project requiring prior clearance from the MoEF. Environmental Impact Assessment (EIA) is a

statutory requirement for obtaining clearance (a comprehensive format for EIA has been prescribed in the notification).

88. According to the notification from the MoEF dated 27th April 1994 and amendment dated 4th May 1994, expansion or modernisation of any activity shall not be undertaken in any part of India unless it has been accorded environmental clearance by the Union Government in accordance with the procedures specified in this notification.

89. Ministry of Environmental and Forests (MoEF) issued a notification on Environmental Impact Assessment for development project. The schedule 1 here in list 31 types of projects which need environmental clearance from MoEF. Highway projects are included in this list.

90. In April 1997, a notification by the MoEF amending Schedule-I of the EIA Notification stated that environmental clearance from the MoEF is not required for highway projects relating to improvement work including widening and strengthening of roads with marginal land acquisition along the existing alignments provided the highways do not pass through ecologically sensitive areas such as National Parks, Sanctuaries, Tiger Reserves, Reserve Forests, etc.

91. In October 1999, MoEF amended the EIA notification clarifying the marginal land acquisition "It is hereby clarified that marginal land acquisition means land acquisition not exceeding a total width of 20 meters on either side of the existing alignment put together. Further, it is also clarified that bypasses would be treated as stand alone projects and would require environmental clearance only if the cost of the project exceeds Rs. 50 crores each."

92. Since this project does not pass through any sensitive areas, clearance from Central Government is not required.

Forest (Conservation) Act as amended in 1980

93. Of all laws, the Forest (Conservation) Act, 1980 stands out as having particular significance for this project. The Act pertains to the cases of diversion of forest land and felling of roadside plantation. Depending on the size of the tract to be cleared, clearances are applied for at the following governmental levels.

Applicability of the Forest (Conservation) Act to the Roadside Strip Plantations

94. In 1986, when MoEF enacted the Environment Protection Act, the entire linear stretches of roadside plantations along the State Highways were declared as protected forest. Although the land is under the control of the PWD, due to its protected status, clearance is required to cut roadside trees. Applicability of the provisions of the Forest (Conservation) Act, 1980 to the linear (road or canal side) plantations was modified by a notification from the GoI-MoEF, dated 18 February 1998. The new notification recognized that the spirit behind the Forest (Conservation) Act was conservation of natural forests, and not strip plantations. In the case of the "notified to be protected" roadside plantations, the clearance now may be given by the concerned Regional Offices of the MoEF, irrespective of the area of plantation lost. While issuing the approval, in place of normal provision for compensatory afforestation, the Regional Offices will stipulate a condition that for every tree cut at least two trees should be planted. If the concerned Regional Office does not accord the clearance within 30 days of the receipt of fully completed application, the proponent agency may proceed with the widening/expansion under intimation to the State Forest Department, and the MoEF, Government of India.

Forest Land

95. Restrictions and clearance procedures proposed in the Forest (Conservation) Act apply wholly to the natural forest areas, even in case the protected/designated forest area does not have any vegetation cover.

96. Since the proposed does not involve acquisition of forest land, clearance from Central Government is not required. However, they have to obtain NOC from regional forest department prior to construction.

The Wildlife (Protection) Act 1972

97. This act has great relevance to the proposed road project, as the state has the large protected area network. The Wildlife (Protection) Act has allowed the Government to establish a number of National Parks and Sanctuaries over the past 25 years, to protect and conserve the flora and fauna of the State. There are four wild life sanctuaries and one national park in the state. The impacts are negligible as the proposed road located away from these areas.

The Water (Prevention and Control of Pollution) Act 1974 (Amended 1988)

98. The Water (Prevention and Control of Pollution) Act, 1974 resulted in the establishment of the Central and State level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of certain facilities.

The Air (Prevention and Control of Pollution) Act 1981 (As Amended in 1987)

99. In the state, Sikkim State Pollution Control Board is empowered to set air quality standards and monitor and prosecute offenders under the Air (Prevention and Control and pollution) Act, 1981.

100. The responsibility for monitoring vehicular air and noise pollution lies with the State Transport Authority (STA), not with the PCB. For water pollution and erosion, there is no institutional set-up for the road sector.

101. The Government of India (Gol) standards for the discharge of pollutants to the environment (Water and Noise standards) are listed under the Environmental Protection Act. These standards apply mainly to the control of industrial pollution, with some applying to road construction projects.

102. Before implementation of the project, it is mandatory requirement to get NOC from Sikkim State Pollution Control Board.

103. In order to obtain an environmental clearance from the MoEF, "Public Hearing" was previously mandatory, as per the MoEF notification, which came into effect on 10th April 1997. However, a recent notification of the MoEF, dated 3 January 2001, exempts highway widening/upgradation projects from public hearing.

The Noise Pollution (Regulation and Control) Rules, 2000

104. The Union Government has laid down statutory norms to regulate and control noise levels to prevent their adverse effects on human health and the psychological well being of the people. The rules titled Noise Pollution (Regulation and Control) Rules, 2000 have come into force at February 14, 2000. Under the new regulation, different areas and zones are to be identified as industrial, commercial, and residential or silence areas and anyone exceeding the specified noise level would be liable for action. In industrial areas, the noise level limit during the day time (6 am to 10 pm) is 75 decibels and during night (10 pm to 6 am) 70 decibels.

105. Similarly, for commercial areas day time limit is 65 decibels and night limit is 55 decibels. In the case of residential areas, the limits are respectively 55 and 45 decibels and for the silence zones, 50 and 40 decibels.

The Motor Vehicles Act 1988

106. In 1988, amendment of the Indian Motor Vehicle Act empowered the State Transport Authority to enforce standards for vehicular pollution prevention and control. The authority also checks emission standards of registered vehicles, collects road taxes, and issues licenses.

107. In August 1997, the “Pollution Under Control” (PUC) programme was launched in an attempt to crackdown on the amount of vehicular emissions in the state. To date, is has not been highly effective.

The Movement of Hazardous Chemicals

108. Movement of hazardous chemicals by road is governed by Central Motor Vehicle Rules, 1989 (rules 129 through 137). Besides, regulations and precautions has to be taken while transporting such goods, the rules stipulate availability of a Transport Emergency (TREM) Card with the driver of the carrier which shall provide information on hazardous nature of the chemical carried and also precautions required to handle emergencies such as spillage and fire.

Environmental Administrative Framework

109. The MoEF has the overall responsibility to set policy and standards for the protection of environment along with the Central Pollution Control Board (CPCB). This includes air, noise and water quality standards and the requirements for the preparation of Environmental Impact Assessment (EIA) statements for development projects. These standards are of significance for the proposed project. The status of key environmental legislation in India is given in Table 3.8. Salient features of relevant environmental laws and regulations, including their applicability to this project is given below.

Table 3.8: Statutes, Policies, Regulations and Responsible Agencies

Sl. No	Agency	Statute/Policy	Relevant objectives
1	Ministry of Environment and Forests	Environment (Protection) Act 1986	To protect and improve the quality of the environment and to prevent, control and abate environmental pollution
		Forest (Conservation) Act, 1927 Forest (Conservation) Act, 1980 (as amended in 1998) Forest (Conservation) Rules, 1981	To restrict deforestation by restricting clearing of forested areas
		Environmental Impact Assessment Notification 1994 Environment Protection Rules, 1986	To ensure that appropriate measures are taken to conserve and protect the environment before commencement of operations
2	Pollution Control Boards (State)	Water (Prevention and Control of Pollution) Act 1974 as amended in 1988 Air (Prevention and Control of Pollution) Act 1981 as	To provide for the prevention and control of water pollution and the maintaining or restoring wholesomeness of water To provide for the prevention,

Sl. No	Agency	Statute/Policy	Relevant objectives
		amended in 1987	control and abatement of air pollution and for the establishment of Boards to carry out these purposes.
3	Environment and Forest Department	Wildlife (Protection Act), 1972	To protect wild animals and birds through the creation of National Parks and Sanctuaries
4	Department of Transport and Department of Police	Motor Vehicle Rules, 1989 Motor Vehicles Act, 1988 Rules of Road Regulations, 1989	To check control vehicular air and noise pollution To regulate development of the transport sector
5	Archaeological Survey of India, Directorate of Archaeology	Ancient Monuments and Archaeological sites and Remains Act, 1958	To protect and conserve cultural and historical remains To regulate construction activities near the monuments and sites protected by the Government
6	Revenue Department	Land Acquisition Act, 1894	To set out rules for acquisition of land by the Government departments and agencies

110. Other guidelines available in respect of highway projects are:

- Indian Road Congress IRC 104 : 1998
- ADB Environmental Assessment Guidelines (2003)
- ADB Guidelines on Environmental Assessment Guidelines of selected infrastructure projects (2000)
- ADB Environment Policy, the Operations Manual F1/BP and F1/OP (2003)
- Ministry of Surface Transport 1995, now Ministry of Road Transport and Highways (MORTH)

National Environmental Quality Standards

Air Quality Standards

111. In order to evaluate air quality and to design appropriate air pollution control systems, it is necessary to know the concentration of various air pollutants. The guidelines issued by CPCB on ambient air quality standards are reproduced in the Table 3.9. It needs to be mentioned here that for HC, ambient air quality standards have not been specified.

Table 3.9: National Ambient Air Quality Standards

Pollutant	Time weighted average	Sensitive area	Industrial area	Residential, rural & other areas	Method of measurement
Sulphur Dioxide (SO ₂)	Annual*	15 µg/m ³	80 µg/m ³	60 µg/m ³	Improved West and Gaeke Method Ultraviolet Fluorescence
	24 hours**	30 µg/m ³	120 µg/m ³	80 µg/m ³	
Oxides of Nitrogen as NO _x	Annual*	15 µg/m ³	80 µg/m ³	60 µg/m ³	Jacob & Hochheiser Modified (Na-Arsenite) method Gas phase Chemiluminescence
	24 hours**	30 µg/m ³	120 µg/m ³	80 µg/m ³	
Suspended Particulate Matter (SPM)	Annual*	70 µg/m ³	360 µg/m ³	140 µg/m ³	High Volume Sampler (Average flow rate not less than 1.1 m ³ /minute)
	24 hours**	100 µg/m ³	500 µg/m ³	200 µg/m ³	
Restorable Particulate Matter (RPM) size less than 10 µm	Annual*	50 µg/m ³	120 µg/m ³	60 µg/m ³	Respirable Particulate Matter Sampler
	24 hours**	75 µg/m ³	150 µg/m ³	100 µg/m ³	
Lead (Pb)	Annual*	0.5 µg/m ³	1.0 µg/m ³	0.75 µg/m ³	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 hours**	0.75 µg/m ³	1.5 µg/m ³	1.0 µg/m ³	
Carbon Monoxide (CO)	8 hours**	1.0 mg/m ³	5.0 mg/m ³	2.0 mg/m ³	Non - dispersive infrared Spectroscopy
	1 hour	2.0 mg/m ³	10 mg/m ³	4.0 mg/m ³	

Source: Central Pollution Control Board, 1997

Note: Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval, 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days

Water Quality Standards

112. The project that crosses waterways viz. rivers, canals, streams, etc can have significant impacts on both surface and groundwater hydrology. A change in water hydrology may affect the surface water quality as well as sediment transport, changes in water table, water logging and changes in infiltration rates.

113. The excerpts from guidelines issued by CPCB (based on BIS standards) on primary water quality have been reproduced in Table 3.10.

Table 3.10: Guidelines of CPCB on Primary Water Quality

Designated Use	Best Use	Class of Water	Criteria
Drinking water source (with conventional treatment)		A	Total Coliforms MPN/100ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg/1 or more Biochemical Oxygen Demand (BOD) 5 days 20°C 2 mg/1 or less
Outdoor bathing (organised)		B	Total Coliforms MPN/100ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg/1 or more Biochemical Oxygen Demand (BOD) 5 days 20°C 3 mg/1 or less
Drinking Water Source (without conventional treatment)		C	Total Coliforms MPN/100 ml shall be 5000 or less pH between 6.5 to 8.5 Dissolved Oxygen 4 mg/1 or more Biochemical Oxygen Demand (BOD) 5 days 20°C 3 mg/1 or less
Propagation of Wildlife		D	pH between 6.5 to 8.5 for Fisheries Dissolved Oxygen 4 mg/1 or more Free Ammonia (as N) 1.2 mg/1 or less
Irrigation, Industrial Cooling, Controlled Waste		E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C Max 2250µ mhos/cm Sodium absorption ratio Max. 26 Boron, Max. 2 mg/1

Noise Standards

114. The MoEF has notified ambient noise level standards vide Gazette Notification dated 26th December 1989. It is based on the weighted equivalent noise level (Leq). These are presented in Table 3.11.

Table 3.11: National Ambient Noise Standards

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

* Day time is from 6 am to 9 pm whereas night time is from 9 pm to 6 am

** Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicles horns, loud speakers and bursting of cracking are banned in these zones

115. As mentioned in section 3.1.5, these noise standards have been given the status of statutory norms vide Noise Pollution (Regulation and Control) Rules, 2000. However, these rules have changed the periods for 'Day Time' and 'Night Time' to 6 a.m. to 10 p.m. and 10 p.m. to 6 am respectively.

4. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Introduction

116. This chapter presents key environmental issues associated with various aspects of the proposed project. Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at four different stages namely:

- the project location;
- design;
- construction; and
- operation stages.

117. The implementation of a road project can cause environmental impacts that are short, or long-term, and beneficial, or adverse, in nature. As it is further discussed, the overall long-term impacts will be largely beneficial. The proposed Melli to Nayabazar road section will have major positive impacts in regard to the socio-economic environment and quality-of-life particularly in South and West Sikkim districts.

