National Highways Authority of India
(Ministry of Road Transport & Highways)
Government of India

Consultancy Services for Preparation of Detailed Project Report for Rehabilitation and Upgradation of National Highway Stretches under NHDP-IVB, Group-B (Package No. UP/DPR/NHDP-IV/08




Draft Detailed Project Report
For
Haridwar - Kashipur Section of NH-74
Volume IVA:
Environmental Impact Assessment Report

September 2012

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ABBREVIATIONS

Abbreviations	Full Form	Abbreviations	Full Form
AAQ	Ambient Air Quality	LHS	Left Hand Side
AAQMS	Ambient Air Quality Monitoring Station	NHAI	National Highways authority of India
MOEF	Ministry of Environment and Forests	MoRTH	Ministry of Road Transport and Highways
UKPCB	Uttarakhand State Pollution Control Board	NAAQS	National Ambient Air Quality Standards
UPPCB	Uttar Pradesh State Pollution Control Board		
MDR	Major District Road	NGO	Non Governmental Organizations'
WB	World Bank	NH	National Highway
BPL	Below Poverty Line	NOC	No-objection Certificate
CE	Chief Engineer	NO_X	Oxides of Nitrogen
CD	Cross Drainage Works	OP	Operational Policies
ODR	Other District Roads	PAF	Project Affected Family
CO	Carbon Monoxide	PAH	Project Affected Household
CoI	Corridor of Impact	PAP	Project Affected Person
CPCB	Central Pollution Control Board	PCC	Project Co-ordinating Consultants
DE	Divisional Engineer	PD	Project Director
DFO	Divisional Forest Officer	PF	Protected Forest
DR	Drains	PT	Plain Terrain
DLC	District Level Committee	PWD	Public Works Department
PIU	Project Implementation Unit	R&R	Resettlement and Rehabilitation
EIA	Environmental Impact Assessment	RAP	Resettlement Action Plan
RAS	Rapid Assessment Survey	RF	Reserved Forest
EMP	Environmental Management Plan	RHS	Right Hand Side
EPM	Enhanced Periodic Maintenance	ROW	Right of Way
RPM	Respiratory Particulate Matter	SC	Supervision Consultant
GEMS	Global Environmental Monitoring System	SA	Social Assessment
GO	Government Order	SH	State Highways
GoI	Government of India	SO_2	Sulphur Dioxide
GoK	Government of Karnataka	SOS	Strategic Options Study
GWQMS	Ground Water Quality Monitoring Station	SWQMS	Surface Water Quality Monitoring Station
HC	Hydrocarbons	SPM	Suspended Particulate Matter
HD	Highways Department	SPCB	State Pollution Control Board
HQ	Head Quarters	TDS	Total Dissolved Solids
IMO	Indian Meteorological Organization	JD	Joint Director
IRC	Indian Roads Congress	LAO	Land Acquisition Officer
IS	Indian Standard		

CHAPTER - 1

INTRODUCTION

1.1 INTRODUCTION

National Highways Authority of India (NHAI) has been entrusted by the Ministry of Road Transport and Highways, Government of India with the task of the development of selected stretches of National Highways into 2-lane with paved shoulders configuration with provision of capacity augmentation. The project is being prepared for implementation under the NHDP, Phase-IVB programme on BOT Mode / EPC Mode.

National Highways Authority of India (NHAI) has taken up the task of developing various National Highway Corridors where the intensity of traffic has increased significantly requiring, augmentation of capacity for safe and efficient movement of traffic. Golden Quadrilateral connecting four metros namely Delhi, Mumbai, Chennai and Kolkata and North-South and East-West Corridor connecting Srinagar (Jammu & Kashmir) to Kanyakumari (Tamil Nadu) and Silchar (Assam) to Porbander (Gujarat) respectively for a total length of about 13,000 km has already been taken up.

NHAI has been entrusted to implement the development, maintenance and management of National Highways under NHDP, Phase-IVB Programme for rehabilitation and upgrading of National highways to 4 lanes standards. The NHAI of India has accordingly taken up detailed project preparation of NH-74 Haridwar to Kashipur.

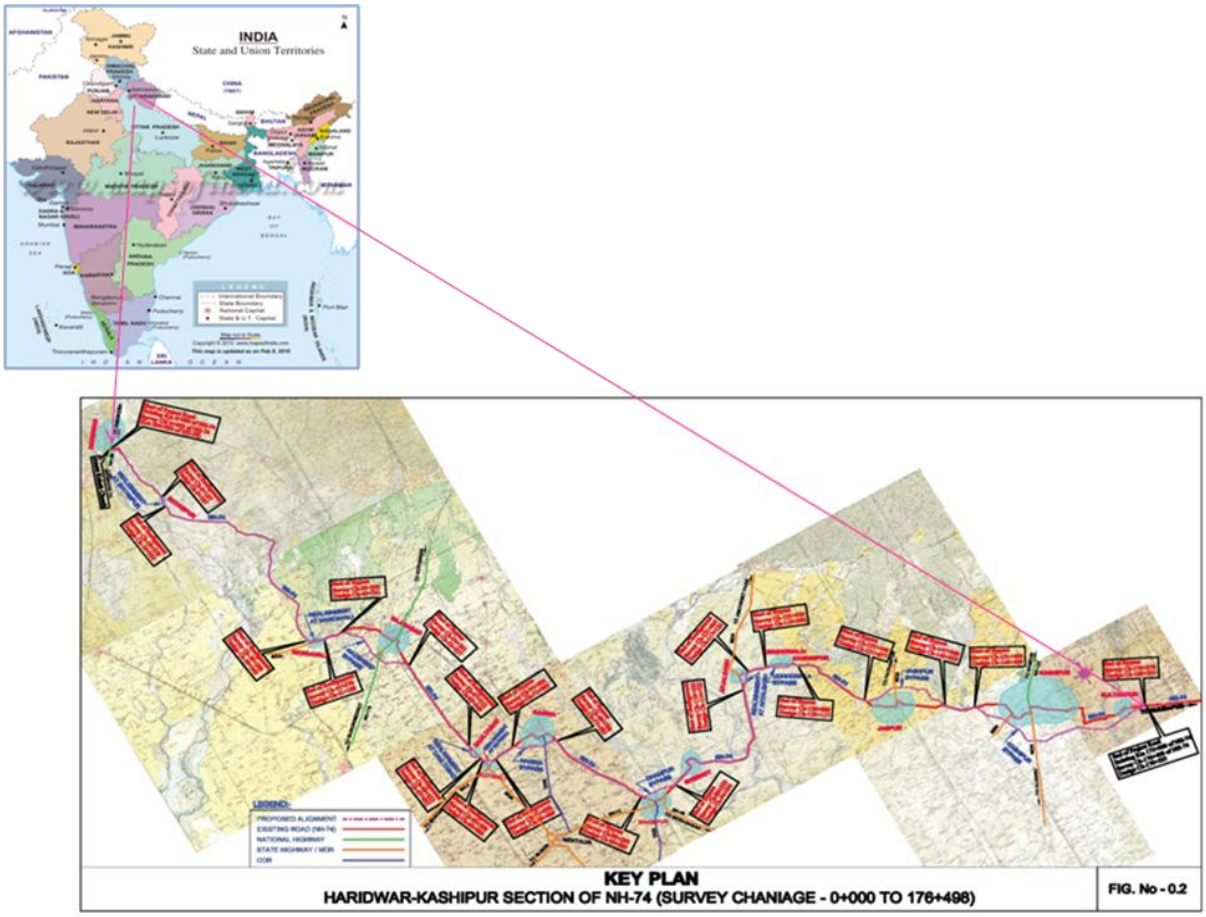
1.2 PROJECT ROAD & AREA

This section of project road is situated partially in Haridwar & Udham Singh Nagar districts of Uttarakhand and partially Bijnor district of UP. The stretch of road from km 0.000 to km 30.000 and km 132.000 to km 175.000 of NH-74 lies in Haridwar & Udham Singh Nagar districts of Uttarakhand respectively. The remaining stretch of NH-74 from km 30.000 to km 132.000 lies in Bijnor district of UP. Haridwar is located at 29°58' N and 78°09' E, Najibabad is located at 29°40'N and 78°20'E and the Kashipur is located at 29°15' N and 79°00' E.The project road predominantly passes through the rural area, except the towns like Najibabad, Kotwali, Nagina, Dhampur, Afjalgarh, Jaspur and Kashipur. There are also small commercial/residential built-up areas in location like Bhagguwala, Mandawali, Akbarabad, Sherkot, Udhowala, Kunda, Missarwala, Sarwarkhera, Hempur Ismail and Sultanpur Patti along the project road. In Najibabad, Kotwali, Nagina, Dhampur, Udhowala, Afjalgarh, Jaspur and Kashipur places, congestion was observed for a substantial length along the road. Particularly Najibabad, Dhampur, Udhowala, Jaspur and Kashipur are highly congested places. Apart from these locations there are also few settlements locations, where there is a bottleneck for a very small length. Elsewhere there is no major congested area, except few houses/building may be close to the existing road. There is no industrial area along the road. Few sugar/rice mills were observed along the road. However these mills are at sufficient distance from the road. Brick Kiln was also observed along the road

near all the important towns. Initial 31 km length of road passes predominantly through Reserve Forest area. Location of the project was shown in **Figure 1.0.**

The total length of the existing alignment of the section of project road is 175.000 km as per existing kilometer stone & 176.498 km as per Survey Chainage. As per Design Chainage, the total length of proposed/approved alignment of project road is 170.535 km. The project road is proposed to be developed as 4-lane divided road configuration for the entire length of the project road.

Figure 1.1 Location Map of Project Corridor



The project road connecting Haridwar-Kashipur Road section does not pass through any eco-sensitive areas. However, for a length of about 18.2 kms on RHS and 23.5 kms on LHS the stretch is passing through Shyampur and Chidiyanpur Reserve Forest, all along the project Alignment. Though, these are not legally defined eco-sensitive areas as per GOI regulations, the GOI regulations will not be applicable to this. The World Bank Operational Policy 4.01 on environmental and Natural habitats OP 4.04 applies to this corridor.

1.3 SCOPE OF STUDY

1.3.1 Overall Scope of Work

Ministry of Environment and Forest (MoEF) has made prior Environmental clearance (EC) for Highways among others mandatory through its notification dated 14th September 2006 and as amended on 1st December 2009. Accordingly NHAI had applied for prior EC and presented their case through its environmental consultants before Expert Appraisal committee of MoEF on March 6, 2012 for scoping and terms of reference (TOR). MoEF had issued TOR to carryout Environment Impact assessment (EIA) for this project in the month of May 2012. Copy of the TOR is presented as **Annexure 1.1** in this report. This report presents Environment Impacts, Remedial measures and Environmental Management plan during consultation and operation period of the project.

M/s. SAI Consulting Engineers Pvt.Ltd. is the technical consultants for this project. The technical consultants have prepared DPR inter-alia includes Detailed Project Report would inter-alia include detailed highway design, design of pavement and overlay with options for flexible or rigid pavements, design of bridges and cross drainage structures and grade separated structures, design of service roads, quantities of various items, detailed working drawings, detailed cost estimates, economic and financial viability analysis, environmental and social feasibility, social and environmental action plans as appropriate and documents required for tendering the project on commercial basis for international / local competitive bidding.

1.3.2 Environmental Impact Assessment in the Project

The EIA has been included in project preparation to streamline Environmental issues in project design, constructional and operational stages. The scope of the Environmental Assessment (EA) as envisaged in the Terms of Reference (ToR) includes the delivery of a Technical Feasibility Report, which shall contain Environmental Screening and Preliminary Environmental Assessment of the project. The ToR also calls for a DPR report which includes Volume IVA: Environment Impact Assessment along with Environmental Management Plan. This report presents the Environmental Assessment of the project and the EMP for the anticipated impacts.

1.4 APPROACH TO EIA

The study methodology for the DPR stage EIA employs a simplistic approach and analyses of the environmental issues identified during the feasibility stage. The sections below details out the methodology adopted for the assessment of the environment for the project.

1.4.1 Review of Applicable Environmental Regulations

Applicability of various environmental regulations and guidelines was reviewed for the project and its allied activities.

1.4.2 Assessment of Baseline Environmental Profile

The baseline conditions of the project area were studied. Ambient air & noise, ground and surface water samples were monitored at various locations identified along the corridor. The

monitoring and analysis for each component were carried out as per MoEF and CPCB guidelines. The results of the Monitoring were compared with the relevant national standards.

As part of the baseline environmental profile, a detailed tree inventory along the RoW was carried out based on their chainage, species, girth and distance from the carriageway. All trees with a girths size more than 30cm that are falling within the proposed ROW were noted. In order to quantify the impacts of the project road on various receptors a survey was carried out. The receptors included educational institutes, hospitals, cultural & religious properties and community properties.

1.4.3 Consultations

Consultations with community members, PAPs, Focus Group Discussions with teachers, women groups and others and stakeholder were carried out. The feedback generated through these meetings has been incorporated as far as possible in the design and construction of the road. The consultation process shall continue even during the implementation stage to gauge the general opinion.

1.4.4 Assessment of Impacts

Assessments of general potential impacts were made based on the baseline data. Assessment of the environmental impacts was carried out to ascertain that the direct and indirect impacts likely to be induced due to the project are being adequately identified and addressed. The general impacts are land acquisition and allied impacts on society, dust and air pollution due to removal of structures, trees and vegetation, quarrying and other construction activities; noise pollution due to construction, loss of flora and its impacts on the ecology and impacts on water resources.

1.4.5 Assessment of Alternatives

Various project alternatives including with and without scenarios have been assessed during the project. The assessment of alternatives included that of realignments, widening options, service roads, noise barriers in sensitive areas etc. The chapter on Analysis of Alternatives elaborates the process.

1.4.6 Mitigations and Enhancement Measures

All affirmative actions not only to avoid and deter but also to capitalize on the opportunities provided by the project in order to improve the environmental conditions have been deliberated. The various mitigation and enhancement measures proposed have been included in the environmental budget and also in the technical specifications for the aid of the contractor. Based on their applicability, both general and case specific measures were incorporated as follows:

- **Generic measures:** To avoid or mitigate impacts on environmental components, general mitigation measures were identified based on the characteristic features.
- **Site Specific:** At representative sensitive locations, site-specific mitigation measures and enhancement designs have been formulated.

1.4.7 Environmental Management Action Plans

The EMP details out the implementation of the proposed mitigation and enhancement measures. A detailed study of the following has been carried out during the PR stage:

- Prediction and addressal of impacts on the various environmental components;
- Site specific designs for the mitigation measures provided;
- Site specific enhancement designs for water bodies, cattle hats etc;
- Traffic management plans during construction; and
- Monitoring mechanisms and indicators during construction and operation periods.

1.5 STRUCTURE OF THE REPORT

The EIA report excluding the first chapter has been structured into the following chapters:

Chapter - 1 Introduction describes the existing features of the project location, features of the alignment and also discusses the various proposed improvement programmes along the corridor;

Chapter - 2 Project Description describes the existing features and also discusses the various proposed Improvement programmes along the corridor;

Chapter - 3 Analysis of Alternatives (Technologies) describes about the various alternatives of site and technologies etc.

Chapter - 4 Description of Environment describes the entire picture of the existing environmental set up of the project;

Chapter - 5 Anticipated Environmental Impact and Mitigation Measures describes about the anticipated Environment impacts and mitigation measures;

Chapter - 6 Environmental Monitoring Programme identifies and assesses the potential impacts on each of the environmental components due to the proposed project development; gives a brief about the present implementation arrangements for environmental components of the project, compliance monitoring and reporting mechanisms;

Chapter - 7 Additional studies discusses the various additional studies if applicable to the project.

Chapter - 8 Project Benefits describes about the benefits from the project to the local people and the region etc.

Chapter - 9 Environmental cost Benefit Analysis deals with the environmental and economical budget for the implementation of the project

Chapter - 10 Environmental Management Plan details both the generic and specific EMPs for the project road.