118. A few short and long-term negative effects, mainly at the construction and operation stages, are, nonetheless, anticipated. These can, however, be kept in check through proper planning and adopting Environment Friendly Road Construction methods and the appropriate regulatory measures.

119. The present identification and assessment of impacts has been structured in accordance with the sequence in Chapter 3 "Description of the Environment". The project activities are generally described first and the impacts are discussed thereafter.

Identification and Assessment of Impacts

Positive Environmental Impacts due to improvement of road section between Melli and Nayabazar in South Sikkim District

120. The following are expected:

- the improvement of the Melli - Nayabazar section to intermediate /two lane will result in reduction in travel time and lower vehicle operating cost i.e. per kilometre vehicle operating cost from the general improvement work and an absolute saving in cost due to reduction in fuel consumption and therefore exhausts, tyre and spare parts consumption can be expected for the existing traffic.
- It will also provide the better access to other parts of the state by connecting National Highway 31C at Malli (which is a major route connecting state with West Bengal and supply route of the State) and connecting state capital Gangtok. From economic point of view, proposed road will enhance the trade and commerce between Sikkim South and Sikkim West districts.
- Improvement of proposed road, besides providing easier access to remote villages, can also provide easier access to important religious or tourist sites. The Rolu village at km 8 (while travelling from Melli) has a famous religious site (temple of Goddesses Durga) which has great sentiments for local villagers and travelling passengers and tourists.

Negative Environmental Impacts due to improvement of state highway section between Melli and Nayabazar in South Sikkim District

121. The following are expected:

- Improvement of project road may require cutting of road site trees that falls within formation width i.e. 9.5 m. The cutting may reduce the ecological balance of the area and also enhance soil erosion problem. Also, run-off from the road and the rechannelisation of existing drainage may increase erosion; the road may become a barrier to the natural movements of fauna; and the noise and air and water pollution and disposal of waste, during construction, may negatively impact both local residents and wildlife. These latter effects should, however, only be temporary/reversible.
- There will be a number of quarries and other sources (to be identified) as suitable sources for construction materials. The operation of these quarries, the transport of material from quarry to construction site and the scars the quarries may leave on the landscape once work is complete are, however, matters that must be carefully addressed if negative impacts are to be minimised. Usefully, the operation of quarries is an independent and already regulated activity. River sand is available in river Rangit and will not be a problem as the river running parallel to proposed road. Negative impacts on water quality of river Rangit in the form of silt deposition and runoff during construction is expected. However, this is timely phenomenon and will be taken care by controlled construction activities.
- *Also Improvements on road and construction of bridges (very limited) may enhance soil erosion, landslips and reduce the micro -level ecological balance of the area. Construction will also disturb the habitation of a large number of fauna living in this area. These should, however, be only temporary/reversible effects. The widening will also require the cutting of a large number of trees (about 400 to 450).*
- *Minor impacts of noise and air quality for those now living and workings close to the project road (mainly at Melli and Thanlong) will deteriorate during the construction period and afterwards during operation.*

122. The likely negative impacts of various aspects of project on the surrounding environment are more fully described in the following sections.

Negative Impacts Related to Project Location, Preliminary Planning and Design

Location issues

123. There will be a requirement to establish construction camps and related contractor's facilities, borrow pits and quarries. These must be located in environmentally sound and socially safe areas. It is expected that construction materials for the road works will be mined only from approved quarries. The following criteria must, however, be applied when locating borrow areas:

- borrow areas are not to be established in ecologically sensitive areas;
- villagers are to be consulted in regard to the design and location of all borrow areas – these should ensure the safety of local communities and, if possible, should incorporate beneficial post construction features for the villages;
- borrow areas are to be located away from the road and hill slopes as well as settlements facing the road, so as to minimise visual impacts.
- In case of reserve forest areas, construction facilities such as temporary workers camp, hot mix plants, and concrete batching plant and stone crushers must not be should not

be established in stretches that passes through reserve / protected forests. Consult forest department / village forest management committees before locating temporary project facilities such as construction camps and workers camp.

124. In regards to the setting-up of construction camps for labourers:

- these should be located at least 500 m away from settlements;
- living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer-in-Charge; and
- toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard.

125. There are no adverse impacts expected on historical places/monuments. However, there are two temples (km 8 and km 25) which are coming within ROW and adjacent to existing carriageway. Care must be taken to avoid any damage to these structures. Also earthworks, as associated with the actual road construction/improvement works, or deriving from secondary sites such as quarries or borrow pits, may reveal sites or artefacts of cultural/archaeological significance. Fig. 4.1 shows the typical temple along the road. In the event of such discovery, the proper authorities should be informed and the requirement to take such action should be incorporated in contract documents.



Fig 4.1: Cultural Place at Rolu Village along the road

126. The most of the project road passes though forest areas. Since, improvement work will be limited to the available ROW, no adverse impacts due to diversion of forest land. Also, these forests are not categorised as protected forests. None the less the land clearing will involve cutting of a large number of trees. Problem of soil erosion is expected in some locations. There will not be any hydro-ecological impacts. To minimize loss of vegetative coverage and/or trees and soil erosion the following mitigation measures will be adopted during the detailed design and construction stage of the project:

- i. The detail engineering design study will carry out for widening proposal in order to minimize the need for tree felling or removal of vegetation.
- ii. The detailed engineering design will identify areas prone to erosion and include land stabilization as part of the design.
- iii. The detail engineering studies and construction activities will strictly enforce the environmental conditions put as part of the environmental clearance by the MoEF and SPCB.
- iv. The improvement of road will be done by adopting Environmental Friendly Road Construction (EFRC) methods.

127. The improvements of the proposed road will largely be confined to the existing alignment. At some locations, improvements to the geometry may involve cutting and filling and the need to cut vegetation along most of the project road length. This will inevitably have a more significant impact and this matter is discussed in the sections which follow.

128. In forests areas, it is particularly important that the road improvement works should minimise environmental impacts from inadequate drainage and/or slope failures and should

assist in maintaining, or repairing, forest cover. Wildlife should be preserved and hunting will be restricted completely.

Other Impacts deriving from the Project Preliminary Planning and Design Process

129. During preliminary planning and design of this project, the Consultant should take into account the need for:

- optimum siting and control of quarries;
- reduced incidence of slope failures due to inadequate drainage;
- providing adequate culverts/drains;
- providing side-drainage structures;
- mechanised construction methods and thereby, for example, reduced use of firewood for heating bitumen;
- maximising safety and thereby reducing traffic accidents;
- reducing travel times and, thereby, fuel consumption and emissions;
- increased accessibility for residents to education and health facilities, markets etc., and for others who might come for tourist or other purposes; and
- improving the socio-economic conditions of residents in the project areas of influence.

130. As part of the engineering works for this work, the following have been the guiding principles in determining preliminary alignments and other matters concerning route. These principles should be continued during any detailed design phase and, if this is not possible, the appropriate adjustments should be made on site during the construction phase:

	Environmental Issue	Measures to be taken
1	Alignment	Final alignment should be determined so as to minimise land take, air pollution and the impact on people and animals and to avoid unfavourable geological condition and cultural relics.
2	Balancing cut and fill	The design should attempt to equalise cut and fill. The centreline should be aligned so that on all slopes below 60 degrees, half cut and half fill can be achieved.
3	Soil erosion	Temporary and permanent drainage systems should be designed to minimise the soil erosion.
4	Dust and air pollution	Borrow sites, waste disposal sites and asphalt mixing sites should be identified – keeping in mind environmental issues such as dust.
5	Cultural heritage	Any archaeological sites identified along the alignment should be excavated prior to construction.
6	Wildlife Habitat	Care should be taken in preservation of wildlife and construction workers should be educated on wildlife protection.

Construction: Permits and Environmental Impacts to be taken into Particular Account During Construction

Permits

131. As a mandatory requirement of Environmental Impact Assessment Notification, April 1994, by Government of India, any development activities should not be taken in any part of

country unless it has granted clearance from Ministry of Environment and Forests, Government of India.

132. Highways are classified as one of the project, listed in said notification, which require prior clearance. However, an amendment to this notification clarifies, that the highway improvement project are excluded from this list unless they pass through environmentally sensitive areas.

133. Indian Road Congress and Ministry of Road Transport and Highways published guidelines for environmental considerations into highway projects. Accordingly, for the proposed road improvement project, implementing authority has to apply for the environmental clearance from the regional office of ministry of environment & forests, located in Shillong.

134. At present, No clearances for any of the project road has been obtained so far. The process is to ensure minimal negative environmental effects. Prior to applying for environmental clearance, a number of resource-specific clearances and permits have to be obtained. The following table outlines the type of clearances and permits and the authorised bodies that issue them along with the procedures involved.

Sl. No.	Clearance/ permit	Authorised body	Procedures involved	Time involved
1	Clearance from Forest Department	Regional Office of MoEF, Principal Chief Conservator of Forests, Gangtok, Sikkim	Detailed proposal in appendix specified in Forest (Conservation) Act, 1980 along with project report and necessary details of tree felling. Local division office will forward after joint verification of site and preliminary scrutiny of proposal to PCCF office for approval. Joint verification and enumeration of trees to be cut shall be done by division office and after approval shall be allowed to cut.	Approximately 6 months or more
2	NOC from Sikkim State Pollution Control Board, Gangtok	Member Secretary, Sikkim State Pollution Control Board	Application in prescribed form along with project report and required fee shall be submitted to pollution control board. After scrutiny of application if required, concerned pollution control board shall conduct public hearing in particular district involving state authorities and forest department and affected persons. After fulfilling the requirement SPCB may issue the NOC with specific conditions.	Between 6 month to 1 year
3	Clearance for quarry sites	Department of Geology and Mines, Govt. of Sikkim, Gangtok	Submission of application for quarry site to mining department. Department of mines and geology after scrutiny of application and consultation with forest department and revenue department together with site verifications will give approval with specific conditions.	Takes between 3 months and six months.
4	Clearance for blasting	State Mining department, Gangtok	Detailed application with blasting locations and amount of blasting shall be submitted to DoM. Mining department may issue the conditional approval.	2 to 6 months

135. Any felling of trees requires forestry clearance and appropriate permits. The procedures necessary to obtain such permits will require liaison with local territorial forestry offices and their head office in Gangtok. No clearance is required for the use of surface sand and stone from the river banks as for commercial purposes they can only be purchased in an open auction carried out by the forestry office. It is imperative that all necessary clearances and permits be obtained before commencement of work.

Environmental Impacts to be Taken into Account During Construction

General

136. Spoil and waste generated at construction camps will need to be properly disposed, otherwise it may create odour, other nuisances and disturb local drainage systems.

137. Quarries and borrow pit sites and the need for such have not been finalised. Localised problems may, however, be expected at the finally selected sites. These problems may include dust and noise pollution and respiratory problems to both workers and local residents.

138. The improvements to the road section may involve the cutting of some hill slopes and the destruction of some trees. At few location amount of cut and fill work expected to be significant mainly at curves and bridge locations. It also involves uprooting of trees. Debris generated during hill slope cutting should be disposed off in proper places.

139. The likely environmental impacts from construction activities are summarised in the sections follows.

Previous Experience: General

140. Virtually all road construction in state is through mountainous terrain. Slopes are steep and frequently unstable. Much of Sikkim is geologically young, resulting in soft/fragile substrates. Another complicating factor is the high monsoon rainfall throughout most parts of the state. The above factors mean that states conditions are amongst the most difficult in the world for road construction. Landslides frequently caused by inappropriate construction techniques, slope instability, and inadequate drainage are major problems and are associated with all types of road construction. It should, however, be noted that a significant number of the landslides that occur in the vicinity of roads are caused by factors/features only indirectly linked to the road itself – frequently, irrigation channels, logging, quarrying and cultivation practices.

141. To control this, following measures are suggested by local environmental authorities.

- logging immediately above roads should be restricted to reduce erosion/landslide potential;
- quarrying along road ROW should be restricted;
- excavated material should be properly disposed of and not simply dumped downhill;
- adequate reclamation (e.g. fertilisation and reseeded) along denuded ROW should be implemented;
- particular care should be given to providing adequate drainage;
- careful supervision/training of blasting technicians is required; and
- to the largest extent possible, care should be taken to avoid sacred and religious sites.

Previous Experience: Environmentally Friendly Road Construction

142. Previous studies (Border Road Organisation and CRRI) indicate the need to incorporate the following measures as:

- *a better balance of cut and fill*: with a prohibition on the dumping of spoil over the road edge – thus minimising erosion;
- *more frequent use of retaining walls* - to control landslips;
- *improved drainage* - again so that erosion is minimised;
- *controlled blasting in rock-cut areas* - to minimise erosion;
- *use of bioengineering technique for slope protection*: use of native species of plants and shrubs for slope stabilisation.

143. These measures may increase the capital cost, but the benefits are deemed more than sufficient to offset the increase in cost.

144. Unstable and uncompacted road embankment materials and exposed material in cut can result in soil erosion, clogging of side drains and the spillover of rainwater runoff onto the road surface and down slopes – all of these sometimes causing landslides, and hindering traffic movements. These problems can be mitigated by maintaining the batter gradients as specified in the MoRT&H guidelines. As far as possible, the existing vegetation on slopes outside the immediate area of construction should remain undisturbed during construction and/or upgrading. Bioengineering techniques should be used to prevent barren slopes and to stop soil erosion and to protect the animals from grazing animals. Support structures should be erected where slope failures are anticipated or may have occurred previously. Slope failures should be monitored and remedial actions initiated at the earliest possible time.

Physical Environment

(i) Topography, Geology and Soil

145. During the improvement works for the road section and because of the cutting of hill slope, filling, the cutting of trees, stone quarrying, and construction of structures etc. the micro-level topography will change. With proper planning, these topographical impacts can be kept within acceptable limits and sometimes even used to enhance local aesthetics. Any negative impacts on topography (existing or new), particularly soil erosion due to a lack of drainage facilities, will be minimised with the provision of proper drainage facilities such as culverts, causeways etc. The overall impact on topography is, therefore, anticipated to be insignificant.

146. The terrain and geological conditions of area are such that, even with reasonable care exercised during final design, during construction the interaction between proposed road features and existing land features may reveal/result in significant land instabilities.

147. During the construction phase the following restrictions should be imposed:

- existing vegetation including shrubs and grasses along the road (except within the strip directly under embankments or cuttings) should be properly maintained;
- sites for quarrying, borrowing and disposal of spoils are to be confirmed according to the applicable laws and regulations in the state and the practices followed in recent/ongoing internationally funded road projects should be continued;
- controlled and environmentally friendly quarrying techniques should be applied to minimise erosions and landslides;
- blasting should not be carried out during busy periods;
- cut material should be disposed of in suitable depressions;

148. It is also important to:

- maintain adequate vegetative cover above and below the road;

- maintain the natural course of water bodies (that is as far as possible) and avoid throwing debris into stream courses;
- construct proper drainage structures – this in order to prevent soil from being saturated with water and hence susceptible to erosion;
- minimise the construction of hair-pin bends that are close to each other: as this often adds to instability.

149. Given the existence of high slope and high rainfall in almost entire project area and weak geology in some areas, it is inevitable that some sites will face problems of erosion, mostly debris slides.

(ii) *Erosion, Silt Run-Off and Landslides*

150. Construction involving rock/soil cutting of hillsides may render hill slopes unstable and increase vulnerability to landslides. The blasting of rocks may also result in landslides.

151. All hill/soil cutting areas should be revegetated as soon as construction activities are completed. At more vulnerable locations, selected bioengineering techniques should be adopted - a combination of bioengineering techniques and hard engineering solutions such as rock bolting and the provision of bank drains may be required. Solutions will, however, need to be individually tailored by the geo-technical/ environmental experts of the Supervision Consultant. Fig. 4.2 shows the typical landslide on project road.



Fig 4.2: Landslide prone location along the road

152. Excavation and earthworks should be mainly undertaken during the dry season when the risks from erosion and silt run-off are least. The materials used for surface dressing will consist of aggregates and gravel, which do not contain silt. Internationally accepted best practice engineering approaches to minimise landslide and erosion risks and silt run-off will be incorporated into contract documents and monitored during construction.

153. In order to minimise erosion, silt run off and landslides, it will also be important to:

- ensure that all embankment grades are not too steep and prone to erosion;
- waste material is not thrown into nearby river Rangit and cross cutting water bodies;
- temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies;
- the topsoil of borrow areas is preserved and used for re-vegetation;
- borrow areas are provided with gentle side slope that are re-vegetated and connected to the nearest drainage channel to avoid the formation of cess pools during the rainy season;
- control the disposal and ensure the vegetative stabilisation of spoil.

(iii) *Climate*

154. The proposed improvement/construction works will be localised activities and the Project should not have any significant impact on climatic conditions viz. rainfall, temperature and humidity in the project area.

(iv) *Surface and Ground Water and Drainage and Hydrology*

155. Given the presence of river Rangit and project road running parallel to this river, and small streams crossing the project road, improvement of road may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.

156. The natural courses of Rangit River should, therefore, as far as possible be maintained. Appropriate temporary diversions of cross water-courses may be made if necessary. These streams should, however, be brought back to their natural course as soon as is possible. Disposal of construction debris in streams and rivers should be avoided. This would disturb the water flow, cause siltation and also make the area look unattractive.

157. Minor impacts on water resources are expected during the construction phase. The rehabilitation of existing bridges may also cause soil erosion and turbidity in downstream water bodies. To mitigate this, river-bank slope stabilities should be monitored and, if necessary, appropriate remedial measures applied throughout the construction period. If possible, construction work at bridges should also be avoided during the rainy season. This should minimise erosion and sedimentation.

158. The likely impacts of surface water movements are changes in the natural drainage systems and downstream scour and erosion due to constriction in flows. If suspended solid concentrations in the water are affected, this could also affect aquatic river ecology. Construction activities could also lead to:

- *the temporary pollution of water bodies*: from spillage of chemicals and oil at construction sites and of waste from construction camps;
- *discharge of sediment-laden water from construction areas*;
- *uncontrolled surface water discharge over the road edge*: creating large-scale erosion on down-slopes.

159. To mitigate these impacts the following should be implemented:

- chemicals and oils should be stored in secure, impermeable containers, and disposed of well away from surface waters;
- no vehicle cleaning activity should be allowed within 300 m of water bodies/ drains;
- construction camps should be equipped with sanitary latrines that do not pollute surface waters;
- the work on bridges and culverts should be limited to dry seasons, when many of the smaller streams will have low water - water diversion works can thus be minimised and the original course restored immediately after the work has been completed;
- drivers should be made aware of diversions and other works at bridge construction sites; - this is particularly important at night, if accidents are to be avoided;
- drainage structures should be properly designed to accommodate forecast discharges;
- side drain waters must be discharged at every available stream crossing so that the amount of discharge water is minimised and minimal erosion occurs at the water outlets;
- lined drainage structures should be provided;
- where an increased discharge of surface water endangers the stability of the water outlet, erosion protection measures such as bioengineering measures, ripraps, check dams etc. should be incorporated;
- in areas with high water tables, seepage may occur and side drains and up-slope catch drains must always be lined - this so that no surface water can penetrate into the subsoil; and

- all debris and vegetation, clogging culverts should be regularly cleared.

160. Ground water pollution most frequently occurs when a disposal site contains chemical substances, which are leached out during precipitation and then percolate to the ground water table. It is envisaged that no such materials, in any substantial quantity, will be used in this project. Negative impacts on ground water quality are, therefore, not anticipated - neither during the construction nor operation phases.

(v) *Air Quality*

161. During construction, and at the micro-level only, air quality may be degraded for short periods. This will occur from: (i) the exhaust emissions from the operation of construction machinery; (ii) fugitive emissions from brick, concrete, and asphalt plants; (iii) the dust generated from the haulage of materials, exposed soils and material stockpiles, (iv) cutting and filling of hill slope, (v) cleaning of the road, (vi) material loading, (vii) unloading and (viii) blasting activities. The impact is, however, expected to be localised, temporary and confined to construction areas.

162. Negative air quality impacts during construction are likely to result from three main sources, viz. (i) emissions from construction equipment, including delivery trucks; (ii) fugitive dust from earth-moving operations and demolition; and (iii) localised increased traffic congestion in construction areas.

163. The negative impacts on air quality during construction stage can be classified as in Table 4.1. There are two types of pollution, dust pollution and pollution from harmful gases.

Table 4.1: Impact on Air Quality during Construction Stage

	Impact	Source
1	Generation of Dust (SPM)	Cutting of slopes towards hillsides Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense; Blasting operations; Activation of landslides and rock falls etc.; Transportation of raw materials from quarries and borrow sites; Stone crushing, handling and storage of aggregates in asphalt plants; Site levelling, clearing of trees, laying of asphalt, construction of bridges; Concrete batching plants; Asphalt mix plants – due to the mixing of aggregates with bitumen; and Construction of structures and allied activities
2	Generation of polluting gases including SO ₂ , NO _x and HC	Hot mix plants; Large construction equipment, trucks and asphalt producing and paving equipment; The movement of heavy machinery, oil tankers etc. on steep slopes will cause much higher emissions of gases; Toxic gases released through the heating process during bitumen production; and Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

164. On the Melli – Nayabazar road, it is expected that air quality will be affected to some minor extent by dust and particulate matters generated by construction, vehicular movements, site clearance, earth filling and material loading and unloading. The impacts are, however,

expected to be localised, temporary and confined to construction areas. Care should, however, be taken at sensitive urban locations so that harmful impacts can be minimised.

165. As it is expected that Suspended Particulate Matter (SPM) levels will increase during construction, certain mitigation measures are suggested in order to bring down these levels to prescribed standards – or, as far as is possible. The following actions should be implemented:

- there should be regular check-up and maintenance of construction equipment - the idling of engines should be discouraged and machinery causing excessive pollution (i.e. visible clouds of smoke) should be banned from sites;
- mixing plants i.e. asphalt, concrete, and bricks, should be operated within the permissible limits of CPCB, and be located away from settlements;
- the contractor should submit a dust suppression and control programme to the PWD prior to construction – this plan should detail actions to be taken to minimise dust generation and identify equipment to be used;
- vehicles delivering loose and fine materials should be covered to reduce spills;
- controlled blasting should be carried out and such only with the prior approval of the site Engineer and, if required, PWD;
- bitumen emulsion should be used wherever feasible, and
- bitumen heaters should be used and the use of wood for fuel discouraged or prohibited.

(vi) *Noise Levels*

166. The existing noise in the project area is not a problem. Expect Melli junction and Nayabazar i.e. settlement locations noise is under limits. During the construction period, noise will be generated from the operation of heavy machinery, blasting works, the haulage of construction materials to the construction yard and the general activities at the yard itself. Concrete mixing and material movements will be primary noise generating activities and, most likely, will be uniformly distributed over the entire construction period. These construction activities are expected to produce noise levels in the range of 80 – 95 dB(A). Piling, if necessary, will also cause vibration. Noise and vibration from this source will be unavoidable but the impact will only be temporary and will only affect people living or working near piling locations. In construction sites within 500 metres of a settlement, noisy operations should cease between 22:00 and 06:00 hrs. Regular maintenance of construction vehicles and machinery must also be undertaken to reduce noise. The impact and sources of noise and vibration are summarised in Table 4.2.

Table 4.2: Likely Impact on Noise Quality in the Vicinity of Project Area

Impact	Source
Increased Noise Levels causing discomfort to local residents, workers and local fauna	Mobilisation of heavy construction machinery; Accelerations/decelerations/gear changes – though the extent of impact will depend on the level of congestion and smoothness of the road surface; Use of blasting to cut into hill sides; Excavation work for foundations and grading; Construction of structures and other facilities; Crushing plants, asphalt production plants; and Loading, transportation and unloading of construction materials.

167. Typical noise levels associated with various construction activities and equipments are presented in Table 4.3 below:

**Table 4.3: 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 and 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 Compaction		Landscaping and clean-up	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and 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 Appliance. NJID. 300.1.Decemember 31, 1971

168. The noise levels indicated for various construction activities/equipment, while far exceeding permissible standards, will occur only intermittently and be only temporary. Despite this, these extremely high sound levels present a real risk to the health of workers on-site.

169. Since the anticipated post-construction volumes of traffic on the project road is expected to be low, impacts from higher noise levels will have little significance even though present noise levels in these areas are low. In these areas, the noise produced during construction will also not have a significant impact, if proper mitigation measures are taken. Mitigation Measures should include:

- construction machinery should be located away from settlements;
- careful planning of machinery operation and the scheduling of such operations can reduce noise levels. The use of equipment emitting noise not greater than 90 dB(A) for an eight-hour operations shift and, when possible, the siting of construction yards at least 500 metres from residential areas should be adhered to;
- controlled blasting should only be carried out with prior approval from the Engineer in charge;

- contractors should be required to fit noise shields on construction machinery and to provide earplugs to the operators of heavy machines;
- blasting should be conducted only during day-light hours; and
- only controlled blasting should be conducted.

(vii) *Topography and Appearance*

170. Construction activities of the project roads will bring permanent changes in the local-level topography and appearance of the project site. There will be a loss in aesthetic beauty of the project area mainly due to the earthwork. However this is usually a temporary phenomenon limited to the construction stage and the stage immediately following it. Proper re-vegetation activities and natural resumption of site stabilization generally bring back the previous look of the area. The following table elaborates potential effects on the topography and appearance and appropriate mitigation measures.

	Construction activity	Potential effect on topography and appearance	Mitigation
1	Clearing of vegetation and cutting of hillside for widening of the road	Scarring of landscape from cutting and potential landslides (short term and long term) may be caused. There may be minor permanent changes in the landscape.	Cut material should be used to widen the road or disposed off at proper disposal sites. Cut slopes should be re-vegetated immediately after widening activities.
2	Stone quarrying	Scarring of landscape and potential landslides (rock slides/falls). There may be permanent changes in the landscape.	Stone quarrying should only be undertaken in legally approved areas. Controlled and environmental friendly quarrying should be carried out to minimise land slides and erosion
4	Earthwork from borrow areas	Scarring of landscape due to unearthing activities. Minor but permanent changes in landscape	Borrow areas should be in legally approved locations. As soon as construction activities are complete, they should be re-vegetated and brought back as far as possible to their previous appearance.
5	Waste disposal	Disposal of cut soils and debris at improper locations such as hillside below the road will make the area look untidy and unattractive	Cut off material should be used to widen the road or disposed of at proper disposal sites
6	Establishment of labour camps	Disposal of waste and litter at improper locations and deforestation for fire-wood will make the area look dirty and unattractive.	Provision and allocation of proper waste disposal bins and sites are required. A supply of cooking gas should be provided by the contractor to eliminate the use of fire wood.