Chapter - 11 Summary & Conclusions describes about the overall scenario of the project based on the benefits and adverse effects.

Finalization of ToR for rehabilitation and upgradation from 2- lane to 4 lane of Hardwar- Kashipur section of NH-74 in the State of Uttarakhand and Uttar Pradesh by M/s NHAI [F.No. 10-127/2011-IAIII]

As presented by the project proponent the proposal is for rehabilitation and upgradation from 2- lane to 4 lane of Hardwar- Kashipur section of NH-74 in the State of Uttarakhand and Uttar Pradesh Project road starts at km 0.000 of NH74 at the junction of NH74 & NH58 (km 204.300 of NH58) at Haridwar and ends at km 175.000 of NH74, near Jagannathpur Village under Bajpur Tahsil.Covering about 175km length. The project road falls in Haridwar and Udham singh Nagar Districts of Uttarakhand state and Bijnor District of Uttar Pradesh state. The settlements are; Bhaguwala, Mandawali, Najibabad, Kotwali, Nagina, Dhampur, Afjalgarh, Jaspur, Kashipur, Sultanpur and Jagannathpur**.** The land use pattern within 10km on either side of the project area is predominantly agriculture and Built-up and also partly Forest. Land use pattern of Proposed ROW is also similar in nature. The project does not pass through National park/sanctuary/wild life corridor/eco-sensitive zone. Existing RoW of the project road on an average at varying widths is about 1050m. The proposed RoW is varying from 25-60m. Approximately 1118.32ha land proposed to be acquired for improvement and widening of the road out of which, agriculture, barren and Built up is about 1042.585 ha. and Reserve forest land is about 75.735 ha.

The project road has existing 17 major bridges and 28 minor bridges and 273 pipe/slab/arch/box culverts. All the existing bridges and culverts are proposed to be improved.additional 8 minor bridges and 63 pipe/slab/Box culverts are proposed to be newly constructed. 6 Bypasses has been proposed at Najibabad(from km 42.598 to km 54.053),at Nagina(km 73.362 to km 79.808), at Dhampur (km 92.265 to km 97.005), at Udhhowala (km 122.594 to km 126.335,at Jaspur (km 135.487 to km 145.935),and at Kashipur (km 149.445 to km 174.880). There are 4 rail-road level crossings in this project. 3 ROB?s, 1 flyover, 12 vehicular under passes, 14 pedestrian/cattle under passes and 2 pedestrian foot over bridges are proposed. There are 48 junctions in the Existing Road which will be made 37 junctions in proposed improvement. Service Road has been proposed about 17.859 km length at urban/semi urban areas at 7 no of locations. Flyash source is not available within reach of the Project road. Footpaths have been proposed at built up locations. Busbays have been provided at 52 locations on both sides. Truck lay byes have been proposed at 4 locations on both sides at frequency of 15kms. One trauma centre (medical facilities) and ambulance facilities are proposed at 3 proposed toll plazas. There would be about 14000 project affected persons due to improvement of project road. The entitled persons shall be compensated as per National Highways Act, 1956. Metallic crash barrier guard wall has been proposed at about 19.631km. High mass lights at about 7 locations. About 700 kld of water is proposed to be used (90% from surface water source& 10% from Groundwater source). App. 68,791 trees proposed to be felled for improvement of project road. Against which about 2, 06,373 trees shall be planted as avenue plantation as per IRC SP-21, 2009. The approximate cost of Environmental Management works to be about Rs. 9.38Crores. The cost of resettlement and compensation worked out to be about Rs. 49.52Crores. The cost of land acquisition workout to be about 671.89 Crores. The total civil cost of the project is about Rs. 1325.162 Crores.

During the discussions, the Committee finalized the following TOR for further study:

(i) The proposal indicates the acquisition of 75.735 ha forest land. Necessary stage? I forestry clearance shall be obtained as per OM dated 31.03.2011 and submitted along with final EIA report.

(ii) It is indicated that 68791 nos. trees are proposed to be cut, the information should be provided about their species and whether it also involved any protected or endangered species. Necessary green belt shall be provided on both side of the highway with proper central verge and cost provision should be made for regular maintenance.

(iii) The projects is passing through an Elephant Corridor a map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon should be furnished at the stage of EC. An underpass in Elephant corridor shall be provided.

(iv) Submit the details of the road safety audit and plans for meeting the IRC safety requirements.

(v) The additional ToR and General Guidelines as per the annexure-I and Annexure-II respectively to this Minutes shall also be considered for preparation of EIA/EMP.

(vi) Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website (http://moef.nic.in/Manual/ Highways).

Public hearing to be conducted for the project as per provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan.

A detailed draft EIA/EMP report should be prepared as per the above additional TOR and should be submitted to the Ministry as per the Notification.

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A detailed draft EIA/EMP report should be prepared as per the above additional TOR and should be submitted to the Ministry as per the Notification.

Annexure-I

(i) Any litigation(s) pending against the proposed project and/or any directions or orders passed by any court of law/any statutory authority against the project is to be detailed out.

(ii) Submit detailed alignment plan, with details such as nature of terrain (plain, rolling, hilly), land use pattern, habitation, cropping pattern, forest area, environmentally sensitive places, mangroves, notified industrial areas, sand dunes, sea, river, lake, details of villages, teshils, districts and states, latitude and longitude for important locations falling on the alignment by employing remote sensing techniques followed by ground truthing and also through secondary data sources.

(iii) Describe various alternatives considered, procedures and criteria adopted for selection of the final alternative with reasons.

(iv) Submit Land use map of the study area to a scale of 1: 25,000 based on recent satellite imagery delineating the crop lands (both single and double crop), agricultural plantations, fallow lands, waste lands, water bodies, built-up areas, forest area and other surface features such as railway tracks, ports, airports, roads, and major industries etc. and submit a detailed ground surveyed map on 1:2000 scale showing the existing features falling within the right of way namely trees, structures including archeological & religious, monuments etc. if any.

(v) If the proposed route is passing through any hilly area, examine and submit the stability of slopes, if the proposed road is to pass through cutting or embankment / control of soil erosion from embankment.

(vi) If the proposed route involves tunneling, the details of the tunnel and locations of tunneling with geological structural fraction should be provided. In case the road passes through a flood plain of the river, the details of micro drainage, flood passages and information on flood periodicity at least of last 50 years in the area should be examined.

(vii) The projects is located within 10km. of the sanctuary a map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon should be furnished at the stage of EC.

(viii) Study regarding the Animal bypasses / underpasses etc. across the habitation areas shall be carried out. Adequate cattle passes for the movement of agriculture material shall be provided at the stretches passing through habitation areas.

(ix) If the proposed route is passing through a city or town, with houses and human habitation on the either side of the road, the necessity for provision of bypasses/diversions/under passes shall be examined and submitted. The proposal should also indicate the location of wayside amenities, which should include petrol station/service centre, rest areas including public conveyance, etc.

(x) Submit details about measures taken for the pedestrian safety and construction of underpasses and foot-over bridges along with flyovers and interchanges.

(xi) Assess whether there is a possibility that the proposed project will adversely affect road traffic in the surrounding areas (e.g. by causing increases in traffic congestion and traffic accidents).

(xii) Examine and submit the details of use of fly ash in the road construction, if the project road is located within the 100 km from the Thermal Power Plant.

(xiii) Examine and submit the details of sand quarry, borrow area and rehabilitation.

(xiv) Climate and meteorology (max and min temperature, relative humidity, rainfall, frequency of tropical cyclone and snow fall); the nearest IMD meteorological station from which climatological data have been obtained to be indicated.

(xv) The air quality monitoring should be carried out as per the new notification issued on 16th November, 2009.

(xvi) Identify project activities during construction and operation phases, which will affect the noise levels and the potential for increased noise resulting from this project. Discuss the effect of noise levels on near by habitation during the construction and operational phases of the proposed highway. Identify noise reduction measures and traffic management strategies to be deployed for reducing the negative impact if any. Prediction of noise levels should be done by using mathematical modeling at different representative locations.

(xvii) Examine the impact during construction activities due to generation of fugitive dust from crusher units, air emissions from hot mix plants and vehicles used for transportation of materials and prediction of impact on ambient air quality using appropriate mathematical model, description of model, input requirement and reference of derivation, distribution of major pollutants and presentation in tabular form for easy interpretation shall be carried out.

(xviii) Also examine and submit the details about the protection to existing habitations from dust, noise, odour etc. during construction stage.

(xix) If the proposed route involves cutting of earth, the details of area to be cut, depth of cut, locations, soil type, volume and quantity of earth and other materials to be removed with location of disposal/ dump site along with necessary permission.

(xx) If the proposed route is passing through low lying areas, details of fill materials and initial and final levels after filling above MSL, should be examined and submit.

(xxi) Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality likely impacts on them due to the project.

(xxii) Examine and submit details of water quantity required and source of water including water requirement during the construction stage with supporting data and also classification of ground water based on the CGWA classification.

(xxiii) Examine and submit the details of measures taken during constructions of bridges across river/canal/major or minor drains keeping in view the flooding of the rivers and the life span of the existing bridges. Provision of speed breakers, safety signals, service lanes and foot paths should be examined at appropriate locations through out the proposed road to avoid the accidents.

(xxiv) If there will be any change in the drainage pattern after the proposed activity, details of changes shall be examined and submitted.

(xxv) Rain water harvesting pit should be at least 3 - 5 m. above the highest ground water table. Provision shall be made for oil and grease removal from surface runoff.

(xxvi) If there is a possibility that the construction/widening of road will cause impact such as destruction of forest, poaching, reductions in wetland areas, if so, examine the impact and submit details.

(xxvii) Submit the details of road safety, signage, service roads, vehicular under passes, accident prone zone and the mitigation measures.

(xxviii) IRC guidelines shall be followed for widening & upgradation of road.

(xxix) Submit details of social impact assessment due to the proposed construction of road.

(xxx) Examine road design standards, safety equipment specifications and Management System training to ensure that design details take account of safety concerns and submit the traffic management plan.

(xxxi) Accident data and geographic distribution should be reviewed and analyzed to predict and identify trends ? incase of expansion of the existing highway and provide Post accident emergency assistance and medical care to accident victims.

(xxxii) If the proposed project involves any land reclamation, details to be provided for which activity land to reclaim and the area of land to be reclaimed.

(xxxiii) Details of the properties, houses, businesses etc. activities likely to be effected by land acquisition and their financial loses annually.

(xxxiv) Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment and rehabilitation of the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific

(xxxv) Submit details of Corporate Social Responsibility. Necessary provisions should be made in the budget.

(xxxvi) Estimated cost of the project including environmental monitoring cost and funding agencies, whether governmental or on the basis of BOT etc and provide details of budget provisions (capital & recurring) for the project specific R&R Plan.

(xxxvii) Submit environmental management and monitoring plan for all phases of the project viz. construction and operation.

Annexure-II

General Guidelines

(i) The EIA document shall be printed on both sides, as for as possible.

(ii) The status of accreditation of the EIA consultant with NABET/QCI shall be specifically mentioned. The consultant shall certify that his accreditation is for the sector for which this EIA is prepared.

(iii) On the front page of EIA/EMP reports, the name of the consultant/consultancy firm along with their complete details including their accreditation, if any shall be indicated. The consultant while submitting the EIA/EMP report shall give an undertaking to the effect that the prescribed TORs (TOR proposed by the project proponent and additional TOR given by the MoEF) have been complied with and the data submitted is factually correct (Refer MoEF office memorandum dated 4th August, 2009).

(iv) While submitting the EIA/EMP reports, the name of the experts associated with/involved in the preparation of these reports and the laboratories through which the samples have been got analysed should be stated in the report. It shall clearly be indicated whether these laboratories are approved under the Environment (Protection) Act, 1986 and the rules made there under (Please refer MoEF office memorandum dated 4th August, 2009). The project leader of the EIA study shall also be mentioned.

(v) All the TOR points as presented before the Expert Appraisal Committee (EAC) shall be covered.

CHAPTER - 2

PROJECT DESCRIPTION

This Chapter describes the project and discusses the various improvement measures proposed as part of the project. The project description includes details of existing condition of project road, existing and proposed traffic, pavement conditions, road inventory, safety and community facilities.

2.1 EXISTING ROAD FEATURES

2.1.1 Alignment

The existing alignment of the project road starts at km 0.000 of NH74 at the junction of NH74 & NH58 at km 204.300 of NH58 at Haridwar and ends at km 175.000 of NH74 near Jagannathpur Village under Bajpur Tahsil. This section of project road passes through the towns of Bhaguwala, Mandawali, Najibabad, Kotwali, Nagina, Dhampur, Afjalgarh, Jaspur, Kashipur and Sultanpur Patti. The stretch of road from km 0.000 to km 30.000 and km 132.000 to km 170.535 of NH74 lies in Haridwar & Udham Singh Nagar districts of Uttarakhand respectively. The remaining stretch of NH74 from km 30.000 to km 132.000 lies in Bijnor district of UP.

The total length of the existing alignment of the section of project road is 175.000 km as per existing kilometer stone & 176.498 km as per Survey Chainage.

2.1.2 Terrain

The entire stretch of project road lies predominantly on plain terrain, except some stretches on hilly & rolling terrain between km 0.000 to km 13.000. The road lies on hilly terrain from km 1.300 to km 3.500, km 3.500 to km 5.500 lies on rolling terrain and km 5.500 km 13.000 lies predominantly on rolling terrain on left side & plain terrain on right side, except few stretches on hilly terrain on left side. From km 13.000 to km 175.000, the stretch of this section of project road lies entirely on plain terrain, except few stretches on rolling terrain between km 13.000 to km 21.000.

2.1.3 Road Inventory

Road inventory has been carried out from the Starting point to ending point. The existing highway is a 2-lane single carriageway road with generally 7 m wide carriageway with 1.0 m earthen shoulder on both sides and without paved shoulder, except at few locations where paved shoulder exists. At Kashipur, non-standard 4-lane divided road exists from km 156.800 to km 158.800. There are Seventeen (17) major bridges & twenty eight (28) minor bridges and 273 numbers of existing CD structures (pipe/slab/arch/box culverts) present on the project road section i.e. from Haridwar to Kashipur section of NH-74

2.1.4 Traffic Homogenous Section

For Traffic Study purpose, the project road has been divided in six (6) traffic homogenous sections as follows:

Section-1: Haridwar to Mandawali (km 0.000 to km 40.000)

Section-2: Mandawali to Najibabad (km 40.000 to km 50.750)

Section-3: Najibabad to Dhampur (km 50.750 to km 94.000)

Section-4: Dhampur to Afjalgarh (km 94.000 to km 120.500)

Section-5: Afjalgarh to Kashipur (km 120.500 to km 158.350)

Section-6: Kashipur to End of Project Road (km 158.350 to km 176.498)

The Average Daily Traffic (ADT) and Average Annual Daily Traffic (AADT) in 2010 on the six traffic homogeneous sections of the existing alignment of the project road as determined from the traffic surveys are as detailed below in **Table - 2.1**

Table 2.1 Traffic on the Project Road

Section	Traffic in AADT	
	Total Vehicles	PCU
Section-1, (near Kangadi Village at Km 6.000 of NH-74)	10930	15330
Section-2, (near Puranpur Village at km 48.000 of NH-74)	12209	17645
Section-3, (Near Hotel Walia Residency, Najibabad at km 52.000 of NH-74)	13830	20435
Section-4, (Outskirt of Dhampur at km 96.000 of NH-74)	12923	20132
Section-5, (near Missarwala Village at km 153.200 of NH-74)	11746	15713
Section-6, (near Multiwall Pulp & Board Mills at km 167.400 of NH-74)	12046	16737

Mode wise average annual daily traffic (AADT) on 6 (six) traffic homogenous sections of the project road in the year 2010 are presented in Table below in **Table -2.2**.

Table 2.2 Average Annual Daily Traffic on Project Road

Type of Vehicles	Near Kangri village, Haridwar		Outskirt of Najibabd		Near Hotel Walia residency		Outskirt of Dhampur		Near Missarwala village		Near Multiwall Pulp & Board Mills	
	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT
Two Wheeler	2816	2816	3395	3395	3678	3678	3154	3154	3269	3269	3661	3661
Auto Rick.	323	323	422	422	502	502	558	558	216	216	177	177
Car/ Jeep/ Taxi	3825	3825	3355	3355	3709	3709	3362	3362	2802	2802	3327	3327

Type of Vehicles	Near Kangri village, Haridwar		Outskirt of Najibabd		Near Hotel Walia residency		Outskirt of Dhampur		Near Missarwala village		Near Multiwall Pulp & Board Mills	
	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT
Van/ Tempo	263	263	525	525	0	0	3	3	213	213	300	300
Mini Bus	56	56	197	197	163	163	18	18	285	285	134	134
Standard Bus	628	628	639	639	654	654	643	643	483	483	260	260
LCV	172	172	261	261	461	461	489	489	381	381	162	162
2-Axle Truck	1209	1209	1199	1199	1524	1524	1492	1492	1206	1206	1732	1732
3-Axle Truck	334	334	545	545	743	743	874	874	559	559	726	726
Multi-Axle Truck	36	36	69	69	139	139	131	131	124	124	58	58
Agricul. Tractor	31	31	15	15	15	15	47	47	305	305	285	285
Agricul. Tracter & Trailer	427	427	508	508	678	678	716	716	118	118	166	166
Car (Toll Exempted)	19	19	6	6	2	2	0	0	14	14	7	7
Bus (Toll Exempted)	1	1	3	3	1	1	0	0	1	1	0	0
LCV (Toll Exempted)	2	2	0	0	0	0	0	0	0	0	0	0
2/3-Axle (Toll Exempted)	3	3	1	1	1	1	0	0	1	1	0	0
Animal/ Hand Drawn	6	6	101	101	32	32	43	43	87	87	54	54
Cycle	742	742	824	824	1486	1486	1347	1347	1481	1481	861	861
Cycle Rick.	31	31	137	137	39	39	45	45	199	199	90	90
Others	8	8	7	7	3	3	1	1	2	2	46	46
Motorised (Vehicles)	10144	10144	11140	11140	12270	12270	11487	11487	9977	9977	10995	10995
Non-Motorised	789	789	1069	1069	1560	1560	1436	1436	1769	1769	1051	1051

Type of Vehicles	Near Kangri village, Haridwar		Outskirt of Najibabd		Near Hotel Walia residency		Outskirt of Dhampur		Near Missarwala village		Near Multiwall Pulp & Board Mills	
	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT	ADT	AADT
(Vehicles)												
Total (Vehicles)	10933	10933	12209	12209	13830	13830	12923	12923	11746	11746	12046	12046
Motorised (PCUs)	14857	14857	16473	16473	19456	19456	19170	19170	14174	14174	15676	15676
Non-Motorised (PCUs)	496	496	1172	1172	979	979	962	962	1539	1539	1061	1061
Total (PCUs)	15330	15330	17645	17645	20435	20435	20132	20132	15714	15714	16737	16737

The projected traffic on the project road is presented in **Table 2.3.**

Table 2.3 The Projected Traffic on the Project Road

Year	Haridwar-Mandawali Section at Km 6+000 of NH-74	Mandawali-Najibabad Section at Km 48+000 of NH-74	Najibabad-Dhampur Section at Km 52+000 of NH-74	Dhampur-Afjalgarh Section at Km 96+000 of NH-74	Afjalgarh-Kashipur Section at Km 153+200 of NH-74	Kashipur-End of Project Road at Km 167+400 of NH-74
2010	15330	17645	20435	20132	15713	16737
2011	16737	18706	21656	21316	17093	18243
2012	18284	19839	22960	22579	18613	19898
2013	19981	21053	24354	23927	20277	21713
2014	21844	22352	25845	25367	22100	23702
2015	23889	23744	27442	26905	24097	25884
2016	25083	24942	28826	28261	25302	27178
2017	26338	26200	30280	29684	26567	28537
2018	27654	27522	31806	31179	27895	29964
2019	29037	28911	33410	32750	29290	31462
2020	30489	30369	35095	34400	30755	33035
2021	32013	31888	36850	36119	32292	34687
2022	33614	33482	38692	37925	33907	36421
2023	35295	35156	40627	39822	35602	38242
2024	37060	36914	42658	41813	37382	40154
2025	38913	38760	44791	43903	39252	42162
2026	40858	40698	47030	46099	41214	44270
2027	42901	42733	49382	48404	43275	46483
2028	45046	44869	51851	50824	45439	48808

2029	47298	47113	54444	53365	47711	51248
2030	49663	49468	57166	56033	50096	53810
2031	52147	51942	60024	58835	52601	56501
2032	54754	54539	63025	61777	55231	59326
2033	57492	57266	66177	64865	57992	62292
2034	60366	60129	69485	68109	60892	65407
2035	63384	63136	72960	71514	63937	68677
2036	66554	66292	76608	75090	67134	72111

2.2 PROPOSED ROAD FEATURES

Typical Cross Sections

Typical Cross Sections for widening of the project road has been developed based on guidelines of IRC and are depicted.

Design Speed

The proposed design speed on the project road is presented in **Table 2.4**

Table 2.4 Proposed Design Speed for Various Terrains

Description	Ruling Design Speed (KMPH)	Minimum Design Speed (KMPH)
Plain Terrain	100	80
Rolling Terrain	80	65
Hill/Ghat Terrain	50	40

Right-of-Way (ROW)

As per the Ministry circular and after discussions with client, The proposed RoW will be 60m on existing road at rural areas, 25m-45m on existing road at built-up areas, 60 m on Realignments/ Bypasses, 80 m near major junction, 135 m for Toll Plaza.

Roadway Width

For Four Lane highways **:** 26.0 meters (as per IRC:SP:84 - 2009)

All the new Bridges and Structures will be constructed for standard 4-lane in accordance with guidelines of the IRC: SP: 84 – 2009.

Width of Carriageway

The standard width of carriageway is as indicated below:

4 Lane divided C/W : 17.5 m

The typical widened cross-section would consist of the following salient features:

i) 7.0 m carriageway for 2 lane road
ii) 1.5 m wide paved shoulders

iii) 2.0 m wide earthen shoulders
iv) 7.0m carriageway for service roads in urban area along existing road.
v) 2.0 m median (raised) in urban area and 4.5 m median (raised) in rural area for 4 lane divided road
vi) 0.25m kerb shyness/edge strip at the edge of median for rural & urban area for 4 lane road.

Pavement

Flexible pavements are proposed for all throughout the road except at the toll plazas where rigid pavement is proposed. This is due to the high cost of construction involved for rigid pavements.

Geometric Design Aspects

All geometric design aspects have been carried out as per the IRC and NHAI standards and specifications. Adequate warnings have been provided or maintaining continuity has been emphasized in the design. The existing profile has been maintained all throughout the project road.

The design speed has been kept quite consistent, and speed difference between two Consecutive curves is not exceeded.

Cross Drainage Structures

Drainage

Road drainage includes the collection and diversion of surface and subsurface water. In order to ensure proper drainage of the road surface and the pavement layers different drainage arrangements have been considered for the project and details are given in **Table 2.5**

Table 2.5 Proposed Drainage Details

Type of Drain	Approx.Length (Km)
Length of RCC Covered Drains	40.453
Length of Trapezoidal open lined	Nil
Earthen Drain	277.495

The proposed project as per the design will have following CD structures:

Culverts

There are 273 nos. of CD structures on the existing alignment of project road.

Due to realignment/bypasses, the total no. of CD structures on the recommended alignment of the project road has increased to 336.

Design of Intersections

All major and minor junctions have been studied thoroughly with respect to traffic volume and geometric. The important minor junctions leading to villages and major settlements have been identified and proper junction layouts (including road marking, and traffic signs) have

been applied as per IRC-SP: 41-1994. Design of major junctions has been based on peak hour traffic data.

Traffic Control and Road Safety Features

Traffic control devices and road safety features, including Traffic Signs, Road Markings, Road lighting & Crash Barriers are proposed and designed as per relevant IRC codes and standards.

Proposed Remedial Measures to Reduce Accidents

- Improvement of the road geometry with better horizontal and vertical profile.
- Improvement of junctions with better traffic management and safety measures.
- Provision of required traffic signage's and retro-reflective road markings.
- Provision of proper pedestrian facilities including lighting at the built-up sections and Industrial/institutional locations of merger of gradient.
- Provision of bypass at locations where the geometry is very poor and heavily built up.
- Provision of bus bays as per IRC standards

Other Features

- There is 4 rail-road crossing on the existing alignment of project road. Three (3) numbers ROBs have been provided on the proposed alignment of the project road. One ROB will come on Najibabad Bypass, one ROB on at Nagina Bypass and remaining one ROBs cum Flyover will come on Kashipur Bypass.
- One (1) Flyover has been provided over NH-119 on Najibabad Bypass.
- Twelve (12) Vehicular Underpass & Fourteen (14) Pedestrian/Cattle Underpass have been proposed on bypasses for safety and partial access control.
- In addition, traffic calming measures like Pedestrian Crosswalk, ZEBRA Crossing and Rumble Strip along with pedestrian crossing signs will be provided on existing road at the important intersection locations, locations of school, hospital, religious places and also at the settlement locations for safe passage of pedestrians.
- Two (2) pedestrian foot over bridge have been proposed at Bhaguwala (Existing km 33.122) and Sherkot (Existing Km 102.110).
- Peak demand of water would be about 710KLD during construction, source of water will be ground and surface water bodies.
- Water harvesting system and oil grease separators have been proposed at various locations.

Enhancement of Inventories

Apart from widening of carriageway, the projects have also proposed several other enhancements such as bus-bays, parking provisions for trucks and cars, PCO and Police outposts etc as below:

- **Three Toll Plazas** comprising 3+3 - lanes for normal vehicles and 2x1-lane to cater for over sized/ toll free vehicles complete with administrative offices have been proposed at **Existing Km 31.575 near Bhaguwala village, km 81.610 near Puraini village & km 147.225 near Jagatpurpatti village on NH-74** respectively. Provision has also been kept for adding additional lanes in future on either side as per guidelines of IRC: SP: 84-2009.
- **Truck lay-bye** at 4 (four) locations on both sides at km 6.575, 34.128, 54.850 & 148.700 of NH-74 have been proposed to accommodate 15 to 20 trucks.
- At 52 places **Bus bays** with passenger shelter have been proposed. At each place bus bay will be placed for each traffic direction.

Quarrying and Raw Materials

Raw Materials Type	Leads (Km) w.r.t. CG/ Locations
Aggregates	13.9 Km
Sand	35.00 Km
Borrow	5-15 Km
Water	Nearby surface/ground water/ Ganga,Pilli River/ Dhela River

CHAPTER - 3

ANALYSIS OF ALTERNATIVES

The chapter tries to compare feasible alternatives to the proposed project with respect to site, technology, design etc. The alternatives examined take into account all possible and feasible options and includes both with and without project scenarios in terms of the potential environmental impacts for the justification of the project. The chapter focuses on discussing how environmental parameters were assigned due importance and were carefully considered in the analysis of alternatives.

3.1 WITH AND WITHOUT PROJECT ALTERNATIVES

3.1.1 Without Project Scenario

The existing project road is a 2-lane Road. The road has many roadside settlements and the traffic flow is seriously impacted by severe conflicts between the local and through traffic. This is further compounded by the various land use conflicts, in terms of uncontrolled development along the highway and the encroachments onto the ROW. There will be obvious increase in population growth, increase in traffic volumes and the economic development along the corridor would continue to occur and would certainly worsen the already critical situation. The existing unsafe conditions and the adverse environmental consequences in terms of the environmental quality along the highway would continue to worsen in the absence of the proposed improvements. Moreover, if the decision is against proposed project, then the attendant reduced socio-economic development of this remote, relatively poorly connected area cannot be justified. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development, social inclusiveness and environmental sustainability.

3.1.2 With Project Scenario

The ‘with project scenario’ is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the widening to four lanes of the existing two lanes stretch as envisaged in the project objectives. The scenario is economically viable and will improve the existing conditions. It would contribute to the development goals envisaged by the Government of Uttar Pradesh as well as Government of Uttarakhand and enhance the growth potential of the region in particular and the nation in general. Improved road connectivity helps integration of communities of the region to a greater extent. It also ensures better transporting facilities between the two states.

In spite of the various development benefits likely to accrue due to the project, as is the case of every road development project, the project would be accompanied by certain impacts on the natural, social and environmental components. The potential impacts on the various environmental components can be avoided through good environmental practices. Wherever avoidance of negative impact has not been possible, appropriate mitigation and enhancement actions will be worked out to effectively offset the environmental damages

inflicted due to the project. A detailed Resettlement and Rehabilitation (R&R) Action Plan is also being worked out to improve the well-being and livelihood of the people to be impacted. Comparative assessments of the "with and without" project scenarios are presented in the following **Table 3.1.**

Table 3.1 "With and Without" Project Scenarios - A Comparative Assessment

Component	"With" Project Scenario	'Without" Project Scenario
Highway Geometrics	Upgradation from two lane to four lane carriageway with improved geometrics	Existing two lane carriageway with ordinary geometrics
Total travel length	Will reduce about travel distance by increasing in speed	More travel length
Design Speed	80-100 kmph in plain terrain 40 -60kmph in mountainous terrain	50-60 kmph in rural Sections, 20-30 kmph in Urban Sections
Congestion in Settlements	Segregation of local and through traffic by the provision of service roads or realignment will greatly relieve congestion.	congestion in urban areas as well as some of the rural areas
Felling of road side trees	One side widening has been proposed in rural area or the semi urban locations, so that felling of trees shall be minimum	No felling of trees. The old trees may become a safety hazard to the road users with passage of time.
Catle safety	Provision of cattle underpasses to provide safety to both road users and cattle from accidents.	Accidents involving cattle and livestock shall be a concern. Moreover the area is predominantly built up and forest.
Pedestrian safety	Traffic calming measures like Pedestrian Crosswalk, zebra crossing, Rumble Strip along with pedestrian crossing signs will be provided on existing road at the important intersections, locations of school, hospital, religious places and also at the settlement locations for safe passage of pedestrians.	Pedestrian safety an issue of major concern especially along the settlements and congested sections.
Road Safety Measures	Provision of proper road markings, zebra crossings, service roads, crash barriers and improvement of geometry to reduce accidents.	Accident incidents shall rise with an increased traffic volume.
Environmental Quality	Provision of service lane in urban settlements improves environmental quality within the urban areas due to lowered pollution levels and relieving of congestion. Besides an aggressive tree plantation	Poor due to congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further

Component	"With" Project Scenario	'Without" Project Scenario
	and provision of enhancement features shall not only provide aesthetics but also improve the quality of air	congestion.
Drainage	Various types of drainage systems are to be laid down in accordance to IRC:SP 42	The drainage facilities are very poor and in some areas absent
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate.
Wayside Facilities	Wayside facilities proposed at several locations, where necessary like rest areas, with appropriate facilities for recreation, motels, highway patrol, highway public telephones and Locations for bus stops and Truck lay byes	Not of adequate standards, quality and number.
Environmental Enhancement	Enhancement of community and cultural properties and also water front in an aesthetic manner.	Environmental measures are not sufficient and often impossible to enhance..