Ecological Resources

(i) Wildlife

171. The existence of rich bio diversity and micro climatic conditions, the state is home to a number of important wildlife species. However, in project area presence of wild animals is very rare. Also, project road travels through foothills; it will not have any impacts on movement of wild animals. Though no studies of the impacts of development activities on wildlife have been conducted in state so far, the work on this road may have low-level impacts on wildlife.

172. The improvement works to the existing alignment, usefully should involve minimal tree felling and hence cause little impact. However, some section of the project road passes through dense forests, construction work in this area may, may have impacts on presence of wildlife.

173. Some indirect ecological degradation may also occur from wildlife poaching, by construction workers and outsiders due to greater accessibility and as a result of increased local demands for food resulting from road construction activities. In order to avoid such impacts the contract document should include the following:

- project staff and work crews should not be allowed to have fire-arms and animal traps etc.;
- construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest stretches.
- 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;

(ii) Vegetation

174. The project mostly passes though the forest area of South Sikkim Forest Division. The density of vegetation in forest is 0.4 to 0.5. Removal of the existing vegetative cover and the uprooting of trees is an unfortunate activity, which will reduce the ecological balance in the areas. This will also affect the wildlife habitat and enhance soil erosion. A total of approximately 135000 sq m (5 m strip for entire length 27 km) of scrub forests and vegetation will probably be removed for improvement of road between Melli to Nayabazar. The loss of vegetative cover will mostly be permanent and only some might be revived through mitigation efforts. Another impact from road construction activities and deriving from the cutting of hillsides, quarrying, preparation and transfer of stone chips and other earthwork, is the accumulation of dust on the surrounding vegetation. This will leads to deterioration of the vegetative health, which in turn will affect the ecology as well as the aesthetic beauty of the area. Induced impacts may result from the following:

- increased forest harvesting for fire-wood, construction timber, forage, medicinal plants and other products;
- increased earth and rock extraction;
- construction crew demands for wood as a fuel and for building materials;
- construction crew demands for food and recreational hunting and fishing;

175. To minimise negative impacts on the vegetative cover the contract documents should specify that:

- all wood building material for workers' housing should be brought from outside the project area;

- 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 in charge 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 are minimised.

176. It is estimated that about 500 to 600 trees of dense forests will need to be removed for widening of the road. Generally only part of the removed vegetation can be revived. Revival can be maximised by applying the following methods:

- clearing only the necessary amount of vegetation from the project sites;
- re-vegetation of the slopes above and below the road - plant species that would enhance soil conservation are bamboo and Kew grass – they should also be help to prevent erosion and landslides.

Human Use Values

(i) Land use and Settlements

177. Field reconnaissance surveys of the project roads were conducted in second week of October 2005. These, amongst other things, assessed environmental and social conditions. Particular note was made of likely sensitive issues. In the project area, the relocation of structures will only be required at a very few locations. In these areas, most structures which may require to be removed are, moreover, made of light materials i.e. compacted earth, timber and corrugated iron sheets. The widening options, however, been devised so as to cause minimise destruction of structures.

178. A census survey conducted along the protect road found that there are one temporary structure and one temple is likely to be affected due to widening of road. A short resettlement plan is prepared (included separately as R&R part). The affected people will be compensated and rehabilitated as per the provisions of the Resettlement Plan.

179. There will be negligible land acquisition as the proposed widening will be accommodated within existing ROW i.e. 27 ft either side of the road.

180. At certain locations on the road, and mainly at bridge sites, traffic may have to be temporarily diverted from the existing carriageway while construction is in progress. In these situations, temporary traffic diversions may sometimes be managed within the ROW. In other instances, traffic may have to be diverted across adjacent private land, in which case compensation must be paid for any loss of crops or the replacement of damaged fences or structures. In other situations, most frequently not at bridge sites, for example when bitumen surfacing is in progress, it may be required to close the road temporarily. In these circumstances, adequate radio and press releases should be made beforehand and a date/time given for the re-opening.

181. Most construction should, however, be undertaken during the dry season when few crops are planted. Losses should, thereby, be minimised.

182. On all project road and post construction it is likely that there will be some escalation of land prices. This is a market phenomenon which cannot really be controlled and is in many ways it is a good thing. It is an indication of the increased wealth of local residents. There however also be labour shortages and actions can be taken to prevent or minimise this. The

provision and encouragement of rural enterprise development schemes by Government and NGO's in rural areas will help to reduce rural - urban migration.

(ii) *Health, Safety and Hygiene for Construction Workers*

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

184. The Contractor will be required to control the construction site, keep it clean and provide facilities such as dust bins and dust collectors for the temporary storage of all waste. This waste should be stored adequately to avoid the pollution of water supplies and water sources and to avoid dust formation. The Contractor should be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals.

185. All necessary safeguards should be taken to ensure the safety, welfare and good health of all persons entitled to be on the sites and to ensure that works are carried out in a safe and efficient manner. The personnel working at vulnerable site locations should wear safety helmets and strong footwear. It should be ensured that all workmen and staff employed on site use proper safety equipment – for example, eye protectors, ear plugs, safety helmets, the designated safety equipment when working over water - and that proper rescue equipment is available. Fire extinguishers and first-aid equipments shall be kept at all sites.

186. Inevitably, injuries may occur. At the construction camps and at all workplaces, first aid equipment and nursing staff should, therefore, be available.

187. The construction camps are anticipated to house up to 300 people for two to three years. With this concentration of people, the potential for the transmission of diseases and illnesses will increase.

188. The main health and safety risks during construction will arise from:

- inadequate sanitation facilities in worker camps;
- introduction of sexually transmitted, and other diseases, by immigrant workers; and
- outbreaks of malaria, typhoid, cholera etc. amongst the labour force.

189. The following actions should be undertaken at construction camps and stipulated in construction contracts:

- the contractor should be required to submit and obtain approval for a health and safety plan prior to the commencement of work;
- there should be provision of adequate health care facilities; and
- workers should be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

190. Additionally, the project should support a public health education programme for workers and villagers covering road safety, malaria, hygiene, and sexually transmitted diseases. The district health departments should participate in monitoring and education of communities and workers affected by the project.

(iii) *Nuisance to nearby properties*

191. Nuisance to nearby properties is likely to result from:

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

- fumes from asphalt boiling sites.

192. Much of the project road pass through forest areas and presently air/dust pollution is not a major issue. Nonetheless, there should be regular watering of the road surfaces or the application of emulsion coats near villages, where dust is a nuisance. Noise generating equipment such as power generators and concrete mixers should be kept away from populated/commercial areas. Provisions should also be incorporated into the contract to require the use of dust suppression measures.

(iv) Interference with Utilities and Traffic

193. On the project road, utilities interfere with the ROW at few locations. There are, however, few locations of electricity and telephone cables that will have to be moved prior to construction. This should not be a major problem.

194. Traffic may experience minor delays when diverted around active construction areas, but will be more severely hampered at the locations where temporary road closures are necessary. Such may, however, be unavoidable. Danger points should have proper signs indicating the nature of the problem envisaged. All signs should be distinct and visible.

(v) Community Impacts

195. There will be minor widening work on entire road length - in which case the resettlement problem will be only minor or nil.

196. A public consultation process has been undertaken as part of the IEE study and for the social assessment study. A series of meetings were conducted involving officials of executing agencies, PWD, District Rural Development Officials, Forest department officials, likely affected persons and village heads in the project area. The list of the officials/persons consulted is provided in Chapter 6. Most of the people interviewed strongly support the project. The people living in all the project areas expect the different project elements to facilitate transport, boost economic development and thereby provide directly, or indirectly, benefits to themselves.

197. Construction camps may, however, put stress on local resources and the infrastructure in nearby communities. In addition, local people may raise construction-process related grievances with the workers. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as health care clinics, places of worship and occasional entertainment. The use of local labourers during the construction will, of course, increase benefits to local peoples and minimise these problems. Whenever possible, such people should be employed.

198. Construction activity will, however, inevitably impact community resources, often adversely. Religious sites and places of public entertainment are particularly vulnerable, though the owners of the latter will probably welcome the increased, albeit temporary, patronage.

(v) Quality of Life

199. The impact of the improvements of project road on the socio-economic environment will be significantly beneficial. Improved access and reduced travel times and costs will be major stimuli to economic growth, particularly in rural areas. The better access of agricultural goods to market will be particularly important and a major contributor to poverty reduction.

200. Increased labour mobility will also occur. This may, however, have both positive and negative impacts. Increased access is a two-way phenomenon, and the corollary to increased access to the project areas is increased access for the residents of these areas to more urban

life-styles. Out-migration may, in fact, be the principal outcome. There is also the likelihood of the relocation of homes and businesses to new road-side locations.

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

202. The long-term effects of these roads on poverty reduction are, consequently, expected to be significantly positive.

(v) *Construction Materials*

203. The use of proper sources for stone and aggregates has become a major issue in most states. Historically, stone has been collected from the roadside or from shallow surface workings. Small quarries on steep slopes are often enlarged by blasting or excavation at the base. This is dangerous and can cause slope failures. Roadside stone collection continues in some districts despite its proven negative impacts on road safety and stability. Sand and gravel are often obtained from river deposits. Jurisdiction over stone and aggregates is shared between the "Geological Survey of India" and the "State Forest Department". The "Geological Survey of India" issues licences for major mineral developments. The "Forest Department" issues permits for stone quarrying and for sand and gravel extraction. This is largely because these are mostly found on forest lands. Roadside quarrying is officially discouraged, but unofficially continues, invariably by petty contractors.

204. Road maintenance, repair and new construction will continue to cause large demands for construction materials. There is a clear need for a better materials supply policy in each district, both to minimise environmental impacts of small-scale, poorly managed operations and to improve the quality and reliability of supply. In some districts, it may be appropriate to develop centralised quarries, if an operator can be attracted. In any case, pre-designation of sources would give contractors a level playing field for bidding and minimise incentives for environmentally damaging cost cutting.

205. As a prior requirement of projects every quarry and borrow area: should be subjected to a site specific environmental investigation; should work according to an approved plan; and should be left in a safe condition or restored to a productive land use. Subject to these conditions, obtaining construction materials for projects will not cause unacceptable impacts.

206. Quarry and borrow pits may be filled with rejected construction waste and afterwards should be given a vegetative cover. If this is not possible, then the excavated slopes should be filled in such a way that they resemble an original ground surface.

(i) *Mitigation for Quarries*

- aggregates should be sourced only from licensed quarry sites that comply with environmental and other applicable regulations;
- occupational safety procedures/practices for the work force and as per law should be adhered to in all quarries;
- quarry and crushing units should be provided with adequate dust suppression measures – there should, for example, be water sprinkling in work areas and along the approach roads to quarry sites;
- there should be regular monitoring of the quarries by concerned authorities - such to ensure compliance with environmental management and monitoring measures.

(ii) *Mitigation of Borrow Areas*

- prior approval should be obtained from concerned authorities and all local environmental regulations be complied with;
- within all identified borrow areas, the actual extent of area to be excavated should be demarcated with signs and access to the operational area controlled;
- borrow pit plant and machinery should conform to EPA noise emission regulations;
- protective gear, for example earplugs, should be provided to the workforce exposed to noise levels beyond threshold limits and there should be proper rotation of such personnel; and
- all operation areas should be water sprinkled to control dust levels to national ambient air quality standards.

207. The project will require large amounts of bitumen or bitumen emulsion. This will, most likely, be supplied in drums. These empty bitumen drums are generally recycled as steel sheeting, or used in road construction as parapets or for bank stabilisation. When supplied and used in this manner, bitumen is not regarded as a significant environmental hazard.

208. The project will require the import, transport and use of fuel and oils. Minor diesel spills are common in region, especially around fuel stations. The project provides an opportunity to assist the PWD and contractors in improving fuel handling practices so as to minimise future fuel spillage.

Environmental Effects Related to Operation

Noise Vibration, Air Pollution, Runoff, Spoils of Hazardous Materials

209. The current low traffic flows along the project road is expected to increase because of improved economic activities associated with better access. The larger numbers of vehicles will be an additional source of noise and gaseous emissions. Traffic volumes will, however, remain low and this should not be a significant impact. Repairs to culverts and new drainage work will eliminate/reduce the soil erosion problems presently caused by poor cross drainage. Also, the situation will remain especially good because this road pass through area that are largely forested and trees and plants have the capacity to absorb gaseous as well as noise pollutants. Bioengineering techniques may also help to absorb pollution.

210. The project road is linked to national highway at Melli which carry a variety of goods and materials. With the envisaged improvements, it is envisaged that overall road safety will improve. There will consequently be a reduced risk of accidental spillages. Improving safety is an important concern of the present project.

Land Use and Settlements

211. The likely impacts on land use and settlement patterns are limited. Improved access will inevitably lead to increased in and out migration, but this is likely to occur gradually and over a prolonged period. There will be time for new residential areas to be established. There may, however, be a need to control ribbon development.

Social Impacts

212. The likely social impacts can be divided into benefits that occur to local society and other benefits, in terms of improvements to the wider quality-of-life. Specific benefits to local people will include:

- easier communication;
- easier access to markets (both internally and regionally) with savings in travel times and costs;

- enhanced market efficiency through better distribution and accelerated deliveries etc.,
- improved access to health, education and other social services,
- employment generation;
- improved technical skills; and
- enhanced economic activity.

213. Likely adverse social impacts will include:

- increased chances of exposure to communicable diseases, particularly during construction;
- influxes of new settlers leading to increased pressure on natural resources causing hardship to local communities relying on local/forest resources; and
- rural-to-urban migration causing labour shortages in the depleted rural areas and other negative impacts in the urban areas.