3.2 JUSTIFICATION FOR ENVIRONMENTAL ISSUES

Environmental Issues:

The implementation of this project envisages the following direct benefits:

(i) Improved quality of life for the rural as well as urban population in the project area which will result in:

- Improving performance of road net work for enabling traffic to move safely, expeditiously, economically and comfortably;
- The potential for progress shall be great due to better transportation of both men and material.
- Improve road connectivity across ROW for stimulating growth, better access for interstate traffic and other facilities;
- Accessibility to remote areas will improve and thereby better governance;
- A more efficient and safe road transport system: through reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- The improved road will reduce travel times, fuel consumption and emissions from base traffic volumes.
- The journey would be more convincing with an appreciable environment.
- Drainage/erosion will be considerably improved because of the provision of improved side drains, culverts and causeways;

(ii) Improved road surface will give a satisfactory service throughout the years;

With the implementation of the project, following benefits apart from the benefits targeted through the objectives are envisaged:

- Short term employment opportunities due to construction activities and development of diversified skill set for local labour;
- Improved economic development of corridor villages;
- Improved environmental conditions along the roadside due to judicious design;
- Improved aesthetics due to enhancements and landscaping;
- Improvement in the drainage conditions along the corridors due to improved design and construction of cross drainage structures;
- Improved tree cover along the road due to afforestation / compensatory afforestation;
- Improved safety of road users and roadside communities;

3.3 ENVIRONMENTAL CONSIDERATIONS

The various avoidance measures for minimizing the extent of environmental impacts and avoiding of sensitive environmental features have been worked out. The **Table 3.2** provides the measures that have been adopted for offsetting the impacts. A description of the measures has been presented in the following sections.

Table 3.2 Minimization of Environmental Impacts

Criteria	Means
Maintenance of Design Speed for through traffic	Improved geometrics
Segregation of through traffic from local traffic	Accommodating service roads by reduced medians
Improvement of Road Safety	Intersection Improvements; Geometric improvements at curves; Grade separation; underpasses
Adequate drainage	Provision of cross drains
Reduction of Air and Noise Pollution	Intersection improvements; site specific attenuation measures; aggressive tree plantations
Displacement of Local Population	Limiting ROW; Provision of up gradation of skills of PAPs, financial assistance
Minimization of Direct impact on adjoining settlements	Reduced width of the median
Minimization of Direct Impact on Sensitive Receptors, cultural and religious properties	Public consultations, Realignment Service roads and underpasses provided at site specific locations and Good EMP measures
Minimisation of Property acquisition	Realignments; Concentric widening
Displacement of Commercial Properties	Concentric widening
Minimisation of Loss of Utility Lines	Centre line alterations
Stabilization of Slope	Turfing / Pitching

3.3.1 Improvement of Air and Noise Quality

- By improving intersections;
- By removing traffic bottlenecks;
- By maintaining a steady stream flow of traffic and by segregating slow and fast modes (also by segregation of through traffic by reducing median in small urban areas to accommodate service roads).

3.3.2 Avoidance of Impact of Sensitive, Cultural and Community Properties

- By lateral shifting of the alignment, many cultural properties have been saved;
- By providing service roads at most of these locations especially where educational institutes are present
- By providing underpasses and zebra crossing for smooth travel of local populace
- Providing noise attenuation measures mainly along schools and hospitals
- Avoiding direct impact on sensitive receptors.

3.3.3 Analysis of Noise Barrier Materials

For a good noise barrier, a service life of 40 years is desirable, with no major maintenance required for 20 years. It is therefore inappropriate for environmental barriers to meet requirements for highway structures. Cost Analysis for Noise Barriers is shown in**Table3.3:**

Earthen Mounds

This is the most appropriate barrier form in the rural areas. The earth mound in conjunction with planting is likely to be attractive both to local residents and road users. Where space alongside the road is restricted, they can be built with steep faces by supporting them with retaining structures. An earthen mound is an obvious solution to noise pollution in rural areas because it can be made to fit in with the landscape more naturally especially as it can support planting which greatly improves its appearance in most rural contexts. The amount of space with an earthen mound requires is a major constraint - a 2 meter high earthen mound with 1 in 2 side slopes requires a minimum width of 9 m. Gentler side slopes, particularly on the protected side, are further more often desirable to blend the road with the natural slopes of the area. Land acquisition thus shall be a constraint for using this noise barrier. Mounded areas outside the highway boundary may need a legally binding condition placed on them to prevent the landowners subsequently removing the mounding or vegetation.

Timber

Timber is a common fencing material, but its maximum height is restricted by structural requirements. It is a requirement of the specification that timber screens remain serviceable for 40 years and require no maintenance for 20 years. Factory treatments can provide this life but on site modifications may significantly reduce the durability of timber. Timber paneling is versatile in that it can be readily modeled around existing ground features such as over the root systems of retained trees, thus ensuring the continuity of noise barriers.

Noise absorbent timber barriers have been developed incorporating cavities and dispersing elements behind timber battens, which can be arranged in various patterns.

Concrete

Concrete is used in various ways in the construction of environmental barriers. Structural aspects of using concrete in structures are covered in IS 456:2000 and MoSRT&H. Concrete barriers benefit from low maintenance, but prefabricated barriers are relatively expensive. Concrete barriers are usually sufficiently robust to withstand vehicle impact damage, but a safety barrier may be needed to prevent excessive damage to vehicles if the surface finish is heavily textured.

Brick Walls

The height to which un-reinforced brick and masonry barriers can be built is limited by structural considerations, but their height can be increased considerably with reinforcement. Reference should be made to NHAI. Brick and masonry needs little maintenance apart from occasional cleaning to rectify uneven discoloration from pollutants and rain. In general, masonry walls are assumed to be acoustically reflecting. But absorbent bricks and blocks are available which have a perforated surface and resonant cavities filled with fibrous material.

Table 3.3 Cost Analysis for Noise Barriers

Sl. No.	Barrier Type	Construction Cost Indicators		Maintenance Cost Indicators	
		Assumed features of design	Relative cost	Factors taken into consideration	Relative Cost
1.	Earthen Mound	Agricultural land price, landscape planting excluded local source of fill assumed	Low	grass cutting, planting maintenance	Fairly Low
2.	Timber	Designed in accordance with current standards	Moderate	Inspection / repair, periodic treatment	Moderate
3.	Concrete	Pre cast pier, beams and panels	Fairly High	Inspection / repair, periodic cleaning	Very Low
4.	Brick Masonry Wall	Standard facing brick	Moderate	Inspection / repair, periodic cleaning/ repainting	Very Low

Note: *Costs of the following items not included - Piling, statutory diversions, safety fencing and accesses, damage repair and traffic management. Costs for these items will be additional and requirements will vary for different systems*.

Based on the site conditions, views of the stakeholders, client, availability of materials, durability and a host of other considerations, it is suggested that either Brick Masonry Wall structures or concrete screens are used as noise barrier materials for the Project road. As

brick masonry wall is cost effective it is proposed as noise barrier. In case where space for construction of the wall shall be a constraint, concrete screen shall be used. However the contractor shall explore all those locations and get approval of the NHAI.

3.4 Proposed Bypasses:

3.4.1 Proposed Improvements

The improvement proposals incorporated in the design of the project road are based on the guidelines of IRC: SP:84 – 2009.

The existing alignment of the road is generally retained where the road geometry is within acceptable norms as per design standards and proposed ROW is possible to be acquired/ available. The widening schedule for the project road is given in **Table 3.4**.

Table 3.4 Widening Schedule of Project Road

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
1	0+000	3+025	0+000	2+850	Right Side	Chandi Mandir Area on Left side
2	2+672	2+875	2+500	2+700	Transition	Chandi Mandir Area on Left side
3	2+875	3+983	2+700	3+800	Left Side	Canal on Right side
4	3+983	4+183	3+800	4+000	Transition	Transition from Right to Left Side (Existing Bridge at km 4.125 will be part of left carriageway & new 2 lane bridge will be part of right carriageway)
5	4+183	5+568	4+000	5+400	Right Side	Canal on Left side
6	5+568	5+718	5+400	5+550	Transition	Transition from Right Side to Centre
7	5+718	6+168	5+550	6+000	Both Side	Kangri Village Settlement on the both sides
8	6+168	6+318	6+000	6+150	Transition	Transition from Centre to Right Side
9	6+318	9+368	6+150	9+187	Right Side	Left Side Reserve Forest
10	**9+368**	**10+480**	**9+187**	**10+332**	**Realignment on RightSide**	Reserve Forest on Left Side ·Shyampur Police Station building on left side between km 9.600 & km9.725.Sani Dev Temple at km 9.790 on right side.
11	10+480	19+698	10+332	19+482	Right Side	Reserve Forest on both sides.
12	19+698	19+898	19+482	19+682	Transition	Transition from Right to Left Side
13	19+898	20+740	19+682	20+582	Left Side	Canal on Right side
14	20+740	20+940	20+582	20+782	Transition	Transition from Left to Right Side

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
15	20+940	26+628	20+782	26+482	Right Side	Gurudwara at km 20.800 on left side
16	26+628	26+828	26+482	26+682	Transition	Transition from Right to Left Side
17	26+828	32+554	26+682	32+382	Left Side	Forest Office on right side at km 27.200
18	32+554	32+704	32+382	32+532	Transition	Transition from Left Side to Centre
19	32+704	34+029	32+532	33+882	Both Side	Bhaguwala Village Settlements on the both sides
20	34+029	34+179	33+882	34+032	Transition	Transition from Centre to Left Side
21	34+179	35+351	34+032	35+232	Left Side	Built-up area on right side at some locations
22	35+351	35+501	35+232	35+382	Transition	Transition from Left Side to Centre
23	35+501	36+069	35+382	35+982	Both Side	Mohanpur Village Settlements on the both sides
24	36+069	36+219	35+982	36+132	Transition	Transition from Centre to Right Side
25	36+219	36+919	36+132	36+832	Right Side	Pond at km 36.325 on left side
26	36+919	37+042	36+832	36+982	Transition	Transition from Right Side to Centre
27	37+042	37+442	36+982	37+382	Both Side	Karoli Village Settlements on the both sides
28	37+442	37+592	37+382	37+532	Transition	Transition from Centre to Left Side
29	37+592	39+275	37+532	39+262	Left Side	Built-up area on right side
30	**39+275**	**41+030**	**39+262**	**41+188**	**New Alignment**	**Realignment at Mandawali on left side**
31	41+030	42+598	41+188	42+751	Left Side	Hospital & School on right side between km 41.700 & km 42.030
32	**42+598**	**54+053**	**42+751**	**52+817**	**New Alignment**	**Najibabad Bypass on right side**
33	54+053	58+450	52+817	57+306	Left Side	Factory & Schools on right side
34	58+450	58+600	57+306	57+456	Transition	Transition from Left Side to Centre
35	58+600	59+088	57+456	57+956	Both Side	Built-up area on both sides
36	59+088	59+238	57+956	58+106	Transition	Transition from Centre to Left Side
37	59+238	60+517	58+106	59+406	Left Side	Built-up area on right side at some locations
38	60+517	60+667	59+406	59+556	Transition	Transition from Left Side to Centre
39	60+667	61+268	59+556	60+181	Both Side	Built-up area on both sides

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
40	61+268	61+418	60+181	60+331	Transition	Transition from Centre to Left Side
41	61+418	62+728	60+331	61+656	Left Side	Built-up area on right side
42	62+728	62+878	61+656	61+806	Transition	Transition from Left Side to Centre
43	62+878	64+764	61+806	63+706	Both Side	Built-up area on both sides
44	64+764	64+914	63+706	63+856	Transition	Transition from Centre to Left Side
45	64+914	66+407	63+856	65+368	Left Side	Mango Garden on right side
46	**66+407**	**68+325**	**65+368**	**67+637**	**New Alignment**	**Realignment at Daulatabad on right side**
47	68+325	68+693	67+637	68+005	Both Side	Built-up area on both sides
48	68+693	70+995	68+005	69+609	**New Alignment**	**Realignment at Kotwali on left side**
49	70+995	71+865	69+609	70+479	Both Side	Built-up area on both sides
50	71+865	72+011	70+479	70+629	Transition	Transition from Centre to Left Side
51	72+011	73+362	70+629	71+983	Left Side	Religious Structures on right side at km 73.035, km 73.500 & km 75.250 and School at km 74.700 on right side. Also Mango Garden on right side from km 74.050 to km 74.650. OFC lines on right side.
52	**73+362**	**79+808**	**71+983**	**77+585**	**New Alignment**	**Realignment at Nagina on right side**
53	79+808	82+688	77+585	80+445	Left	Hospital on Right Side at 83.600 and also some buildings are there on right side.
54	82+688	82+818	80+445	80+595	Transition	Transition from Left Side to Centre
55	82+818	83+672	80+595	81+445	Both Side	Built-up area on both sides
56	83+672	83+822	81+445	81+595	Transition	Transition from Centre to Left Side
57	83+822	84+572	81+595	82+345	Left Side	Religious Structures on right side
58	84+572	84+722	82+345	82+495	Transition	Transition from Left Side to Centre
59	84+722	85+562	82+495	83+345	Both Side	Built-up area on both sides
60	85+562	85+712	83+345	83+495	Transition	Transition from Centre to Right Side
61	85+712	88+148	83+495	85+945	Right Side	College on Left Side from km 87.700 to km 87.900
62	88+148	88+298	85+945	86+095	Transition	Transition from Right Side to Centre
63	88+298	89+489	86+095	87+295	Both Side	Built-up area on both sides

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
64	89+489	89+639	87+295	87+445	Transition	Transition from Centre to Right Side
65	89+639	90+437	87+445	88+245	Right Side	School on Left side at km 91.375
66	90+437	90+650	88+245	88+445	Transition	Transition from Right to Left Side
67	90+650	91+236	88+445	89+045	Left Side	Buildings on Right side
68	91+236	91+436	89+045	89+245	Transition	Transition from Left to Right Side
69	91+436	92+265	89+245	90+085	Right Side	Graveyard at km 92.500 and a school at km 92.875 on right side
70	**92+265**	**97+005**	**90+085**	**94+391**	**New Alignment**	**Realignment at Dhampur on left side**
71	97+005	99+093	94+391	96+516	Right Side	Embankment of Khoh River on left side
72	99+093	99+343	96+516	96+766	Transition	Transition from Right to Left Side
73	99+343	101+034	96+766	97+466	Realignment	Realignment for New 4-lane Bridge
	101+034	101+584	97+466	98+016	Left Side Widening	Built-up Area at Sherkot on right side
74	101+584	101+734	98+016	98+166	Transition	Transition from Left Side to Centre
75	101+734	103+062	98+166	100+466	Both Side	Built-up area on both sides at Sherkot and also to improve the geometry along the strecth
76	103+062	103+212	100+466	100+616	Transition	Transition from Centre to Leftt Side
77	103+212	104+112	100+616	101+566	Left Side	New Minor Bridge is suitable on left side at km 104.720
78	104+112	104+312	101+566	101+766	Transition	Transition from Left to Right Side
79	104+312	105+687	101+766	103+116	Right Side	Pond from km 105.675 to km 105.825 on left side
80	105+687	105+837	103+116	103+266	Transition	Transition from Right Side to Centre
81	105+837	106+634	103+266	104+066	Both Side	Built-up area on both sides at Mubarakpur
82	106+634	106+784	104+066	104+216	Transition	Transition from Centre to Left Side
83	106+784	109+914	104+216	107+366	Left Side	HT line on the left side
84	109+914	110+064	107+366	107+516	Transition	Transition from Left Side to Centre
85	110+064	112+163	107+516	109+666	Both Side	Built-up area on both sides at Bhutpura
86	112+163	112+383	109+666	109+916	Transition	Transition from Centre to Left Side
87	112+383	114+713	109+916	112+216	Left Side	School & Pond on right Side
88	114+713	114+863	112+216	112+366	Transition	Transition from Left Side to Centre

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
89	114+863	115+331	112+366	112+816	Both Side	Built-up area on both sides
90	115+331	115+481	112+816	112+966	Transition	Transition from Centre to Right Side
91	115+481	117+195	112+966	114+721	Right Side	Sugar Mill on the left side
92	**117+195**	**120+517**	**114+721**	**117+133**	**New Alignment**	**Realignment at Afjalgarh on right side**
93	120+517	121+504	117+133	118+116	Right Side	School & Buildings on left side
94	121+504	121+654	118+116	118+266	Transition	Transition from Right Side to Centre
95	121+654	122+594	118+266	119+206	Both Side	Built-up area on both sides
96	122+304	122+454	118+916	119+066	Transition	Transition from Centre to Right Side
97	122+454	122+594	119+066	119+206	Right Side	Buildings on left side
98	**122+594**	**126+335**	**119+206**	**123+001**	**New Alignment**	**Realignment at Udhhowala on right side**
99	126+335	128+031	123+001	124+721	Left Side	Building, School, Shops & canal/nalah on right side
100	128+031	128+231	124+721	124+921	Transition	Transition from Left to Right Side
101	128+231	128+931	124+921	125+621	Right Side	Graveyard on Left side
102	128+931	129+131	125+621	125+821	Transition	Transition from Right to Left Side
103	129+131	129+416	125+821	126+271	Left Side	Building, School, & Shops on right side
104	129+416	129+616	126+271	126+471	Transition	Transition from Left to Right Side
105	129+616	131+560	126+471	128+421	Right Side	Buildings & Gurudwara at km 131.375 and Mazar on left side at km 131.840
106	131+560	131+710	128+421	128+571	Transition	Transition from Right Side to Centre
107	131+710	132+763	128+571	129+621	Both Side	Built-up area on both sides
108	132+763	132+963	129+621	129+821	Transition	Transition from Centre to Right Side
109	132+963	133+208	129+821	130+321	Right Side	Canal on Left side
110	133+208	133+358	130+321	130+471	Transition	Transition from Right Side to Centre
111	133+358	133+808	130+471	130+921	Both Side	Built-up area on both sides
112	133+808	133+982	130+921	131+071	Transition	Transition from Centre to Left Side
113	133+982	135+487	131+071	132+561	Left Side	Buildings, Pipe Factory, School and Mazar on right side
114	**135+487**	**145+935**	**132+561**	**143+903**	**New Alignment**	**Jaspur Bypass on left side**
115	145+935	146+697	143+903	144+683	Both Side	Built-up area on both sides
116	146+697	146+847	144+683	144+833	Transition	Transition from Centre to Right Side

Sl. No.	Existing Chainage		Design Chainage		Widening Proposal	Remarks
	From	To	From	To		
117	146+847	148+262	144+833	146+263	Right Side	Buildings & important Majar at km 150.275 on left side with forest land on both side of the road between km 147.847 to km.148.437
118	148+262	148+362	146+263	146+363	Transition	Transition from Right to Left Side
119	148+362	149+445	146+363	147+453	Left Side	Important Buildings on right side
120	**149+445**	**174+880**	**147+453**	**170+415**	**New Alignment**	Kashipur Bypass on right side
121	174+880	175+000	170+415	170+535	Right side	End of the project Road

- Total length of Eccentric (one side) widening =81.783 Km
- Total length of Concentric (both side) widening = 21.323 Km
- Total length of New length (i.e. Bypass) = 67.429 Km

3.4.2 Proposed Bypasses

Based on site visit, discussion with concerned agencies, study of Development Plan (as available), existing RoW (as per details provided by PWD NH Divisions Roorkee, Ghaziabad & Haldwani and existing ROW as per revenue village maps), available present land width between buildings/structures, RoW required for 4 laning with/without service road, geometrics of existing road and associated problems of land acquisition, demolition of structures and utility shifting, it was considered necessary to provide realignment/ bypasses at **Shyampur**, **Mandawali, Najibabad, Daultabad, Kotwali, Nagina, Dhampur, Afjalgarh, Udhhowala, Jaspur and Kashipur** towns during Draft Feasibility Study Report (DFSR) stage.

Need for Realignment at Shyampur (km 9.368 to km 10.480)

There is an old & big Sani Temple at km 9.960 on right side and Shyampur Police Station (from km 9.775 to km 9.900) on left side of NH-74. The Sani Temple & Police Station are very close to road and improvement of existing road to 4 lane road will affect these structures. Acquisition of these structures is not feasible and may be avoided. Hence it is proposed to improve the existing 2 lane road to 2 lane road with paved shoulder configuration and new 2 lane road to be constructed on new alignment on right side of existing road. Hence considering the above realignment of road is proposed on right side from km 9.368 to km 10.480 of NH-74.

Need for Realignment at Mandawali (km 39.275 to km 41.030)

From km 39.750 to km 40.450 of NH-74 there is built-up area of Mandawali town. The available RoW in this stretch varies from 16 – 30 m broadly with average value of 24 m. The existing RoW varies from 19 – 30 m (average ROW 25 m) as per revenue village maps. However as per record available from Uttar Pradesh PWD, NH Division Ghaziabad the existing ROW is 24 m only. There are two sharp curves at km 39.975 & km 40.475 of NH-74.

School and hospital area is also close to the road between km 39.975 & km 40.550. The built-up area is well & deeply developed and it is virtually impossible to acquire additional RoW land on either side of road. Acquisition of additional land for 4 lane divided carriageway with service road on both sides will create social and R & R problems, as large no. Of structures will be affected. Hence it is proposed to realign the road at Mandawali town between existing km 39.275& km 41.030 of NH-74.

Need for Bypass at Najibabad (km 42.598 to km 54.053)

From km 49.000 to km 52.700 the project road passes through the built-up area of Najibabd town. There is huge congestion in Najibabad town area through which the project road passes. The available ROW in Najibabad town between km 49.550 and km 50.650 varies from 6 m to 18 m with average value of 12 m. The existing ROW as per revenue village map record between km 49.550 and km 50.650 also varies from 6 m – 18 m. The geometry of road is also substandard between km 49.850 and km 50.950. The stretch of road from km 49.800 to km 51.100 passes through the oldest & densely populated area of Najibabad town and there is no scope of improvement & widening of road. Land acquisition is also impossible. The average value of available ROW between km 51.100 & km 52.500 is 25 m. The existing ROW as per revenue village map/PWD NH Division Ghaziabad's record between km 51.100 & km 52.500 is 24 m only. Improvement of existing road to 4 lane road in Najibabd town area is not feasible as it will affect large number of structures leading to social and R&R problems and may be avoided.

Further there is a built-up area of Rahatpur village between km 43.500 to km 44.225 of NH-74. Improvement of existing road to 4 lane road will affect large number of structures including 2 (two) schools. The available ROW from km 43.500 to km 44.225 varies from 16 – 24 m, whereas the existing ROW varies from 16 – 26 m as per revenue village map. It may be noted that between km 43.800 & km 44.700 the existing ROW is only 16 m per revenue village map. Hence acquisition of additional land & structure is not feasible in this stretch & may be avoided.

Hence considering the above, bypass has been proposed between km 42.598 to km 54.053 of NH-74 covering Rahatpur village and Najibabad town on right side of NH-74.

Need for Realignment at Daultabad (km 66.407 to km 68.325)

From km 67.000 to km 67.450 of NH-74 there is built-up area of Daultabad village. The available RoW in this stretch varies from 18 – 22 m broadly with average value of 20 m. The existing RoW varies from 29 – 35 m (average ROW 29 m) as per revenue village map. Thus there is an encroachment of land of around 9 m. As the built-up area is well & deeply developed, it will not be possible to remove the encroachments on either side of road and also it is virtually impossible to acquire the additional RoW land on either side of road. Large number of structures will be affected if improvement of existing road is done, which is not feasible and may be avoided. Hence it is recommended to realign the road at Daultabad village between existing km 66.407 & km 68.325 of NH-74.

Need for Realignment at Kotwali (km 68.693 to km 70.995)

At existing Ch 69.850 of NH-74 there is a major junction due to crossing of NH-74 & SH-2. According to guidelines of IRC: SP: 84-2009, grade separator is required to be provided at this intersection. The existing alignment of NH-74 takes a sharp left turn at this junction. Improvement of existing 15 m radius to minimum 400 m will cause acquisition of lots of houses/shops & structures, which is not feasible.

Built-up area of Kotwali town exist between existing Ch 69.500 & Ch 70.150 of NH-74.The available ROW in built-up area varies from 19m – 35 m with average value of 30 m. The existing ROW between existing Ch 69.500 & Ch 70.150 of NH-74 as per revenue village map varies from 25 m – 35 m with average value of 30 m.

For a 4 lane divided road with service road on both sides, minimum 46.5 m ROW is required, for which additional 15 – 20 m width of land has to be acquired, which is not feasible as large number of structures will be affected, considering the well populated built-up area (shops & houses) along both sides of road.

It may also be noted that provision of 400 m radius for grade separated structure (i.e. Flyover) will result in shifting of centre line of road by around 250 m on left side, which is not possible to be incorporated considering the site constraints & built-up area. Hence improvement of existing road may be avoided.

Therefore, considering the above, realignment of road has been proposed at Kotwali on left side between existing km 68.693 & km 70.995 of NH-74.

Need for Bypass at Nagina (km 73.362 to km 79.808)

Built-up area of Nagina town is spread from km 74.450 to km 78.550 of NH-74. The stretch of road from km 76.300 to km 77.000 of NH-74 is most congested. The available ROW from existing km 76.300 to km 77.000 is around 14 – 19 m, with an average value of around 15 m. The existing ROW for the corresponding stretch as per the revenue village map is 14 m. From km 76.300 to km 77.000, railway station area is situated on right side and residential & commercial area is on left side. Nagina Railway station is at km 76.800 on right side. Acquisition of additional land will affect large number of structures and consequently the inhabitants tremendously and will create R&R problems. Site conditions do not permit for additional land acquisition.

Further, there is rail-road level crossing at km 76.225 and a minor junction at km 76.300. From junction at km 76.300, the road turns at 900. Construction of ROB (at km 76.225) along with improvement of Junction (at km 76.300) with proper geometry would not be possible.

Hence considering the above, Bypass has been proposed at Nagina on right side between existing km 73.362 & km 79.808 of NH-74.

Need for Bypass at Dhampur (km 92.265 to km 97.005)

The built-up area of Dhampur town is lying between existing km 92.800 & km 96.000 of NH-74. The available ROW from km 92.800 to km 96.000 varies from 17 m - 32 m. But from km 92.800 to km 95.100, the available ROW varies from 17 m – 26 m, with an average value of 23 m. Built-up area of Dhampur town is well developed and densely populated. Acquisition

of additional land is not feasible inside Dhampur town, as large number of structures will be affected and it will create R&R problems. Dhampur is the Sub Divisional town under Bijnor district of UP and it a good commercial centre with lot of Government offices, educational institutions and other activities.

There are 2 (two) major junction at existing km 93.850 and km 95.150 at Dhampur, on which grade separated structures (Flyovers) will have to be provided as per IRC:SP:84-2009. At km 93.850 the road turns to left at almost 900. Considering the site constraints improvement of junction will require acquisition of additional land which is not feasible.

For a 4 lane divided road with service road on both sides, minimum 46.5 m ROW is required, for which additional 24 m width of land has to be acquired, which is not possible considering the well populated built-up area (shops & houses) along both sides of road.

Hence considering the above, Bypass has been proposed at Dhampur on left side between existing km 92.265 & km 97.005 of NH-74.

Need for Realignment at Afjalgarh (km 117.195 to km 120.517)

Built-up area of Afjalgarh extends from existing km 118.460 to km 119.450. At Afjalgarh the available ROW from km 118.460 to km 119.450 varies from 20 m – 30 m, with an average value of 25 m. However between existing km 118.800 & km 119.300 the available ROW varies from 20m – 26 m, with an average ROW of 24 m. As per revenue village map, the existing ROW from km 118.460 to km 119.450 varies from 20 m – 34 m, with an average value of 25 m.

For a 4 lane divided road with service road on both sides, minimum 46.5 m ROW is required, for which additional 13 - 20 m width of land has to be acquired, which is not possible considering the well populated built-up area (shops & houses) along both sides of road.

Further there is a junction at existing km 119.135 of NH-74 where the road takes sharp right turn for Kashipur at an angle less than 900. The improvement of junction will require acquisition of more land width.

Considering that large number of structures will be affected, improvement of existing road to 4 lane road is not feasible at Afjalgarh and may be avoided.

Hence, realignment of road has been proposed at Afjalgarh on right side between existing km 117.195 & km 120.517 of NH-74.

Need for Realignment at Udhhowala (km 122.594 to km 126.335)

Built-up area of Udhhowala village extends from existing km 123.150 to km 123.950. At Udhhowala the available ROW from km 123.150 to km 123.950 varies from 8 m – 30 m, with an average value of 19 m. However between existing km 123.600 & km 123.875 the available ROW varies from 8 m – 9 m, showing that project road passes through a very congested stretch. As per revenue village map, the existing ROW from km 123.150 to km 123.950 varies from 18 m – 25 m, with an average value of 20 m. This shows that there is encroachment of around 5 m – 10 m in Udhhowala village. But even then the existing ROW is insufficient for a 4 lane road with service road.

Further, built-up area of Kashimpur village also exists from km 124.100 to km 125.400 of NH-74. The available ROW from km 124.100 to km 125.400 varies from 8 – 23 m with an average value of 20 m and existing ROW varies from 19 – 23 m with an average value of 20 m.

Improvement of existing road to 4 lane divided road with or without service road configuration will affect a large number of structures at Udhhowala and Kashimpur villages, which may be avoided.

On both side of road population of inhabitants is dense. Acquisition of additional land will affect the inhabitants.

Considering the above, realignment of road has been proposed between existing km 122.594 to km 126.335 of NH-74 covering Udhhowala and Kashimpur villages on right of NH-74.

Hence considering the above, bypass has been proposed between km 42.598 to km 54.053 of NH-74 covering Rahatpur village and Najibabad town on right side of NH-74.

Need for Bypass at Jaspur (km 135.487 to km 145.935)

Jaspur town comes under Udham Singh Nagar district of Uttarakhand state. Built-up area of Jaspur is spread from km 138.550 to km 141.900 of NH74. The available ROW from km 138.550 to km 141.900 varies from 8 m - 29 m, with an average value of 18 m. However from existing km 139.325 to km 140.700, the available ROW varies from 8 m – 15 m, with an average value of 11.5 m.

As per revenue village map, the existing ROW from km 138.550 to km 141.900 of NH74 varies from 9 m – 24 m, with an average value of 16 m. However from existing km 139.325 to km 140.700, the existing ROW as per revenue village map, varies from 9 m – 15 m, with an average value of 11.0 m.

There is huge congestion along the road in the main town for a length of around 2 km. The movement and volume of local traffic is also substantial. Acquisition of additional land will affect the inhabitants tremendously as the area is hugely & deeply populated. Further the geometrics of the road inside the Jaspur town are also not good, which require improvements.

For a 4 lane divided road with service road on both sides, minimum 46.5 m ROW is required, for which additional 25 m - 38 m width of land has to be acquired, which is not feasible. Acquisition of land will affect large number of structures, which may be avoided.

A PIL is already there in the Nainital High Court on which hearing is going on and the Honb'le High Court is pressing NHAI to construct the Bypass at Jaspur as soon as possible.

Hence considering the above facts for safe & smooth flow of traffic and the site condition as mentioned above, it is recommended to construct the bypass at Jaspur between existing km 135.487 & km 145.935 of NH-74 on left side.

Need for Bypass at Kashipur (km 149.445 to km 174.880)

Kashipur is one of the most important town under Udham Singh Nagar district of Uttarakhand state. Built-up area of Kashipur town is spread from existing km 156.000 to km 161.100 of NH74. There is huge congestion in Kashipur town, which creates impediments in safe and smooth flow of traffic. Traffic congestion has been observed extremely from existing km 157.350 to km 158.800. The available ROW from existing km 157.350 to km 158.800 varies from 13 m – 21 m, with an average value of 16.5 m. From existing km 156.000 to km 157.350 and km 158.800 to km 161.100, the available ROW varies from 14 m – 49 m (average ROW 33 m) and 16 m – 39 m (average value 22.5 m) respectively.

As per revenue village map, the existing ROW from existing km 156.000 to km 157.275, km 157.275 to km 158.470 and km 158.470 to km 161.100, varies from 18 m – 47 m (average ROW 33 m), 10 m – 22 m (average ROW 14 m) and 16 m – 36 m (average ROW 25 m) respectively.