Potential Environmental Enhancement /Protection Measures

214. In order to improve the environment the following measures should be taken during construction.

Sanitation and House Keeping at the Labour /Construction Camps

a) *Site Selection*

- construction camps should be located 200 - 500 m away from existing habitations - the living accommodation and ancillary facilities for labourers should be erected and maintained to standards and scales approved by the Engineer-in-Charge;
- all sites used for camps should be adequately drained and they should not be subjected to periodic flooding; and
- camps should be located such that drainage from and through the camps will not endanger any domestic or public water supply.

b) *Water Supply*

- an adequate and convenient water supply, approved by the appropriate health authority, should be provided in each camp for drinking, cooking, bathing and laundry purposes;
- potable water supply systems for labour camp occupants should be as per the design approved by local public health/engineering departments and meet the water quality standards as prescribed by the WHO. In addition, the design of water system facilities should be based on the suppliers and the Engineer-in-Charge's estimates of water demands;
- the drinking water system must be monitored in accordance with water quality parameters as prescribed by the WHO. Any water supply system used for cooking purposes that is drained seasonally should be cleaned, flushed, and disinfected prior to use. Furthermore, a water sample of satisfactory bacteriologic quality, i.e. a sample showing not more than one coliform bacteria per 100 ml sample, should be obtained before such systems are placed into service; and

- at all construction camps and other workplaces, good and sufficient water supply should be maintained to eliminate the chances of waterborne/water-related/water-based diseases and to ensure the health and hygiene of the workers.
- c) *Toilet Facilities and Hygiene*
- within the precincts of every workplace and accommodation unit, latrines and urinals should be provided in an accessible place, as per standards set locally. Where flushing systems cannot be provided, all latrines should be provided with a dry-earth system, which should be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles should be tarred inside and outside at least once a year;
 - toilet facilities adequate for the capacity of the camp should be provided - each toilet room should be located so as to be accessible;
 - a toilet room should be located within 200 feet of the door of each sleeping room and no toilet should be closer than 100 feet to any sleeping room, lunch area or kitchen; and
 - an adequate number of urinals should be provided.
- d) *Waste Disposal*
- the sewage system for the camps should be designed, built and operated to the satisfaction of the concerned public health engineering department, so that no health hazard occurs and no pollution to the air, ground or adjacent watercourse takes place - compliance with the relevant legislation must be strictly adhered to;
 - garbage bins should be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner to the satisfaction of relevant norms; and
 - on completion of the works, all such temporary structures should be cleared away, all rubbish burnt, excreta tank and other disposal pits or trenches filled in and effectively sealed off and the outline site left clean and tidy to the entire satisfaction of the Engineer-in-Charge.
- e) *First Aid*
- injuries may inevitably occur and it is, therefore, pertinent to provide first aid facilities for all workers - at construction camps and at all other workplaces first aid equipment should be provided;
 - adequate transport facilities for moving injured persons to the nearest hospital should be provided and these should be in a ready-to-move condition;
 - all first-aid units should have an adequate supply of sterilised dressing material and should contain an appropriate selection of other necessary appliances.
- f) *Maintenance*
- all buildings, rooms and equipment and the grounds surrounding them should be maintained in a clean and operable condition and should be protected from rubbish accumulation;
 - all necessary means should be employed to eliminate and control any infestations of insects and rodents within all parts of the labour camps - this should include approved

screening or other control of outside openings in structures intended for occupancy or food service facilities;

- each structure made available for occupancy should be of sound construction, should assure adequate protection against the weather, and should include essential facilities to permit maintenance in a clean and operable condition – the comfort and safety of occupants should be provided by adequate heating, lighting, ventilation or insulation and, when necessary, the facilities to reduce excessive heat; and
- each structure made available for occupancy should comply with the requirements of local building codes – though this should not apply to tent camps.

Guidelines for identification of Debris Disposal Sites

215. The locations of dump sites should be selected in such a manner that:

- residential areas are not located downwind of these locations;
- dump sites do not contaminate any water sources, rivers etc.;
- dump sites have capacity at least equal to the amount of debris to be generated;
- public perceptions about the manner and location of debris disposal are obtained and taken into consideration before finalising locations; and
- permission from the head of the village/community is obtained.

a) *Precautions to be Adopted during Dumping of Debris/Waste Material*

216. The contractor shall take the following precautions while disposing off waste material:

- during site clearance and disposal of debris, the contractor should take full care to ensure that public or private properties are not damaged/affected and that traffic is not interrupted;
- the contractor should dispose off debris only to identified places or with prior permission of the Engineer-in-Charge of works;
- the contractor should only dispose of debris from the improvement of public utilities after the proper consent of villagers and approval of the Engineer-in-Charge of works;
- in the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor should immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Engineer-in-Charge of works;
- the contractor should at all times ensure that all stream/river courses and drains within and adjacent to the site are kept safe and free from any debris;
- when dust is likely to be created, and to dampen stored materials during dry and windy weather, the contractor should apply effective water sprays – this should also occur during the delivery and handling of materials;
- materials having the potential to produce dust should not be loaded to a level higher than the side and tail boards of a truck and should be covered with a tarpaulin in good condition;
- during the cutting of hills and disposal of debris, proper warning signs should be installed to the satisfaction of the Engineer-in-Charge of works;

- any diversions required for traffic during the disposal of debris should be provided with traffic control signals and barriers and after discussions with local people and the permission of the Engineer-in-Charge of works;
- during debris disposal, the contractor should take care of surrounding features and avoid any damage to them;
- while disposing debris/waste material, the contractor should take into account the wind direction and location of settlements to ensure that any dust problems are avoided; and
- adequate arrangements should be made to ensure that debris/waste material is disposed of to the nearest designated dumping site - reports on this activity should be provided regularly by NGOs/ Village Society Heads.

Rehabilitation Plan for Quarry/Borrow Pits

217. The following are important:

- the objective of the rehabilitation programme should be to make the quarry/borrow pit sites safe and secure areas. Securing borrow pits/quarry sites in a stable condition should be a fundamental requirement of the rehabilitation process. This can be achieved by filling the quarry/borrow pit floor to approximately the access road level;
- from the outset there should be a restoration plan, which should influence all day-to-day quarrying activities; and
- land-use planning considerations should be taken into account when defining devising and finalising restoration works and these should take into account the need to preserve the environment and, if possible, to generate income for local communities.

218. Other criteria which should be followed when rehabilitating quarry/borrow pits are-

- quarries and borrow pits should be used to dispose of rejected construction waste and covered with a vegetation. If this is not possible, the excavated slopes should be smoothed and depressions filled in such a way that they look, more or less, like an original ground surface;
- during the execution of works, the contractor should ensure: the preservation of trees and stock-piling of materials; the spreading of stripped material to facilitate water percolation and to allow natural vegetation growth; the reestablishment of previous natural drainage flows; the improvement of site appearance; the digging of ditches to collect runoff; and the maintenance of roadways. Once works are complete, the contractor should restore the environment around the work site to its original state;
- the immediate surroundings of quarry or borrow pits should be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming open spaces. If required, walkways around the borrow site should be constructed. Provisions for future drive-in picnic areas and/or car parking areas may be provided.

Use of Explosive and Blasting

219. The Contractor should follow the explosive guidelines according to the PWD (PIU) Blasting Manual. In particular the following points are important:

- controlled blasting only should be undertaken - this to limit the volume and extent of rock throw;

- the contractor should keep in his site offices copies of laws applying to supply, transportation, handling, storage and use of explosives and should supply one copy of each of these laws to the Engineer-in-charge;
- the contractor should submit to the Engineer-in-charge, the details of the explosives that he/she proposes to use and his/her proposals for their storage and/or transport to site;
- explosives should be used in accordance with the recommendations of applicable regulations of the PWD(PIU);
- explosives should be stored under proper security at a safe distance from the road and at least 300 metres from any inhabited premises;
- the contractor should use explosives for blasting in connection with the work only at such times and places and in such a manner as the Engineer-in-Charge may approve - such approval should not, however, relieve the contractor from his/her responsibility for injury, loss, inconvenience and annoyance to persons, damage to works and adjoining or adjacent structures, road, places and other things;
- the contractor should obtain all necessary permits and pay all necessary fees for the acquisition, storage and use of explosives and explosive accessories;
- the contractor should appoint a responsible person or persons to order and receive explosives on site and to be responsible for all blasting activities on site;
- the contractor should provide an approved system of warning the public (including road traffic) and site personnel of an impending blast by both audible and visible means and should ensure that the blasting area is cleared of all personnel immediately prior to blasting;
- the contractor should keep a current inventory of all explosive and explosive accessories obtained and used and submit a monthly report to the Engineer-in-Charge, detailing the usage of all explosives and explosive accessories by date and location;
- the contractor should be entirely liable for any accident that may occur and should save the employer harmless and indemnified from all claims arising;
- the contractor should give warning each time of his intention to blast and should station personnel on the roads and elsewhere with flags, horns and whistles and prevent persons, animals and traffic entering or remaining within the danger zone;
- the contractor's supervisor in charge of blasting operations should have a current license valid for all types of blasting required including restricted blasting, and the license should be made available to the Engineer-in-Charge for verification;
- in areas, where it is necessary to restrict blasting in order to protect installations of significance or whenever blasts within 400 m of any public utilities are required, the contractor should provide cover to the area to be blasted, to the approval of the Engineer-in-Charge and the authority concerned, to prevent damage by flying debris to such services; and
- after blasting no person should approach the danger zone until the blasting site has been examined by the licensed supervisor or other responsible person and, in the case of misfires, before proper precautions have been taken.

5. INSTITUTIONAL ASSESSMENT AND ENVIRONMENTAL MONITORING PROGRAMME

220. The environmental management and monitoring mechanism required to ensure that the project implementation is carried out in accordance with the due regards to environment. These includes major environmental issues and associated impacts, suggested mitigation measures, implementation and supervising responsibilities, a monitoring plan and institutional assessment and training requirements for successful implementation of the mitigation measures.

Environmental Management and Monitoring Plan

221. In the previous chapters we have dealt with various environmental impact and mitigation measures associated with the road development. Adaptation of appropriate mitigation measures during design, construction and operation stages shall reduce the negative impacts of the project to acceptable limits.

222. Keeping in view various environmental issues associated with road improvement, an environmental impacts and mitigation matrix including time frame and the implementing responsibilities has been worked out and presented in **Table 5.1**. A generic Impact and Mitigation matrix applicable to road project is provided for various stages of project. Site specific impacts and mitigation measures at construction stage are worked out and presented separately for proposed road section i.e. Melli to Nayabazar section.

223. Environmental Monitoring Plan forms the basis for verifying the extent of compliance during the implementation and operation stages of the project.

224. The objectives of an Environmental Monitoring Programme are:

- to evaluate the performance of mitigation measures proposed in IEE;
- to provide information which could be used to verify predicted impacts and thus validate impact prediction techniques;
- to suggest improvement in environmental mitigation measures if required ;
- to provide information on unanticipated adverse impacts or sudden change in impact trends;

225. **Table 5.2** gives a generic monitoring plan for the road sector development. However, depend on ground realities these need evaluation. Monitoring requirements for project road is given in **Table 5.3**.

Table 5.1: Environmental Impact and Mitigation Matrix for Project Road

(Note: A common Impact and Mitigation matrix applicable to road project is provided for various stages of project. Site specific impacts and mitigation measures at construction stage are mentioned for proposed road section i.e. Melli to Nayabazar section.)

Project Stage/Activity	Potential Impacts	Mitigation Measures	Location	Responsible party - Implementation	Responsible party - Monitoring
1. General Matrix applicable to all road sections					
1.1 Preliminary Planning and Design Stage					
1.1 Widening options of project road	Location on agricultural land, dense forests, wildlife habitat, unstable sites and religious/cultural sites. Change in widening option determined during the feasibility stage changing the scope or scale of environmental impacts predicted in the IEE.	Widening on other side of agricultural land, dense forests, wildlife habitat and unstable sites. Widening should avoid religious/cultural sites. Additional environment studies for new alignments (if required).	Entire project length	PIU (PWD) /Consultant	PIU (PWD)
1.2 Location of construction camps and contractor facilities	Location in inappropriate locations such as close to the local community, community drinking water source etc.	Construction camps should be located at least 500m away from community areas and away from water resources, and at least 1 km away from reserve / protected forest stretches. Village Forest Management Committees should be consulted before locating temporary project facilities.	Project construction sites	PIU (PWD) /Consultant	PIU (PWD)
1.3 Location of quarry sites	Location in un approved areas, forest areas etc.	Only government approved quarry sites should be planned for project use Quarries should not be located in the locations of reserve / protected forest stretches.	Environmentally and technically suitable sites near the project road	PIU (PWD) /Consultant	PIU (PWD) /Department of mines
1.4 Location of borrow pits	Location in unstable areas or close to village	Location in environmentally sound areas and away from villages Borrow areas should not be located in the locations of reserve / protected	Environmentally and technically suitable sites and near the project road	PIU (PWD) /Consultant	PIU (PWD)