The area abutting the road in Kasipur town is densely & deeply populated with commercial activities. Kashipur Railway Station is situated at km 157.700 on right side. There is a major junction (NH121 & NH-74) at km 158.350. Kashipur Bus Depot is at km 158.650 on right side. There is a rail-road level crossing at km 158.600 of NH-74. There is frequent closure of gate at rail-road level crossing (LC), which causes traffic jam on both side of LC with traffic queue extending for a kilometre on either side of LC. The movement and volume of local traffic is also substantial. During peak hour traffic jam extends for 1-2 hours. There is no scope for acquisition of additional land in Kashipur town. Acquisition of additional land will affect the inhabitants tremendously and will create serious R&R problems.

For a 4 lane divided road with service road on both sides, minimum 46.5 m ROW is required, for which additional 20 m - 37 m width of land has to be acquired, which is not feasible.

Many VIP references have been sent to Uttarakhand PWD NH Division Haldwani, Govt. of Uttarakhand and MoRT&H for construction of a bypass at Kashipur. The PWD NH Division Haldwani had already submitted a proposal to MoRT&H New Delhi for construction of a bypass at Kashipur between existing km 153.000 to km 167.000 of NH74 on right side.

Further, built-up area of Sultanpurpatti village also exists between km 171.000 & km 172.600 of NH-74. The available ROW between km 171.000 & km 172.600 varies from 23 – 30 m. The existing ROW between km 171.100 & km 172.200 and km 172.200 & km 172.800 are around 10 m and 30 m respectively as per revenue village map.

There are 3 (three) nos. sharp horizontal curves at km 171.420, km 171.620 & km 172.200 of NH-74 at Sultanpurpatti village area.

At Sultanpurpatti village also a large number of structures will be affected in case of land acquisition, which may be avoided. Thus improvement of existing road to 4 lane standard at Sultanpurpatti village is also not feasible.

Hence considering the above facts for safe & smooth flow of traffic and the site condition as mentioned above, it is recommended to construct the bypass covering Kashipur town & Sultanpurpatti village between existing km 149.445 & km 174.880 of NH-74 on right side.

Based on Alignment Options Study of Realignments/Bypass Alternatives, the Consultant has recommended realignments/bypasses at Shyampur (Km 9.368 to Km 10.480), Mandawali

(km 39.275 to km 41.030), Najibabad (km 42.598 to km 54.053 of NH-74), Daultabad (Km 66.407 to Km 68.325 of NH-74), Kotwali (km 68.693 to km 70.995 of NH-74), Nagina (km 73.362 to km 79.808 of NH-74), Dhampur (km 92.265 to km 97.005 of NH-74), Afjalgarh (km 117.195 to km 120.517 of NH-74), Udhhowala (km 122.594 to km 126.335 of NH-74), Jaspur (km 135.487 to km 145.935 of NH-74) and Kashipur (km 149.445 to km 174.880 of NH-74).

All the Bypasses/ Realignment shall be constructed as 4 lane divided road. The summary of preferred alternative of bypasses is detailed in **Table3.5** below:

Table 3.5 Summary of Recommended Bypass/Realignment

Bypass	Start Point		End Point		Length of Bypass (km)	Length on NH-74 (km)	Cost of Civil Works (Rs. millions)
	Place	Existing Chainage on NH-74	Place	Existing Chainage on NH-74			
Realignment at Shyampur	Shyampur	km 9+368 of NH-74	Shyampur	km 10+480 of NH-74	1.145	1.163	182.028
Realignment at Mandawali	Meerampur	km 39+275 of NH-74	Mandawali	km 41+030 of NH-74	1.926	2.09	128.362
Najibabad Bypass	Rahatpur	km 42+598 of NH-74	Fajalpur	km 54+053 of NH-74	10.066	11.828	1324.358
Realignment at Daultabad	Daultabad	km 66+407 of NH-74	Ghosipur	km 68+325 of NH-74	2.269	1.91	163.404
Realignment at Kotwali	Gaunsipur	km 68+693 of NH-74	Roshanpur	km 70+995 of NH-74	1.604	2.34	98.173
Nagina Bypass	Nagina	km 73+362 of NH-74	Aligarh	km 79+808 of NH-74	5.602	6.486	581.490
Dhampur Bypass	Rashulpur Amla	km 92+265 of NH-74	Dhampur	km 97+005 of NH-74	4.306	4.935	308.390
Realignment at Afjalgarh	Chauwala	km 117+195 of NH-74	Afzalgarh	km 120+517 of NH-74	2.412	3.312	185.667
Udhhowala Bypass	Zigariwala	km 122+594 of NH-74	Badhigarh	km 126+335 of NH-74	3.795	3.94	339.155
Jaspur Bypass	Kishanpura	km 135+487	Govindpur	km 145+935 of	11.342	10.5	737.862

Bypass	Start Point		End Point		Length of Bypass (km)	Length on NH-74 (km)	Cost of Civil Works (Rs. millions)
	Place	Existing Chainage on NH-74	Place	Existing Chainage on NH-74			
		of NH-74		NH-74			
Kashipur Bypass	Kunda	km 149+445 of NH-74	Jagannathpur	km 174+880 of NH-74	22.962	24.888	2314.846

CHAPTER - 4

DESCRIPTION OF THE ENVIRONMENT

This chapter assesses the nature, type and dimensions of the study area and describes the physical, biological, culture components along the Road. The baseline data on the Environmental Components were generated by primary surveys conducted during project preparation including EIA study, interactions at various levels with local people and other stakeholders. The socio-economic profile has been distilled from the census report and the RAP Report.

4.1 PROJECT AREA

4.2 PHYSICAL ENVIRONMENT

The project road falls in two states, Uttarakhand and Uttar Pradesh. Uttarkahand is a state in the northern part of India. It extends from 28º 43' N to 31º 27' N latitude and 77º 34'E to 81º 02' E longitude. Uttarakhand is surrounding by Nepal in the East, China in the North, Himachal Pradesh in the West and U.P. in the South. Uttarakhand has a total geographic area of 53,566 km², of which 93% is mountainous. The state is endowed with good forest cover extending to about 64%of its geographical area. Most of the northern parts of the state are part of Greater Himalaya ranges, covered by the high Himalayan peaks and glaciers. Uttar Pradesh is a state located in the north western part of India. With an area of 243,290 km^2, Uttar Pradesh covers a large part of the highly fertile and densely populated upper Gangetic plain. It lies between 23º 52'N and 31º 28' N latitude and 77º 5'E and 84º 38' E longitude. The state can be divided into three physiographic regions viz. the northern mountains of Himalaya, the southern hills and plateau and the vast alluvial Gangetic plains between the two. It shares an international border with Nepal to the north. Other states along Uttar Pradesh's border include Uttarakhand, Haryana and Delhi to the north and northwest, Rajasthan on the west, Madhya Pradesh on the south, Chhattisgarh and Jharkhand on the south east, and Bihar on the east.

This section of project road is situated partially in Haridwar & Udham Singh Nagar districts of Uttarakhand and partially Bijnor district of UP. The stretch of road from km 0.000 to km 30.000 and km 132.000 to km 175.000 of NH-74 lies in Haridwar & Udham Singh Nagar districts of Uttarakhand respectively. The remaining stretch of NH-74 from km 30.000 to km 132.000 lies in Bijnor district of UP. Haridwar is located at 29°58' N and 78°09' E, Najibabad is located at 29°40'N and 78°20'E and the Kashipur is located at 29°15' N and 79°00' E.

4.2.1 Meteorology

The study of meteorological and micro meteorological parameters is significant in a road project as these parameters regulate transport and diffusion of pollutants released in atmosphere.

Climate

Uttarakhand-Climate

The climate of Uttarakhand is stridently distinguished in its two diverse divisions: the major hilly terrain and the smaller plains. The northern part of the state enveloped in the mighty Himalayas shows complete traits of Himalayan climate exerting an appreciable extent of influence on monsoon and rainfall patterns. The climate however also varies within the mountains in accordance with the altitude of the place. In the southern foothills, the average summer temperatures vary between 30 ^{o}C and 18 ^{o}C and winter is also bearable and normal. In the areas of the Middle Himalayas, the summer temperatures are usually around 15^{0}C and 18 ^{0}C; however winters temperature even drop below the freezing point. The higher altitudes of Himalayas (more than 15,000 feet) are cold throughout the year and at times become inaccessible due to heavy snowfall. The eastern edges of the Himalayan ranges are subject to heavy rainfall while the western division is relatively dry. However in Gangetic plains, summers are extremely hot and humid with temperature crossing the 40 ^{o}C mark. Winters here can be relatively quite cold with temperatures dipping below 50 ^{o}C at times.

Uttar Pradesh-Climate

The climate of Uttar Pradesh is predominantly subtropical but weather conditions change significantly with location and seasons:

Temperature: Depending on the elevation, the average temperatures vary from 12.5–17.5 °C (55–64 °F) in January to 27.5–32.5 °C (82–91 °F) in May and June. The highest temperature recorded in the State was 49.9 °C (121.8 °F) at Gonda on 8 May 1958.

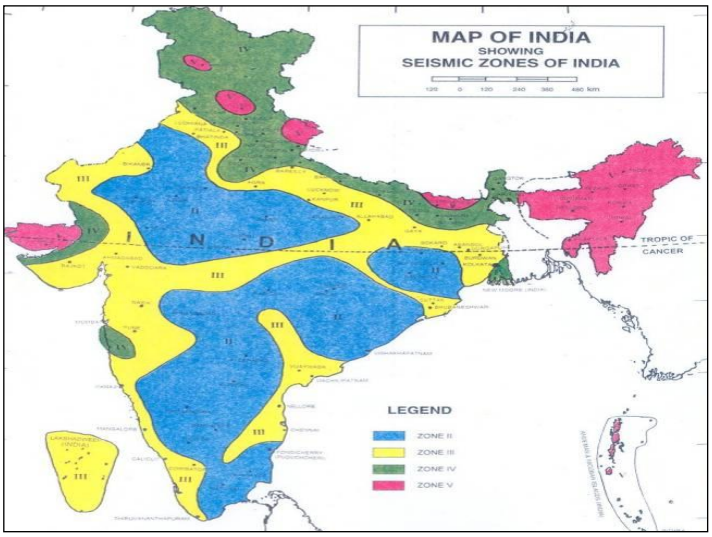
Rainfall: Rainfall in the State ranges from 1,000–2,000 mm (39–79 in) in the east to 600–1,000 mm (24–39 in) in the west. About 90% of the rainfall occurs during the southwest Monsoon, lasting from about June to September. With most of the rainfall concentrated during this four-month period, floods are a recurring problem and cause heavy damage to crops, life, and property, particularly in the eastern part of the state, where the Himalayan-origin rivers flow with a very low north-south gradient.

4.2.2 Land

Seismicity

The project area falls in zone IV of seismic zone, in accordance with seismic zoning map, Fig: 4.1. Suitable seismic factor, as per the India Meteorological Department (IMD), would be adequate and considered for design purpose for Civil Engineering structures and while finishing civil designs.

Fig. 4.1 Seismic Map of India



Geology

The geology of the region belongs to Cenozoic era. These rocks have valuble deposits of petroleum and coal. Further the north rocks found in the Simla area are divided into three series, the Sabathu series consisting of grey and red shales, the Dagshai series comprising bright red clays and the Kasauli series comprising sandstones. Along the foothills of the Himilayas the Siwalik molasse is composed of sandstones, conglomerates and shales with thicknesses of 16,000 feet (4,877 m) to 20,000 feet (6,096 m) and ranging from Eocene to Pliocene. These rocks are famous for their rich fossil vertebrate fauna including many fossil hominoids.

Geology of Uttarakhand

The Uttarakhand hills forms the easternmost part of the western Himalayas. The geology of this region resembles that of Himachal Pradesh in the west and Nepal in the east. The main difference between the geology of Himachal Pradesh and Garhwal-Kumaun is that in the former area, the tethyan zone is very well developed.

From south to north, the Uttarakhand Himalayas may be divided into:

1. Siwalik Himalayas or Sub-Himalayas
2. Lower or lesser Himalayas
3. Central or Higher Himalayas
4. Trans or Tibetan or Tethvan Himalayas

Geology of Uttar Pradesh

The State of Uttar Pradesh comprises an area of about 2,40,928 sq. km and forms one of the largest states in the country. It extends from latitude 23052'15": 30025'05"N and

longitude 77005'36" : 84038'10"E and is characterized by rock formations ranging in age from the Archean (the Bundelkhand Granitic gneisses) to the Recent (the Ganga alluvium).

The Ganga plain which dominates the landscape and nearly covers three fourth of the geographical area of the State, lies between the rocky Himalayan belt in the north and the southern hilly tract comprised of mainly Pre-Cambrian rocks. Flexing of the Indian lithosphere in response to the compressive forces due to collision, and thrust fold loading produced the Ganga Plain foreland basin. It is filled with recent alluvial sediments which is at places more than 1,000 m. thick and an amalgams of sand, silt, clay in varying proportions.

The southern hilly tract is roughly parallel to the Ganga-Yamuna lineament. The tract is underlain by granitic complex in Bundelkhand region and in Sonbhadra. It is overlain by rocks Mahakoshal (Bijawar) and Vindhyan Supergroup. The younger rock comprise of coal bearing Gondwana in south Sonbhadra and basaltic rocks in southern part of Lalitpur. The granitic complex is considered to be potential for the search of metallic minerals like copper, lead, zinc, molybdenum, gold, nickel, Uranium and Platinum group of elements. The overlying sediments of Mahakoshal (Bijawar) and associated Iron Formation show a potential for the search of copper, uranium, and gold in Lalitpur and andalusite, sillimanite, gold, calcite, marble and clay in sonbhadra. The lower Vindhyan sediments of Sonbhadra contain deposits of cement grade limestone, flux grade dolomites, building stone and is also potential for the search of placer gold and other metals. While the Upper Vindhyan sandstones are suitable for making decorative slab/tiles or ballast. Deposits of silica sands and bauxite are available in Allahabad and chitrakoot districts while coal deposits occur in the Gondwana rocks in southwestern corner of Sonbhadra.

Soil

The formation soil type along all the stretches of the project road is alluvial soil (predominantly Silty Sand, some locations it may be Silty Clayey Sand) in plain terrain and matrix of sand-silt-clay-intermixed with boulders in hilly terrain. Soil type falls under the semi-impervious to impervious category. As per the soil classification for highway pavement construction use, the soil falls under poor to fair category for base course construction. However, it is fairly suitable for forming homogeneous embankment.

Minerals

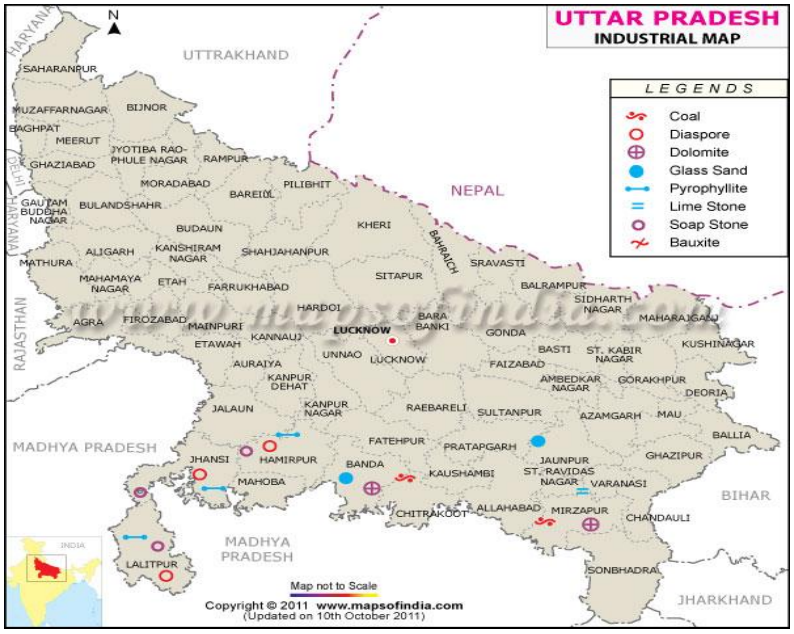
Mineral resources of Uttarakhand play a significant role in the economy of Uttarakhand. Although, the mineral resources of Uttarakhand are not as varied as that of other Indian states, yet mineral resources at Uttarakhand largely contribute towards the economic well being of the state.

The Chamoli district of Uttarakhand is especially famous for housing a number of mineral resources in Uttarakhand. The northern division of the district consist entirely of medium to high grade metamorphic rocks, which also contains bands of volcanic rocks in some areas; the southern division contains sedimentary and low-grade metamorphic rocks, with bands of volcanic rocks in some regions

Although much is not known about the geology of the first division of Chamoli, yet the

mineral resources contain rocks such as quartzite, marble, and various types of schist and gneiss. The southern division contains rocks such as gneiss, limestone, phyllites, quartzite, sericite- biotite schist and slate. Mineral map of Uttarkhand and Uttar Pradesh is presented in **Fig. 4.2.**

Fig. 4.2 Mineral Map of Uttar Pradesh and Uttarakhand



Forests

Forests: This is the most important parameter in the environmental screening process because of the biodiversity related issues. More over if impacted it requires many months /years of legal process to obtain clearance for environmental and forestry clearances if the Forest in various importance (RF, Sanctuary, National parks etc) are impacted.

Uttarakhand

Uttarakhand has about 65% of its island under forests. Forest cover of Uttarkhand is presented in **Fig.4.3**. Most of it is managed by the Forest Department. The variation in the landscape has created great diversity of flora and fauna, and consequently, resources. The Department has added to these resources through plantation activities. The resources pertaining to forest areas are briefly mentioned below.

Uttar Pradesh

Forests constitute about 12.8% of the total geographical area of the state. The Himalayan region and the terai and bhabhar area in the Gangetic plain have most of the forests. The Vindhyan forests consist mostly of scrub. The districts of Jaunpur, Ghazipur and Ballia have no forest land, while 31 other districts have less forest area. Forest cover of Uttar Pradesh is presented in **Fig.4.4.**

Fig. 4.3: Forest Map of Uttarakhand

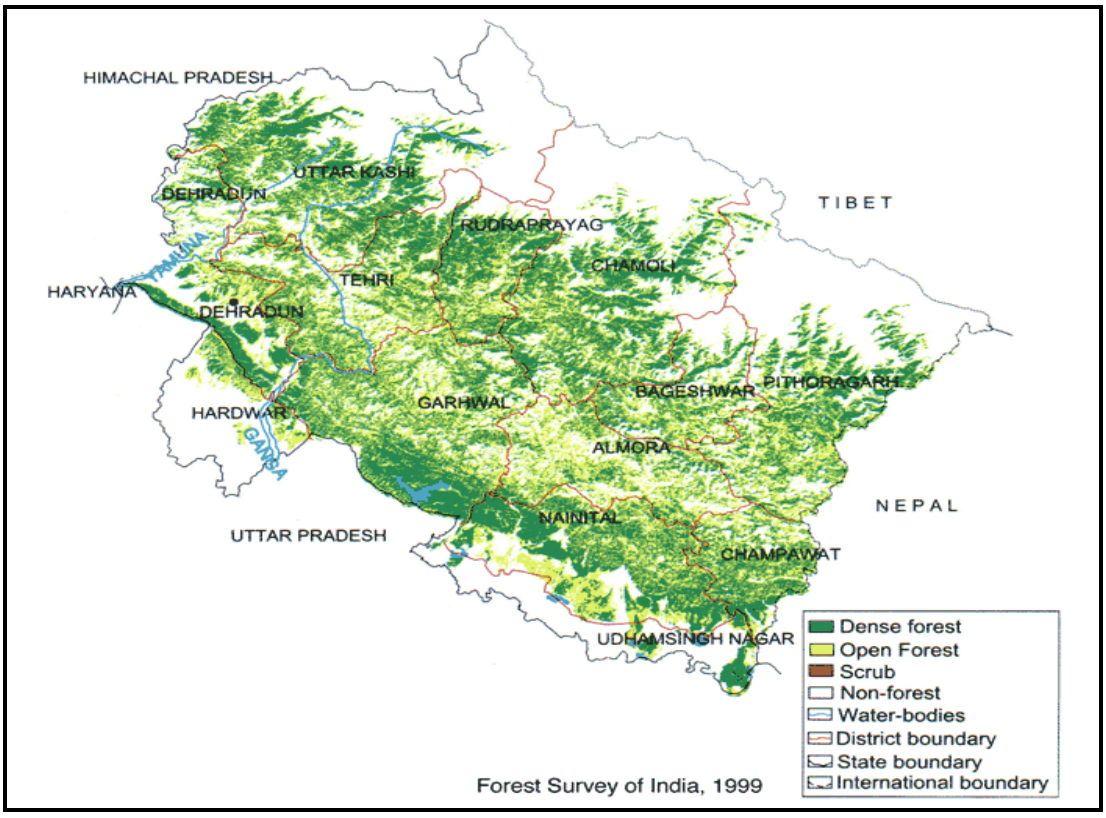
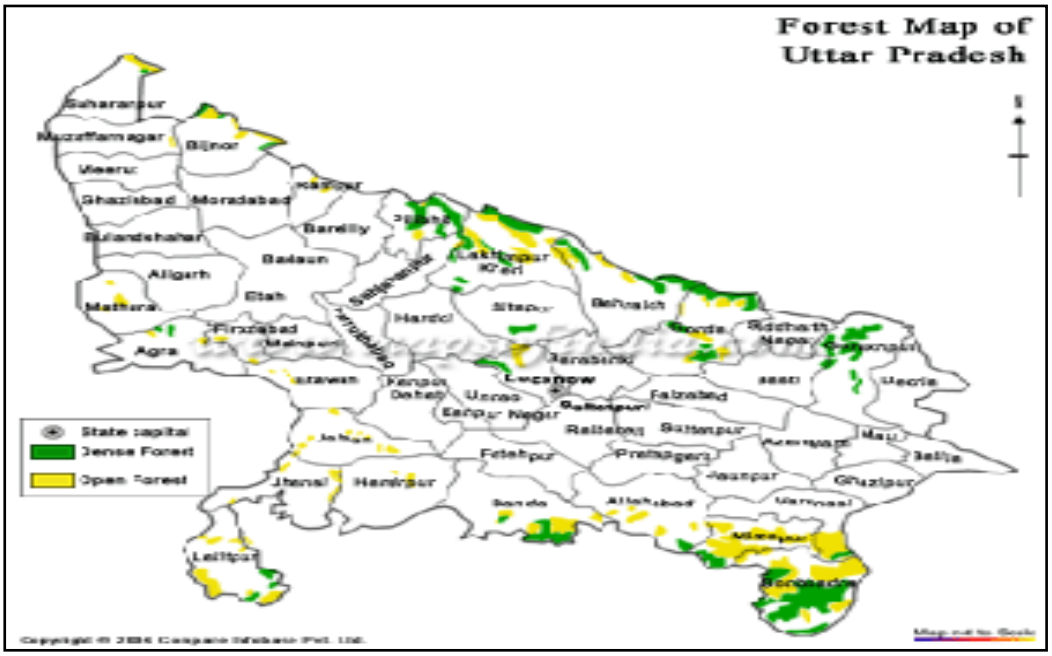


Fig. 4.4 Forest map of Uttar Pradesh



4.3 DESCRIPTION OF ENVIRONMENT

4.3.1 AIR ENVIRONMENT

Dispersion of different air pollutants released into the atmosphere has significant impacts on the neighborhood air environment of an industrial/project and forms an important part of impact assessment studies. The ambient air quality status with respect to the study zone of 10 km along the road alignment will form the base line information over which the predicted impacts due to the proposed expansion of project can be super imposed to find out the net (Final) impacts on air environment. From the final impacts a viable Environmental Management Plan (EMP) can be prepared based on the impact statement for the air environment. The baseline status of the ambient air quality can be assessed thorough scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has to be based on the following considerations.

- *Meteorological conditions on synoptic scale*
- *Topography of the study area*
- *Representation of regional background levels*
- *Representation of cross sectional distribution in the downward direction*
- *Influence of the existing sources if any, are to be kept at minimum*
- *Inclusion of major distinct villages to collect the baseline status*

4.3.2 Micrometeorological Data

Micro-meteorological data within the project area during the air quality survey period is an indispensable part of air pollution study. The meteorological data recorded during survey period is very useful for proper interpretation of the baseline information as well as for input, to predictive models for air quality impacts.

To understand meteorological scenario the parameters considered for primary data collection and interpretation are presented in **Table 4.1.**

Table 4.1 Micro-meteorological Parameters Considered for Study

Meteorological data	Primary data: Hourly data collected at site using AWS (10 days) Wind speed, Direction, Temperature, RH,RF & Solar radiation

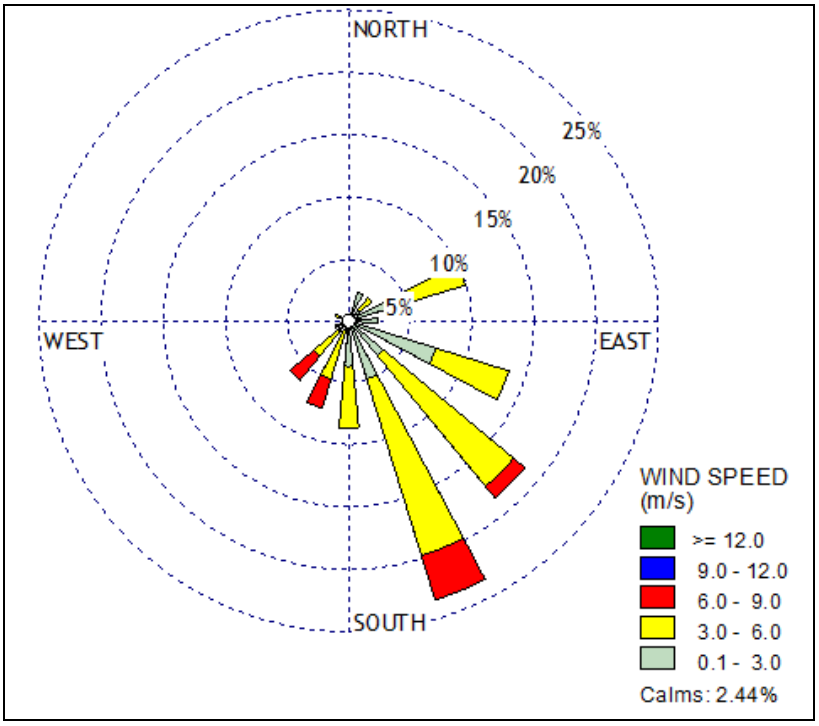
Meteorology of the study zones plays an important role in the study of air pollution. Micrometeorological conditions at the proposed project site regulate the dispersion and dilution of air pollutants in the atmosphere. For this purpose a weather station was installed near the Chhutmalpur for 10 days and recorded hourly observations for the parameters like Temperatures (ºC), Relative Humidity (%), Wind Speed (km/hr), Wind direction, Solar radiation and Rainfall (mm). Summary of the results are presented in **Table 4.2.**

The hourly-recorded observations (wind velocity and wind direction) during the study period are used in computing percentage frequencies (0-7 morning, 8-15 noon, 16-23 evening & 0-24 hrs) and are depicted in the form of ‘wind roses’ in **Fig. 4.5**.

Table 4.2 Summary Results of Micro-meteorological Observations

Period	Predominant Wind direction	Wind Speed		Temperature(^{0}C)			Relative Humidity (%)	Rain fall
		(Kmph) Max.	% Calm	Mean	Max.	Min.		No. of rainy days
May-12	SSE	8	10.33	31	35	27	67	-

Fig 4.5 Meteorological Scenario-Wind Rose



4.3.3 Ambient Air Quality

The monitoring of the ambient air quality (AAQ) for the various land uses along the project corridor was carried, by taking 24 hourly samples at each location as per guidelines of Central Pollution Control Board (CPCB) and the requirements of MoEF.

4.3.3.1 Selection of AAQ Stations

A network of six ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone (Fig. 4.6). The heights of the sampling locations were kept between 3 to 6 m in all the locations. After reconnaissance of the area and observing the topographical features and review of the available meteorological data and local conditions the sampling sites were chosen which will be the representative of the local areas under study.

Baseline AAQ Monitoring

AAQ Stations were also considered with an idea of establishing correlation between pollution levels and road geometrics and air pollution and land use along the road. The methodology for the monitoring including instruments and techniques has been in accordance with the guidelines laid by the CPCB. Although the selection of locations is not in direct connivance with the traffic locations, the total no of stations have been distributed throughout the study area so as to get representative baseline of any variation in land use as well as road geometrics and traffic conditions across the project road. The purpose is also to establish a benchmark, which can form the reference for monitoring in the construction and operation phases. The following **Table 4.3** gives the criteria for selection of the monitoring stations and **Tabe 4.4** shows the details of the Air Quality Monitoring stations.

Ambient level of pollutants such PM_{10}, $PM_{2.5}$, SO_2, NOx and Carbon Monoxide was determined. The methodology of sampling and analysis in detail is given in the following tables.

Air – Parameters Analyzed and Sampling Duration

Attribute	Parameter	Frequency of Monitoring
AAQ	PM_{10},$PM_{2.5}$ SO_2 , NO_x & CO	24 hr sampling for PM_{10}, $PM_{2.5}$, SO_2, NOx & 8 hr sampling for CO & Sampling height varies between 3-6 m above ground level.

Ambient Air Quality - Methodology

	Pollutant			Method of analysis
Variables	Dust	PM_{10}	Particulate Matter less than 10µ size	FDS (fine dust sampler)
		$PM_{2.5}$	Particulate Matter less than 2.5µ size	FDS (fine dust sampler)
	Gases	SO_2	Sulfur dioxide	Improved West and Geake Method
		NOx	Nitrous Oxides	Jacob & Hochheisser Modified Na-Arsenate
		CO	Carbon Monoxide	GC method

Various statistical parameters like standard deviation, geometric mean, minimum, maximum concentrations and different percentiles have been computed from the data generated during sampling in all sampling stations (**Tables 4.4. to 4.6**).