Project Stage/Activity	Potential Impacts	Mitigation Measures	Location	Responsible party - Implementation	Responsible party - Monitoring
		forest stretches.			
1.5 Obtainment of appropriate NOC/permits	Delays in processing permits causing further delay in initiation of project construction	Processing of NOCs/permits on a timely basis.		PIU (PWD) /Consultant	ADB
1.6 Preparation of project detailed design and contract bidding documents	Exclusion of environmental management and mitigation measures hence lack of EFRC during construction	Incorporation of all mitigation measures into the project detailed design and contract bidding documents		PIU (PWD) /Consultant	ADB
1.7 Removal of encroachment along road.	Loss of livelihood and structures.	Compensation against loss of structures and should be rehabilitated as per the provisions of resettlement plan.	locations where resettlement required	PIU (PWD) /Consultant	ADB
1.2 Construction Stage					
1.2.1 Removal of dense vegetation and uprooting of over 400 trees	Change in micro level habitat/environment. Soil erosion. Scarring of landscape.	Removal of only necessary vegetation. Re-vegetation of the left and right boundary of the road with suitable soil conserving plants immediately after earth removal activities. Compensatory afforestation in the available land @ 1:2 ratio in consultation with forest department	Area of the ROW	Contractor / Forest Department	PIU (PWD)
1.2.2 Quarrying	Landslides (rockslides/falls), scarring of landscape	Use of environmental friendly techniques of quarrying.	Quarry sites	Contractor	PIU (PWD)
1.2.3 Crushing of stone and transport of stone and materials.	Dust pollution for construction labourers and local vegetation. Air pollution from machinery and vehicle exhaust. Noise pollution and disturbance to nearby wildlife.	Water sprinkling of stone crushing site. Proper coverage of vehicle transporting stone and material. Regular maintenance of machinery and vehicles. Conduction of stone crushing and transportation activities only during the day. Stone crushers should be located away from settlements and forest stretches.	Stone crushing sites and road construction	Contractor	PIU (PWD) /Mining department

Project Stage/Activity	Potential Impacts	Mitigation Measures	Location	Responsible party - Implementation	Responsible party - Monitoring
1.2.4 Establishment of construction camps	Deforestation and poaching by labourers. Improper waste disposal. Loss of aesthetic beauty. Health issues.	Provision of cooking gas. Contractual agreements should include penalties for poaching. Provision of proper waste disposal facilities as well as health facilities.	Construction camp sites	Contractor/PIU (PWD)	PIU (PWD)
1.2.5 Operation of machinery and equipment and general activities of labourers	Spillage/leakage of chemicals and oil and contamination of soil and water resources. Injury to labourers. Respiratory problems from dust and machinery emissions. Hearing problem due to high level of noise. Traffic delays and congestion.	Proper storage and handling of chemicals and oil. Provision of adequate facilities such as construction hats, facemasks, earplugs, gloves etc. Provision of well equipped First Aid Kit and health facilities. Preparation of traffic control plans, proper maintenance of road surface to allow smooth flow of traffic.	Construction site	Contractor	PIU (PWD)
1.2.6 Water supply for construction activities and labour camps	Disruption of water supply of local communities	Independent arrangements be made for requirements for construction work in such a way that water availability and supply to nearby communities remains unaffected	Construction camps and work place	Contractor	PIU (PWD)
1.2.7 Unexpected environmental problems/calamities (eg. flash floods) during construction activities	Destruction of constructed road and road furniture, injuries, loss of lives and property,	Undertake appropriate remedial actions in coordination with relevant government and local agencies.	Construction camp and sites	Contractor, PIU (PWD)	PIU (PWD)
1.2.8 Implementation of EMP during construction.	Inadequacy of environmental management measures or deviation from the EMP measures mentioned in the contract documents.	Strictly following and implementing the EMP measures mentioned in the contract documents and maintaining proper documentation of measures taken.	Construction camp and sites	Contractor	PIU (PWD), ADB
1.3 Operation Stage					
1.3.1 Movement of vehicles	Air pollution from emissions. Noise and vibrations causing disturbance to residents and wildlife. Contamination of soil and water resources due to poor drainage.	Bio engineering techniques to absorb air pollution and block out noise. Periodic cleaning of drains.	Along the road	Contractor, PWD	PIU (PWD) /Local Traffic Police

Project Stage/Activity	Potential Impacts	Mitigation Measures	Location	Responsible party - Implementation	Responsible party - Monitoring
2. Site Specific impact matrix applicable to Melli – Nayabazar road section					
2.1 Construction Stage					
2.1.1 Cutting of hill slope and earth removal from borrow areas	Soil erosion and landslides. Scarring of landscape due to improper disposal of debris. Dust pollution. Disruption of local drainage. Siltation in nearby water river Rangit and hence negative effects on aquatic ecology.	Cutting activities during dry season. Use of cut and fill method. Disposal of debris at proper disposal site. Use of bio engineering techniques to maintain stability of slope above and below ROW. Avoid placing hairpin bends very close to each other as it enhances erosion. Proper re-vegetation of borrow areas. Provision of appropriate drainage structures/facilities.	Entire road section, which is geologically weak zone. Locations of hairpin bends /curves Landslide locations at km 2.4, 3.5 to 3.9, 13.2	Contractor	PIU (PWD)
2.1.2 Removal of dense vegetation and uprooting of trees	Change in micro level habitat/environment. Soil erosion. Scarring of landscape.	Removal of only necessary vegetation. Re-vegetation of the space available on left and right boundary of the road with suitable soil conserving plants immediately after earth removal activities. Removal of trees should be compensated with planting new trees @ 1:2 ratio on available space along the road.	Entire project length that passes through dense forests	Contractor / Forest Department	PIU (PWD)
2.1.3 Construction of culverts and bridges	Disruption of local stream/river course and aquatic hydrology.	Construction during dry season. Provision of appropriate drainage facilities and river/stream diversion structures.	Entire road length parallel to Rangit river, bridge/culvert construction locations along the road i.e. km 5.75, 13.55, 17.3, 22.2, 23.9.	Contractor/ PIU (PWD)	PIU (PWD)
2.1.4 shifting of religious structures	Loss of religious sentiments of local communities	As much as possible temples will be left unaffected by modifying the alignment during final design. In case of shifting the temples, local communities will be consulted and necessary assistance should be providing to shift the temples	Temple of goddess durga at Rolu village i.e km 10 and km 25.5	Contractor/ PIU (PWD)	PIU (PWD)

Project Stage/Activity	Potential Impacts	Mitigation Measures	Location	Responsible party - Implementation	Responsible party - Monitoring
2.1.5 Blasting activities	Injury to labourers. Noise pollution and air pollution.	Provision of adequate facilities such as construction hats, facemasks, ear plugs, gloves etc. Provision of well equipped First Aid Kit and health facilities.	Steep and rocky locations	Contractor/ PIU(PWD)	PIU(PWD)

Acronyms:

PIU: Project Implementation Unit

PWD: Public Works Department

ROW: Right of Way

EMP: Environment Management Plan

ADB: Asian Development Bank

Table 5.2: Typical Environmental Monitoring Plan

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Responsible party
A. Physical Environment				
i) Air and Noise	Level of SPM, SO ₂ and NO _x Noise levels on dB (A) scale	Before starting of any construction activities.	At selected locations	PIU, PWD
		Once in every section while construction is ongoing.		
		Once after completion of construction activities.		
ii) Topography and Soil	Number and scale of soil erosion and landslide sites.	Before starting of construction activities.	Full length of project road where work will be undertaken including realignment	PIU, PWD
		Once a year during construction activities.		
		Once after completion of construction activities thereafter once every year for the next 5 to 10 years depending on budget availability.		
	Number of properly bioengineered sites.	Once every summer during construction activities.	Wherever bio-engineering technique have been done	PIU, PWD
		Once after completion of construction activities and thereafter once every year for the next 5 to 10 years depending on budget availability.		
iii) Water Bodies	Concentration of sediments and presence of construction debris.	Before starting of construction activities.	Major water bodies and perennial streams	PIU, WPD
		During construction activities in the vicinity of each water body.		
		Once after completion of construction activities.		
	PH, BOD, COD, DO, TDS, MM, NO ₃ and Coliform	Same as above.		
	Length of line drainage structures constructed and strengthened.	During construction activities in the vicinity of each water body.	Full length of project road	PIU, PWD
	Length of damaged or missing line drains.	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once after completion of construction activities.		
	Total number, type and lengths of cross drainage structures including bridges constructed or strengthened	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once a year during construction activities		
		Once after completion of all construction activities.		
	Number of weak cross drainage structures.	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once after completion of construction activities.		
iv) Geology and Seismology	Number of rock slides.	Before starting of construction activities.	Full length of project road	PIU, PWD, DoM&G
		Once a year during construction activities.		
		After completion of construction activities.		

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Responsible party
	Number of cases of illegal quarrying or mining	Once a year after completion of construction activities.	Entire project length.	PIU, PWD, DoM&G
B. Ecological Resources				
i) Flora	Total area of vegetative cover	Before starting of construction activities.	Entire project section	PIU, PWD, Forest Department
		Once after completion of construction.		
	Total number of trees	Same as above.		
	Average tree density	Before starting of construction activities.	Full length of project road	PIU, PWD, Forest Department
		During construction (once a year per section)		
		Once after completion of construction activities and thereafter once every year for 5 to 10 years depending on budget availability.		
	Number of cases of illegal tree felling	Once a year during construction activities	Full length of project road	PIU, PWD, Forest Department
		Once after completion of all construction activities.		
ii) Fauna				
Wild Animals	Approximate number of animals seen, frequency of presence. Months and time of sighting. Location of sighting	Before starting construction activities.	Full length of project road	PIU, PWD, Forest Department
		During construction activities (through out the year).		
		Once after completion of construction activities and thereafter once every three years.		
C. Social Environment				
i) Health	Number of accidents amongst construction workers.	During construction activities.	All construction sites along project road	PIU, PWD, Contractor, local health officials,
		Number of accidents due to moving traffic amongst local community members	Before starting construction activities.	All villages along project road
		Once a year during construction activities.		
		Once every year after completion of construction activities.		
ii) Travel time	Time taken to travel within each road section.	Before starting construction activities.	Full length of project road	PIU, PWD, Contractor, local health officials,
		After construction activities and thereafter once every year for the next 5 to 10 years depending on budget availability.		
	Number and extent of travel delays	During construction activities (throughout the year).	Full length of project road	PIU, PWD, Contractor,
iii) Traffic count	CVC and speed delay	3 day hourly count annually three years during operation period	Full length of project road	PIU, PWD, Contractor

Institutional Assessment

226. The proposed North Eastern State Roads Project has been initiated and is being carried out by the Ministry of Development of North Eastern Region (MDONER), Government of India. The responsibility for effective implementation of all project activities will be Public Works Department of each State.

227. Public Works Department (PWD), Government of Sikkim is responsible for implementation of project activities related to improvement of present project road i.e. Melli to Nayabazar section.

228. For the projects related to road improvement and maintenance, the PWD has separate Road and Bridge Department and the project will be implemented by R&B Department with external consulting assistance. The R&B department provides its services through a network of divisional and circle offices.

229. At present, there is no specific cell within PWD to look after environmental aspects of road development. The planning, design and monitoring work is being co-ordinated by Chief Engineer's office and divisional office is looking after the execution of plans and projects. The Assistant Executive Engineer at the divisional office is the responsible person to look after environmental consequences along with road engineering aspects. He is the responsible person who interacts directly with the forest departments, pollution control board, getting necessary clearances and implementing and monitoring of the environmental safeguards. Assistant Executing Engineer is supported by the Junior Engineer based at sub-division office. Additionally, time to time assistance from private environmental experts is being taken to carry out the work related to environmental impact assessment etc. The existing capacity of the executing agency is inadequate and need to be enhanced to implement and monitoring of the environment mitigation measures proposed in IEE.

230. The proposed project is likely to be implemented by a "Project Implementation Unit (PIU)" comprising of a project director and resident engineer. They will be responsible for monitoring all activities resulting to present project. During implementation this PIU will be supported by Design Project Management Consultants (DPMC) and Construction Supervision Consultant (CSC) in detailed project preparation and implementation of the project. To look after environmental mitigation measures and monitoring, the PIU will have environmental management cell consist of executive engineer (environment). With appropriate training and exposure, this setup would become competent to implement the EMMP. The setup may be further modified and strengthened, as the project is implemented. The Environmental Cell of the PIU and environmental officer of CSC will ensure that all the EMMP would be implemented fully and that it will prepare regular progress reports for transmission to the regulatory authority by certifying that the relevant environmental measures have been complied with during project implementation.

231. Additional assistance, to strengthen the environmental capacity of the PWD might usefully, however, be provided in the form of training in social and environmental issues and long term monitoring.

232. A mitigation plan will be included in the construction contract and the contractor will responsible for its implementation. The PWD will monitor the implementation of these mitigation measures by the contractors through environmental officer of its appointed Project Management Consultant and engineer in charge at site. It is these site engineers that are responsible for the field level monitoring of new and ongoing road projects.

233. The PIU (PWD) will bear full responsibility for ensuring that the project complies with the best environmental practices and meets the mitigation and monitoring requirements described in the Environmental Report. Both social and environmental parameters related to the project would be monitored.

234. During construction the likely impacts will also be required to be monitored. The likely changes in the quality of various parameters such as Air and Water Quality, and Noise levels should be monitored periodically - say once every four months and during pollution causing activities.

235. The State Pollution Control Board, Gangtok and Directorate of Environment & Forests, Gangtok are two organisations in the state providing training on environmental monitoring and are responsible to check the pollution control activities. These agencies are better staffed and equipped.

Training

Need for Training

236. The PWD's present environmental and social expertise should be augmented as soon as possible – this in order to enable the PWD to:

- integrate social and environmental issues into its day-to-day operations; and
- internalising environmental and social issues in its future road development projects.

237. In order to achieve this goal, the personnel needs to be trained in road development and environmental management and the effective implementation of environmental issues.

Targets of Proposed Training

238. The training programme should:

- expose senior members (CE, SE, EE) of the PWD to environmental and social issues associated with road projects; and
- train and equip members of the PIU, AE and JE responsible for processing environmental clearances and site JE's with the expertise and tools needed to implement and supervise environmental mitigation measures.

239. The senior members of the Environmental/PIU might then be given the additional responsibility for active dissemination of the culture of environmental/ social consciousness and ethics within the rest of the PWD.

240. In order to disseminate environmental experiences gained, each staff member would be required to maintain good records and prepare dissemination notes on specific issues and problems encountered and resolved, and how the experience gained could be integrated into future road projects.

241. Once the staff of the Environmental/PIU have received training and have gained experience in the implementation of mitigation measures, they should be ready to resume a leadership role within the PWD in providing training and in implementing future projects. Competent members of the PWD should be offered additional environmental training and should be encouraged to train other staff.

Training Components

242. Training of the senior staff should be carried out in the following fields:

- Understanding of relevant environmental regulations, environmental assessment procedures and evaluation of environmental assessments carried out by consultants,

243. The training of staff of the PIU, the JE responsible for processing environmental clearances and site engineer's should encompass the following:

- understanding of relevant environmental regulations and their application to road projects,

- environmental management practices in mountain/hilly road construction and maintenance;
- major project environmental impacts;
- options for mitigation measures and their implementation: methods for incorporating these in design and the roles for construction supervision and monitoring,
- duties and responsibilities of the Contractors, Supervision Engineers, Supervision Consultants and the Environmental/PIU,
- public/ community consultation and its role during the formulation and implementation of the project;
- the need for liaison with other departments and relevant agencies such as the forest department, SPCB;
- supervision of the implementation of mitigation measures during construction and operation and the resolution of environmental and social issues and their reporting;
- monitoring during construction and operation;
- monthly and quarterly report preparation and submission;
- the preparation of dissemination notes, the holding of workshops and the training of other staff.

244. Specific training would also be required in:

- wildlife protection and biodiversity;
- slopes stability and vulnerability of landslides;
- sitting criteria for “dump” sites;
- the disposal of debris;
- environmentally sound construction work; and
- the concept of bioengineering.

Environmental Monitoring Cost

245. It is expected that the construction period will be about two to three years. The costing has been done on the basis of unit rate and depends on the construction period. The expected cost of the environment monitoring is US \$ 27,050. The details of the cost are given in Table 5.3.

Table 5.3 Environmental Monitoring / Mitigation Cost

	Parameters / Components	Parameter to be monitored	Guidelines	Unit Cost (US \$)	Total Cost (US \$)
1	Air Monitoring: Melli to Nayabazar (3 times in a year for 3 years) In forest locations during construction (3 times in a year for 2 year)	SPM, SO2, NOx	High volume sampler to be used and located 50 m from the construction site	200	1800
				200	1200

	Parameters / Components	Parameter to be monitored	Guidelines	Unit Cost (US \$)	Total Cost (US \$)
2	Water Monitoring: Melli to Nayabazar (3 times in a year for 3 years)	PH, BOD, COD, DO, TDS, MM, NO ₃ and Coliform	Analyse as per the standard methods for examination of water and waste water	100	900
	Groundwater samples at construction camps (2 times in a year for 2 year)			100	400
3	Noise Monitoring: Melli to Nayabazar (3 times in a year for 3 years)	Noise levels on dB (A) scale	Using an integrated noise level meter kept at a distance of 15 m from the construction site	50	450
	At forest locations (3 times in a year for 2 years)			50	300
	Total Monitoring Cost				5,050
4	Bioengineering Cost: Melli to Nayabazar (about 1/3rd of road length has been considered) i.e. 10 km		IRC Code of Practice and MoRT&H manual	2,000/k m	20,000
	Total Bioengineering Cost				20,000
5	Miscellaneous		Lump Sum		2,000
Total cost in US \$					27,050

6. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

246. In accordance with the ADB's Initial Environment Examination guidelines, public consultation were held, as part of IEE study with beneficiaries, local /government officials, community leaders, NGO's, stakeholders in corridor of impact and people likely to be effected due to the project on various issues affecting them and incorporation of various measures pertaining to environmental issues based on the responses from the people.

247. Since only improvement of existing road with widening to two lanes is envisaged - in this case the resettlement problem will be negligible. Also, improvement work will be limited to existing ROW, therefore, there will not be any forest land or private land acquisition.

Objectives of Consultations

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

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

Methodology for Consultations

249. Consultation with the stakeholders, beneficiaries, and community leaders were carried out using standard structured questionnaires ([given as Attachment 2](#)) as well as unstructured questionnaires. In addition, personal discussions with officials, on site discussion with affected stakeholders, and reconnaissance visits have also been made to project area.

Identification of Stakeholders

250. Stakeholders were identified to ensure as wide a coverage as possible of the project area as follows:

- Households in the project area including potential Project Affected Persons
- Local voluntary organisations / Non-government Organizations (NGOs)
- Government agencies / forest department
- Community leaders

251. Questionnaire survey/discussions were designed to obtain background information and details of general environmental issues that concern people in the project area. In addition,

environmental issues were discussed with relevant organizations, government officials, beneficiaries, community leaders and experts.

252. The official consultation with the Stakeholders was carried out in **second week of June 2005** at respective offices in state head quarter Gangtok. Various officials consulted include Conservator of Forest, Wildlife Warden, Environmental Officer from pollution control board, statistical officer etc. The various issues discussed are:

1. Statistics of forests cover in the State and its legal status i.e. Reserved, Protected, Unclassed;
2. Requirements of Forest Department to carryout project activities within forest areas;
3. Flora and Fauna and endangered species in the State;
4. Scope of the proposed road development, IEE and likely impacts on flora & fauna;
5. Major threats to flora & fauna in the state;
6. Procedure to get clearance from forest department and NOC from pollution control board;
7. Environmental Quality parameters i.e. Air, Water, Noise quality in the State and major sources of pollution;
8. Instructional capacity of state authorities in pollution control and environmental management;
9. Socio-economic conditions and likely impacts on due to proposed road improvement;

253. The list of officials / people contacted along with the **venue, issues raised, date of consultation** is presented on Table 6.1.

Table 6.1: List Of Officials Consulted & Issues Discussed During Field Visit

Sl. No.	Name of Official Consulted	Department	Issue discussed	Date
1	Mr. D.T. Lepcha	Chief Engineer, PWD Sikkim, Gangtok	Existing conditions of state roads, Major problems of State roads, Treatment to landslides, Flora & fauna & road safety	15th June 2005
2	Mr. Amrit Singh	Add. Officer, State Aids Control Society, Sikkim, Gangtok	HIV/AIDS status of state, preventive and care activities in state, active NGO's in control activities	15th June 2005
3	Director	Directorate of Economics & Statistics, Govt. of Sikkim, Gangtok	Economic indicator in the State, Likely impacts of NESRP on economy of State	15th June 2005
4	Mr. T.R. Poudyal	PCCF cum Wildlife Warden, Directorate of Environment & PCCF office, Govt. of Sikkim, Gangtok	Scope of IEE, Impacts on Wildlife and forest, Wildlife status in state, flora & fauna species, Environmental aspects of hilly roads	15th June 2005
5	Mr. Manjeet Singh	Chief Conservator of Forests, Directorate of Environment & PCCF office, Govt. of Sikkim,	Scope of IEE, Impacts on Wildlife and forest, Wildlife status in state, flora & fauna species, Environmental aspects of hilly	15th June 2005

		Gangtok	roads	
6	Mr. C.S. Rao	Conservator of Forests (Working Plan), PCCF office, Gangtok	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project	15th June 2005
7	Mr. Gopal Pradhan	Sr. Scientist, State Pollution Control Board, Govt. of Sikkim, Gangtok	Status of Air, Water and Noise Quality in State, Available resources to monitor environmental quality, scope of IEE, sources of pollution in state	15th June 2005
8	Mr. Sharma	Team Leader, North Eastern Region Urban Infrastructure Development Study	Environmental Issues of urban areas in North Eastern Region, Solid Waste Management, Water Supply, Transportation facilities, Proposed project, Scope of IEE	10th June 2005
9	Chinpal Raunier	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005
10	Mr. Madhusudan Mitra	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005

254. Consultation with affected persons, local communities, village heads, shop owners were carried out through structured questionnaire (Attachment 2) during the field assessment in the month of October 2005. In total 12 stakeholders were interviewed formally and their view were recorded. The consultation is focussed on:

- General awareness in local communities about environmental quality in terms of quality of water in rivers, ponds, lakes, ground water, ambient air and noise quality and its sources.
- Presence of Archaeological / Historical sites, monuments in the project region and likely impacts
- Presence of endangered /rare species of flora and fauna and its locations in the project region
- Frequency of natural calamities / disasters in the region
- Cultural places along the project roads and likely impacts of proposed road development, etc.

Following table shows the details of consultation through questionnaire.

Date	Venue / Place	Participants	Remarks
7 th and 8 th October 2005	Villager - Melli Villages – Rolu Village – Rawangla Village – Nayabazar	Total – 12 participants Local villagers, affected persons, shop owners, formers, forest guards, community leaders,	

Results of Consultations

255. Most of the people interviewed strongly support the project. The people living in the entire project area expect the different project elements to facilitate transport, employment, boost economic development and thereby provide direct, or indirect, benefits to themselves.

256. Construction camps may, however, put stress on local resources and the infrastructure in nearby communities. In addition, local people raised construction-process related grievances with the workers. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as proper housing, health care clinics, proper drinking water and timely payment. The use of local labourers during the construction will, of course, increase benefits to local peoples and minimise these problems. Wherever possible, such people should be employed.



Fig 6.1: View of Community consultation

257. In order to access the existing environment and likely impacts on PAPs, an interview survey has been carried out. A sample of PAPs has been interviewed through a designed questionnaire. Precaution has been exercised during the survey to ensure that the sample interviewed is truly representative of the affected groups and the questions are worded so as not to generate a bias response. Fig 6.1 shows one such interview survey.

258. It is envisaged from the interview survey that there is increased environmental awareness among the people. It can also be seen from the table that more than 50 percent of the persons are in the opinion that environmental conditions of the area is good. About 60 to 65 percent of the people are agreed that the quality of air, water and noise in the area is good; whereas, about 30 percent respondent feel that the environmental quality is being deteriorated. Poor road condition and vehicular emissions are the major sources they feel responsible for this. In case of presence of archaeological / historical the responses are very few. The area has great cultural significance as 67 percent people say that there are places of cultural significance in the region. The area experiences minor natural disasters i.e. floods, earthquake etc. as it also envisaged that only 33 percent of respondent reported history of natural disaster. About 58 percent people indicated that there are rare and endangered species of fauna in the forests of the region. Overall, the general environmental conditions in the region are good and people have increased environmental awareness. Table 6.2 shows the result of public opinion survey carried out in the region.

Table 6.2: Peoples’ Perception about Environment Degradation

Sl. No.	Question asked about	No. of people interviewed	Positive response (%)	Negative response (%)	No response (%)
1.	Water quality of rivers, ponds, wells, and canals	12	67	33	0
2.	Noise quality of the area	12	58	33	8
3.	Air quality of the area	12	67	33	0
4.	Archaeological sites	12	17	67	17

5.	Natural disaster	12	33	58	8
6.	Rare species of animals and birds	12	58	25	17
7.	Cultural sites i.e. market, melas	12	67	25	8

Note: Positive response shows that the overall environmental scenario in the area is good and vice versa

Public Disclosure

259. The IEE report will be disclosed in the English language in the office of PWD, MDONER. The full reports will also be available to interested parties on request from office of PWD.

7. FINDINGS AND RECOMMENDATIONS

Findings: Positive and Negative Impacts

260. The following are the Consultants’ initial findings in regard to likely positive and negative impacts.

Positive Impacts:

- *the improved road:* will reduce travel times, fuel consumption and emissions from base traffic volumes;
- *drainage/erosion and landslide will be considerably improved:* this because of the provision of improved side drains, culverts and causeways;
- economic development and access will be stimulated; and
- significant archaeological/religious monuments will be unaffected in the entire project area, temple locations at km 8 and km 25.5 will be enhanced.

Negative Impacts

- most of the project road passes though the forest areas. Minor impacts on flora and fauna are expected. However, prior clearance from the forest department should be obtained before execution of work. Careful attention should be given to the incorporated mitigation works;
- unstable rock formations and soil types and high precipitation combine to make many areas land-slide prone – in these areas, appropriate measures should be taken to minimise the likelihood of slides;
- if possible, re-aligned sections should minimise the likelihood of land-slides and/or damage from land-slides: if land-slide prone areas cannot be avoided, bioengineering techniques should be used to stabilise slopes; and
- minor deteriorations in the present minimum levels of air, water and noise quality may be expected during construction - but this should be short-term and localised – in order to minimise the impacts, the mitigation measures recommended in Chapter 4 should be followed during detailed deign and construction.

- construction will require the uprooting of a large number of trees: this will negatively affect the ecological balance of the area - the impact is, however, expected to be short term, localised and temporary in nature;
- the large-scale uprooting of trees will also enhance soil erosion;
- the disposal of surface water may lead to destabilisation of downstream water courses and landscapes;
- bioengineering technique should be incorporated along all unstable slopes: native plants and shrubs should be planted, so that ecological condition of the area can also be improved.

Significant Impacts

261. Presently, the only “significant” impacts identified are:

- the likely impacts on forest resources i.e. flora and fauna between Melli and Nayabazar;
- occasionally disturbance from noise generated during construction of project road - leading to disruption in livestock and wildlife, and annoyance and to local residents.
- landslips and erosion: from the sections of the project road that are geologically unsound areas;
- cutting of trees and plants: due to widening of road;
- occasional high concentrations of airborne dust during construction of project road resulting in deposition and some damage to vegetation, crops and water quality of Rangit River :

262. To minimise the above negative impacts: the following suggested mitigation measures should be incorporated during detailed design and construction:

- the potential impacts on wildlife and forest resources should be confirmed with forest conservators staff during detailed design and if required additional measures should be incorporated;
- stockpiled sand and soil should be slightly wetted before loading, particularly in windy conditions - vehicles transporting sand and soil should be covered with a tarpaulin;
- blasting and the operation of heavy equipment should be performed only in daylight hours;
- stone crushing plants should be located away from population centres, drinking water intakes, cultivable lands and sensitive ecosystems - stone crushing equipment should be fitted with approved dust control devices and operated in accordance with manufacturer’s specifications;
- hazardous materials should not be stored near surface water - all used lubricants and oils should be collected and recycled or disposed off site and plastic sheeting should be placed under hazardous material storage areas to collect and retain leaks and spills;
- contaminated runoff from storage areas should be captured in ditches or ponds with an oil trap at the outlet. Contaminated and worn plastic sheeting should be packed into drums and disposed off site;
- use of fuel wood for heating bitumen should be discouraged: where heating is required, bitumen heaters should be used, fuelled by kerosene, diesel or gas - no bituminous material should be discharged into side drains;

- exposed slopes should be protected using conventional civil engineering structures in conjunction with bioengineering techniques: slopes should be planted with appropriate vegetation as soon as possible and using previously stockpiled topsoil.

Recommendations

263. Detailed design work has not yet been undertaken for the project road. Most likely, such work will be undertaken, prior to the award of contracts for construction. As part of these latter works, draft Contracts for Construction and the attached Bills of Quantities should incorporate the requirements for all the earlier-referred to environmentally-recommended working practices and for the Consultants' suggested measures designed to mitigate long-term post construction adverse impacts.

264. The following are deemed to be the most important initial recommendations designed to make the project environmentally sound and sustainable:

- the contractors should comply with all environmental mitigation measures specified in this IEE report;
- the first priority should be to reuse excess material in the construction works:
 - discarded materials that cannot be used in construction and fill should, if suitable, be used for bioengineering measures;
 - all other excess material should be disposed of in locations or landfills that will not promote instability and result in destruction of property, vegetation, irrigation and drinking water supply systems; and
 - extreme care should be taken to avoid disposal near wetlands or in areas that will inconvenience or deprive local residents of their livelihood;
- the contractors should consult with the Engineer-in-Charge before locating project offices, sheds and construction plants;
- camps should not be located near settlements, nor near drinking water supply intakes, nor to negatively impact local residents' access to drinking water;
- temporary construction facilities i.e. construction camp, workers camp, hot mix plant, batching plant, stone crusher must not be established in the stretch that passes through protected and reserved forests. Village forest management committees should be consulted while locating these facilities.
- camps should not be located in the vicinity of landslides nor in the forest areas;
- camps should be operated within a self-sufficient infrastructure and no trees should be cut for wood fuel;
- the PIU should ensure that the contractors identify environmentally safe locations for siting construction camps and other plants, machinery, vehicles and equipment, as well as locations for storage and disposal of wastes - both from the construction camps and from the sites;
- the contractors should prohibit employees from poaching wildlife and cutting trees - the contractor should be made responsible for the actions of their workers;
- the PIU should ensure that the regulatory permissions required for the construction equipment, vehicles and machinery have been obtained by the contractors and are valid at all times during the execution of the project;
- the PIU should ensure that pollution control equipment is installed on all equipment and

operating properly by the contractors;

- during haul operations, measures should be enforced to ensure environmental protection - namely regular sprinkling of water to suppress dust, use of spillage proof vehicles for hauling and regular maintenance of vehicles etc.
- contractors should be required to maintain construction sites, keep them clean and provide appropriate facilities for the storage of all waste until it is disposed;
- work forces should be provided with adequate water supply, septic tanks with soak pits, health care facilities and LPG to reduce their dependence on wood fuels;
- the contractors should ensure that the safety of workers and other site users is not compromised during construction;
- logging immediately above the improved roads should be restricted to reduce erosion/ landslides;
- where possible, quarrying along the road and close to the Right of Way should be restricted;
- where possible, quarry sites should be located away from population centres, drinking water intakes and streams, cultivable lands and natural drainage systems;
- where possible, quarries should be located in structurally stable areas even if some distance from construction activities;
- no bituminous material should be discharged into side drains;
- nearby trees, vegetation and private property should be protected during bitumen spraying work;
- bitumen drums should be stored in designated locations and not scattered along the road;
- borrow areas should not be established in ecologically sensitive areas;
- borrow areas should be located away from the road and the steeper hill slopes and settlements facing the road - this so as to minimise visual impacts;
- vehicles delivering loose and fine materials should be covered to reduce spills;
- particular care/attention should be given to adequate drainage;
- at construction sites within 500 metres of settlements, noisy operations should be stopped between 22:00 to 06:00 hrs,
- care should be taken to avoid sacred and religious sites;
- bioengineering techniques should be employed for stabilising soils and for reclaiming both quarry and dump sites;
- cut and fill methods of construction should be employed to the extent possible, and using excavators; and
- loss of trees should be compensated by planting trees on available space in consultation with forest department;
- in case of loss of land and structures, compensation should be paid in accordance with the government norms and affected people should be rehabilitated as per Resettlement Plan; and
- the Environmental Management and Monitoring Plan provided in chapter 5 may be

updated after the detailed engineering design.

8. CONCLUSIONS

General

265. On the basis of (i) available information, (ii) field visits over the entire length of the project road, (iii) discussions with the project sponsors; (iv) other discussions amongst the project team, NGOs, local people and various governmental officials, it has been concluded that overall:

- all elements of the projects will be beneficial;
- all negative impacts, during and post construction, including those deemed “significant” can be properly mitigated; and
- no comprehensive, broad, diverse or irreversible adverse impacts have been identified.

266. For all works, the PWD will, however, have to obtain clearances from the Forest department and Pollution Control Board. The required procedures have, however, been documented.

267. Environmental Management Plan (EMP) are also essential requirements for each of the elements of this project. This plan may be modified during detailed engineering design as necessary. During construction, environmental management cell is also recommended. The function of this officer will be to ensure the implementation of both the recommendations made in this IEE and the proposed EMP. Suggestions from the EMP should also be incorporated into the design and construction process.

268. The most significant negative impacts that have been identified, and that will need to be the focus of the clearance procedures, are indicated below.

Project Road Specific

269. The envisaged impact on wild-life and flora in the forest area and the appropriateness of the mitigation measures described in this report will, of course, also need to be confirmed with forest authorities during detailed design.

270. Landslides and the measures that can be used to mitigate their impact and the locations of quarries are the most important other major issues that will need to be addressed. These matters can, of course, also only be finalised during detailed design.

271. Soil erosion due to the cutting of hill slopes and trees, may create some ecological disturbances and there will be some air and noise pollution due to construction equipments and machineries etc. These impacts will, however, be localised and mainly temporary and will mainly occur during construction. The incorporation of the Consultants’ recommendations in regard to the proper care to be taken during construction should cause these disturbances to become insignificant.

272. Landslides and the measures that can be used to mitigate their impact and the locations of quarries are the other major issues that will need to be addressed. These matters can, of course, also only be finalised during detailed design.

Attachment 1

Rapid Environmental Assessment (REA) Checklist - SK 01 Section

Country/Project Title: **INDIA: North Eastern State Roads Project**
 Sector Division: **Roads and Highways**
 Road Section: **SK-01: Nayabazar – Melli sections in the State of Sikkim - 27 km**

Screening questions	Yes	No	Remarks
A. Project siting			
Is the project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural heritage site		X	
▪ Protected area	X		The project road is passing through the reserved forest area of Sikkim south forest division. A detail assessment and specific mitigation measures with respect to flora and fauna shall be worked out and shall be followed strictly.
▪ Wetland		X	
▪ Mangrove		X	
▪ Estuarine		X	
▪ Buffer zone of protected area		X	
▪ Special area for protecting biodiversity		X	
B. Potential environmental impacts			
Will the project cause...			
Encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?	X		<p>There is temple of Mata ji at Rolu exist adjacent to road. It has cultural significance for tourists and local villagers. Due importance shall be given and incorporation of suitable mitigation measures in the EMP shall avoid any adverse impact on cultural value of the people.</p> <p>The project road is running along the river Rangit on one side and forest hillocks on other side. It is a landslide prone alignment. Impacts of landslide, of road embankments, cuts and fills are anticipated.</p> <p>Proper management plan for will be required during construction to sustain the quarries.</p>

Screening questions	Yes	No	Remarks
Encroachment on precious ecology (e.g. Sensitive or protected areas)?		X	
Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?	X		Project road is running along the perennial river rangit though out its length. Impacts on surface hydrology are expected during construction. Controlled construction activities will ensure sediment discharge into streams to the extent.
Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?	X		Adverse impacts due to silt runoff are expected. During construction period suitable mitigation measures will be required to control the silt runoff. Adequate sanitary facilities and drainage in the workers camps will help to avoid this possibility. As the construction activity in this project will not contain any harmful ingredients, no impact on surface water quality is anticipated.
Increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels.
Noise and vibration due to blasting and other civil works?	X		Short term minor impact may occur during constriction period, suitable mitigation measures will be required to minimize the adverse effects
Dislocation or involuntary resettlement of people		X	
Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		X	Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
Hazardous driving conditions where construction interferes with pre-existing roads?		X	To minimized the impact suitable traffic management plan will be required
Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?	X		Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility. Workers will be made aware about communicable diseases
Creation of temporary breeding habitats for mosquito vectors of disease?		X	

Screening questions	Yes	No	Remarks
Dislocation and compulsory resettlement of people living in right-of-way?		X	No encroachment
Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?		X	Adoption of suitable traffic signage system at sensitive places will reduce such possibility.
Increased noise and air pollution resulting from traffic volume?		X	Due to improvement in riding quality & comfort in driving due to unidirectional traffic such pollution will be reduced. Mitigation measures along with monitoring plan will be required
Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?	X		Controlled construction activities and proper drainage system will reduce this possibility.

After reviewing the answers above the Mission Leader and Environment Specialist agree that the project.

- should be categorized as an A project.
- should be categorized as a B project.**
- should be categorized as a B project in an environmentally sensitive area.
- should be categorized as a C project.
- should be categorized as an A/B project because (give reason) .
- requires additional information for classification. Therefore,
 - o an Environment Specialist should be involved in the PPTA Fact-finding Mission.
 - o the Mission Leader should gather additional information during the PPTA Fact-finding Mission.

Project Site Description

The proposed road section (Nayabazar to Malli) is a State Highway measuring 27 km in length located at Sikkim South District. The topography of the project area is hilly. It passes entirely through hillock in one side and river valley (perennial river Rangit) on other side. The land use is completely forest type. It is situated within the Reserved Forest area of Sikkim South Forest Division. Project area is covered with greenery having a vegetation density of about 0.4 to 0.5. The existing condition of the road is moterable with average carriageway width of 4.0 to 5.0m. The project area is high rainfall zone. The soil is poor and unstable which leads to frequent landslides and soil erosion mainly in rainy season. Cases of landslide were observed during site visits. There are no historical places in the project area; however, two temples exist near to existing carriageway. Temple of goddess Durga at chainage Km 10 i.e. Rolu village has the great cultural significance for local residents of hillocks and the travelers. There is no major settlement in between the project road. Santhang (Nayabazar is the only town at the start of the project road. There is no encroachment on the road and available ROW is 27 ft either side of road.

ENVIRONMENTAL SURVEY**Practical View of the Community about Environmental Scenario**

- | Km: | From- | To- | Team No- |
|------------|--------------|------------|-----------------|
|------------|--------------|------------|-----------------|
- Q.1- What do you think about the quality of water from ponds, wells, rivers or canal in your area?
Good
Satisfactory
Polluted
- Q.2- If the quality of water is polluted /poor then in your opinion what are its reasons?

Ingress of industrial effluent in the source
Sewage leakage/discharge in the source
Animal water holes
Rain water storage
Others, please specify
- Q.3- Is the noise level in your area disturbing / irritating?
Yes
No
- Q.4- If the Noise level is disturbing / irritating then in your opinion, it is due to
Vicinity of industry
Vehicular Traffic
Construction work
Work shop / scooter repair shop
Aviation zone
Others, please specify
- Q.5- How, in your opinion, the noise level can be brought to satisfactory level in your area.
- Q.6- Is the quality of air, which you breath is healthy and clean
Yes
No
- Q.7- If not, then what are the reasons ?
Due to vehicular pollution
Due to Industrial pollution

Due to poor sanitation
 Due to tanneries in the vicinity
 Due to domestic smoke
 Others , please specify

Q.8- Are there any places of Archeological / historical importance in your vicinity, if yes, please give details

Q.9- Is there any previous history of natural disaster viz. Floods, Drought, earthquake etc. in your area, if so give details with year of occurrence and damage.

	Location:	Year:
Flood	Yes / No	
Drought	Yes / No	
Earthquake	Yes / No	

Q.10- Are any rare species of Birds, Animals etc. visiting your area during winter, if so please give details and locations

Name of the Species	Location

Q.11- Do you have any market place, melas etc. in your areas and it is likely to be affected by proposed expansion of road, if yes then which site do you suggest for relocation the markets.

Q.12- Do you have any suggestion to improve the Environment w.r.t. Air, Water and Noise in your area.

Particular	Name	Sign/Date
Recorder		
Scrutinizer		