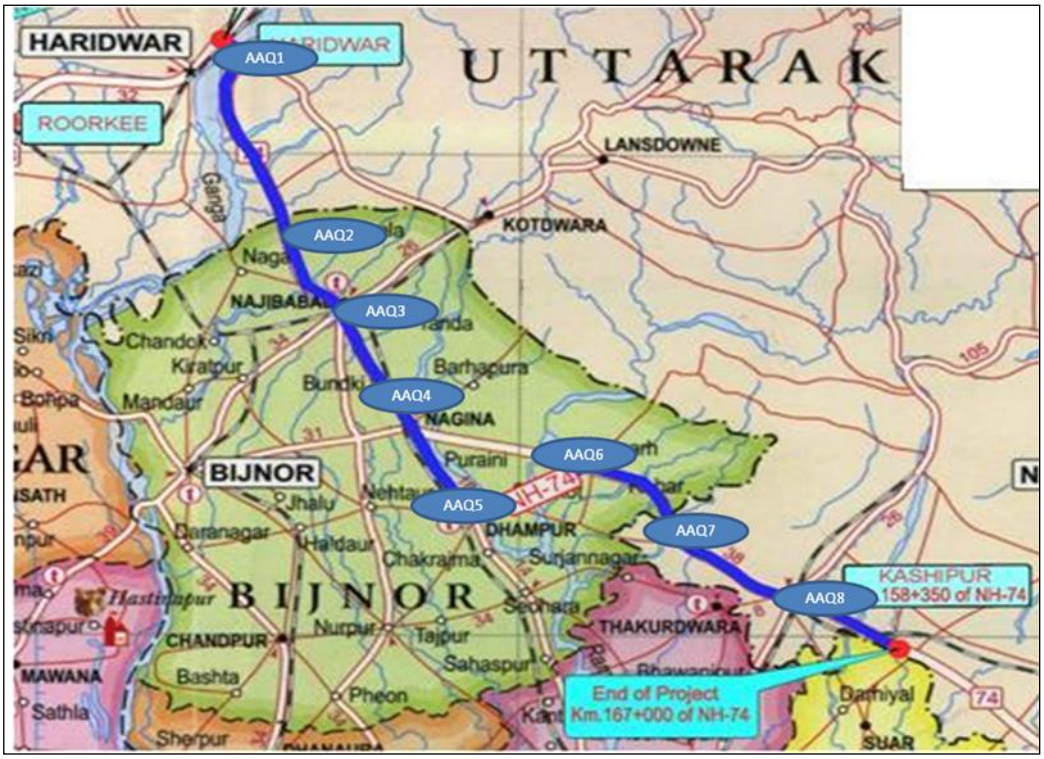
Table 4.3 Air Pollution Receptors Types Identified along the Project Road

Sl. No	Location of Receptor	Criteria for Selection
1	Near sensitive areas viz., educational institutes, hospitals, forest areas, etc.	To obtain baseline concentrations at sensitive receptors and benchmark existing pollution levels
2	Within urban areas	As a representative for concentrations in urban areas and also to check the available concentrations and to benchmark existing pollution levels
3	In rural areas that present a pristine environment	As a representative sample for obtaining the concentrations in rural areas and to benchmark existing pollution levels

Table 4.4 Details of Monitoring Station for Air Quality Monitoring

Sl. No.	Monitoring Station Code	Location
1	AAQ1	Haridwar
2	AAQ2	Bhagowalla Village
3	AAQ3	Najibabad
4	AAQ4	Nagina
5	AAQ5	Dhampur
6	AAQ6	Afzalgarh
7	AAQ7	Jaspur
8	AAQ8	Kashipur

Figure 4.6 Ambient Air Quality Monitoring Locations



Results & Analysis of Ambient Air Quality

The maximum concentration of PM_{10} and $PM_{2.5}$ was 140.0μg/m^3 and 76.0μg/m^3 at Haridwar and bhagowala village respectively. The maximum concentration of SO_2 found to be 16.0 μg/m^3 at Haridwar. The maximum concentration of NO_x found to be 21.0 μg/m^3. at Haridwar and Kashipur. The concentration of Carbon monoxide is found to be <0.2 mg/m^3 at all locations. The baseline study of the National highways NH74 and NH72A reveals that relatively high concentration of Particulate matter is found at all most all locations except Dhampur.since these locations are near to the National highway. All the other values, however, are found to be within the National Ambient Air Quality Standards.

Table 4.5 Summary of Ambient Air Quality Results

Sl. No.	Location	PM_{10} ($\mu g/m^3$)			$PM_{2.5}$ ($\mu g/m^3$)			SO_2 ($\mu g/m^3$)			NOx ($\mu g/m^3$)			CO (mg/m^3)
		Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	
1.	Haridwar	133	140	137	74	75	75	15	16	16	19	21	20	<0.2
2.	Bhagowalla Village	120	121	121	74	76	75	12	13	12	18	19	19	<0.2
3.	Najibabad	138	140	139	74	75	75	15	15	15	19	20	19	<0.2
4.	Nagina	96	111	104	57	65	62	12	14	13	18	19	19	<0.2
5.	Dhampur	91	93	92	56	59	57	13	14	13	18	19	18	<0.2
6.	Afzalgarh	104	120	114	70	71	70	13	14	14	18	19	19	<0.2
7.	Jaspur	101	103	102	61	62	61	12	12	12	18	19	18	<0.2
8.	Kashipur	110	112	111	65	65	65	12	13	12	21	21	21	<0.2

Avg: 24 hrs.

Source: Field Monitoring

4.3.4 Water Environment

4.3.4.1 Surface Water

Surface Water includes drainage channels (rivers, streams, and canals) and stagnant water bodies (lakes, ponds, tanks and other impounded water bodies). A highway project can significantly alter the hydrological setting of the project area by acting as an impediment to the natural drainage system of the region. It is therefore essential that all surface water resources and ground water resources and their characteristics be identified and examine along the project road. **Figure 4.7**

Figure 4.7 Ganga River Along the Project

Ganga River

The Ganges River is the greatest waterway in India; it is one of the longest rivers in the world. The Ganges river flows through Bangladesh, but the greater part of it flows through India. The river begins high in the Himalayas as a pair of head streams. It begins in an ice cave in the mountains about 10,300 feet above sea level. The river flows across the northern corner of India. The Ganges flows across India and Bangladesh until it empties out into the Bay of Bengal. The great river provides water to many places, and many places rely on it.

The Ganges River has always been known as a religious icon in the world. The River is known as a spiritual centre because the people of India rely on the river for most life functions in the area. The uses in India for the river are nearly endless; the main functions of the river are Agricultural use, Industry, as an energy source, transportation, Drinking, bathing, and baptisms. Along the river there are also many industries such as textiles, paper, leather, and many more who use the water for power, cleaning, etc. Power, which is used by industries, is also used by the common population.

The Ganga has an exalted position in the Hindu ethos. It is repeatedly invoked in the Vedas, the Puranas, and the two Indian epics, the Ramayana and the Mahabharata. Babies are baptized in the river because they believe it cleanses the child, also when a person dies and is cremated their remains are released into the river for the same reason, because they believe it cleanses the soul. Ganges is the ultimate adventure point as far as river rafting in India is concerned. And the major rafting site from where any experienced rafter as well as an amateur one would love to start of his rafting trip in India is Rishikesh. Even the rafting gear that you require is an ordinary one, that is if you like to get wet. The magic of white water rafting on the Ganges, the adrenaline rush with the thrill of negotiating speedy river currents or just gently floating past terraced hillsides and forest is one experience you wouldn't like to miss. The moods of the Ganges rafting trip can be as diverse as an adventure lover seeks.

In the Uttarakhand Himalayas where glacial water flowing from a cave at Gaumukh, is the origin of the Bhagirathi river. Gaumukh has been described as a desolate place at an altitude of about 4,000 meters (13,000 feet). Twenty-three kilometres from Gaumukh, the river reaches Gangotri, the first town on its path. Thousands of visitors come to Gangotri .each year, from every part of the world. The river which joins the Alaknanda river at Devaprayag, also in the Uttarakhand Himalayas, to form

the Ganga. The Ganga then flows through the Himalayan valleys and emerges into the north Indian plain at the town of Haridwar. The river is shown snaking through the Himalayan mountains as one long, sandy stretch minus any water. Other rivers emanating from the Gangotri glacier, including the Bhilangana, the Assi Ganga and the Alaknanda, all tributaries of the Ganga river, are also drying up.

Ganga River in Plains

On its 1,560-mi (2,510-km) course in plains, Ganga flows southeast through the Indian states of Uttar Pradesh, Bihar, and West Bengal. The Ganga passing some of the most populous cities of India, including Kanpur , Allahabad, Varanasi, Patna, and Kolkata. The Yamuna, which originates less than a hundred miles east of the Bhagirathi, flows parallel to the Ganga and a little to the south for most of its course before merging with the Ganga at the holy city of Allahabad, also known as Triveni Sangam. New Delhi, capital of India, and Agra, site of the Taj Mahal, are two of the major cities on the Yamuna River.

The largest tributary to the Ganga is the Ghaghara, which meets it before Patna,in Bihar,bearing much of the Himalayan glacier melt from Northern Nepal. The Gandak, which comes from near Katmandu, is another big Himalayan tributary. Other important rivers that merge with the Ganga are the Son, which originates in the hills of Madhya Pradesh, the Gomti which flows past Lucknow, and then meets with the river Chambal.

On its way it passes the towns of Mirzapur, Varanasi, Patna and Bhagalpur. At Bhagalpur, the river meanders past the Rajmahal Hills, and beings to change course southwards. At Pakaur, the river begins its first attrition with the branching away of its first distributary, the River Bhagirathi, which goes on to form the River Hooghly. Close to the border with Bangladesh, the Farakka Barrage, built in 1974 controls the flow of the Ganges, diverting some of the water into a feeder canal linking the Hooghly to keep it relatively silt free.After entering Bangladesh, the main branch of the Ganges is known as Padma River till it is joined by the Jamuna River the largest distributaries of the Brahmaputra. Further downstream, the Ganges is fed by the Meghna River, the second largest distributaries of the Brahmaputra and takes on its name. Fanning out into the 350 km (220 mi) wide Ganges Delta, it empties out into the Bay of Bengal. The delta of the Ganga, or rather, that of the Hooghly and the Padma, is a vast ragged swamp forest (42,000 sq km) called the Sundarbans world's largest Ganga delta.

Ramganga

Ramganga West river originates from Doodhatoli ranges in the district of Pauri Garhwal, Uttarakhand state of India. The river Ramganga flows to south west from Kumaun Himalaya. It is a tributary of the river Ganga, originates from the high altitude zone of 800m-900m. Ramganga flows by the Corbett National Park near Ramnagar of Nainital district from where it descends upon the plains. Bareilly city of Uttar Pradesh is situated on its banks. There is a dam across this river at Kalagarh for irrigation and hydroelectric

generation. An annual festival of Ganga Dassahra is organised on its banks annually during the months of September and October at Chaubari village near Bareilly.

Another Ramganga called Ramganga East originates from the Namik Glacier in Pithoragarh district of Uttarakhand and flows towards East. The river is fed by numerous small and big rivers and finally joins river Sarju at Rameshwar near Ghat of Pithoragarh. This river finally confluences with River Kali.

Water Quality

⊙ Selection of Sampling Location

Representative surface water and ground water monitoring stations was selected based on their importance as source of irrigation and water supply, size, future impacts and quantum of water available. The physical and chemical parameters of the collected samples were tested as per established standard methods and procedures. The locations selected for water sampling are presented in **Table 4.6.** And water sampling locations are shown in **Figure 4.8.**

The monitoring has been carried out with the following objectives:

- To establish the baseline water quality at critical locations to be impacted; and
- To work out the extent of enhancement of water resources along the corridor in terms of improvement of water quality.

Table 4.6 Details of Water Quality Monitoring Station

Sl. No.	Location Code	Location	Type of sample
1	GW1	Haridwar	Bore well
2	GW2	Nagina	Bore well
3	GW3	Afzalgarh	Bore well
4	GW4	Kashipur	Bore well
5	SW1	Ganga River(Near Haridwar)	Surface water
6	SW2	Near Najibabad	Surface water
7	SW3	Near Dhampur(Sherkot river)	Surface water
8	SW4	Near Jaspur	Surface water

Figure 4.8 Water Sampling Locations Along the Project Corridor

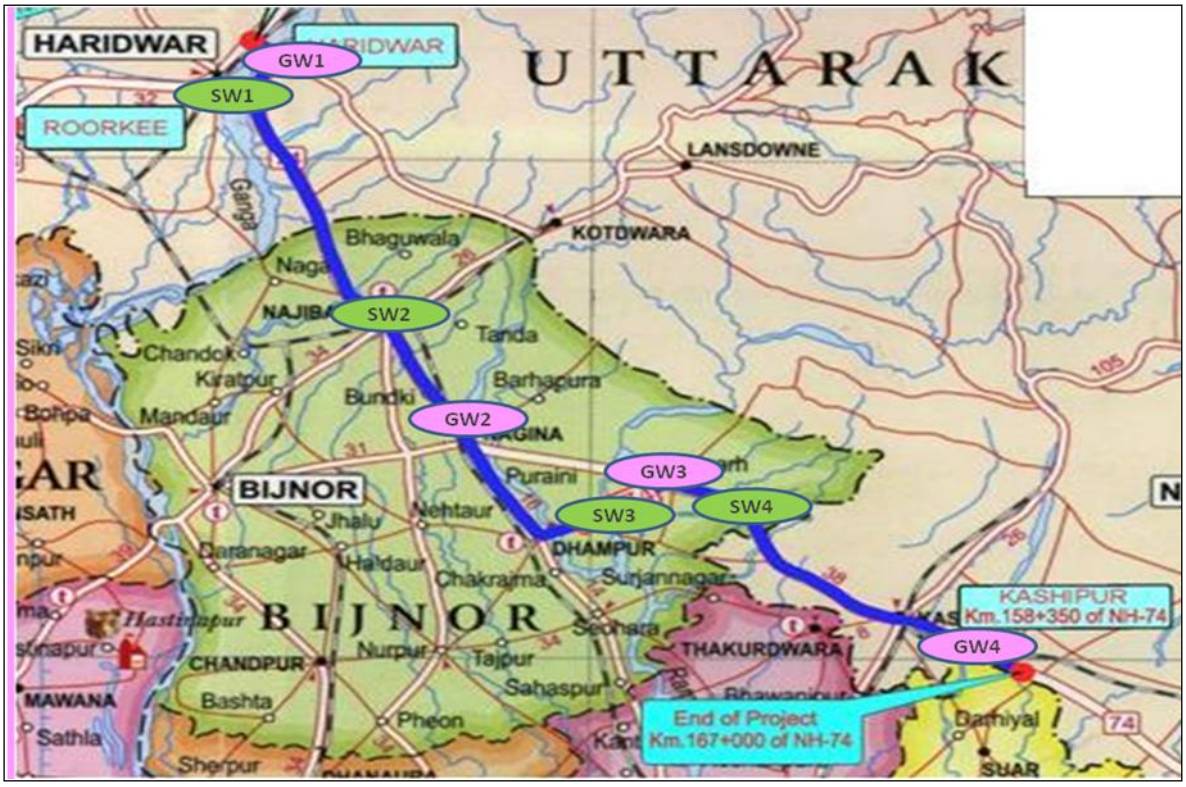


Table 4.7 a Water Quality - Physico-chemical Analysis of Ground Water

S.No	Test Parameters	Unit	Haridwar (GW1)	Nagina (GW2)	Afzalgarh (GW3)	Kashipur (GW4)	Requirements As per IS 10500: 1991	
							Desirable Limit	Permissible Limit
1	Colour	Hazen	< 5.0	< 5.0	< 5.0	< 5.0	5 Max	25 Max
2	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Turbidity	NTU	< 1.0	< 1.0	< 1.0	< 1.0	5 Max	10 Max
5	pH Value	--	7.64	7.61	7.62	7.64	6.5 – 8.5	6.5 - 8.5
6	Total Hardness	mg/l	159.0	48.9	44.8	118.2	300 Max	600 Max
7	Iron (as Fe)	mg/l	0.24	0.23	0.24	0.13	0.3 Max	1.0 Max
8	Chloride (as Cl)	mg/l	55.7	19.7	23.6	35.4	250 Max	1000 Max
9	Residual Free Chlorine	mg/l	Nil	Nil	Nil	Nil	0.2 min when chlorinated	

10	Total Dissolved Solid	mg/l	452.6	260	210.8	355.0	500 Max	2000 Max
11	Calcium (as Ca)	mg/l	57.1	11.4	16.3	24.5	75 Max	200 Max
12	Magnesium(as Mg)	mg/l	10.3	9.3	8.7	14.5	30 Max	100 Max
13	Manganese(as Mn)	mg/l	<0.01	<0.01	<0.01	<0.01	0.1 Max	0.3 Max
14	Sulphate (as SO_4)	mg/l	28.2	19.2	15.7	14.3	200 Max	400 Max
15	Nitrate (as NO_3)	mg/l	<1.0	<1.0	<1.0	<1.0	45 Max	100 Max
16	Fluoride (as F)	mg/l	0.17	0.17	0.08	0.12	1Max	1.5 Max
17	Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001	<0.001	0.001 Max	No Relaxation
18	Conductivity	µmhos/cm	730	420.6	340	574.6	--	--
19	BOD	mg/l	<2.0	<2.0	<2.0	<2.0	--	--
20	COD	mg/l	< 4.0	< 4.0	< 4.0	< 4.0	--	--
21	Lead(as Pb)	mg/l	< 0.01	< 0.01	< 0.01	< 0.01	0.05 Max	No Relaxation
22	Zinc (as Zn)	mg/l	<0.01	<0.01	<0.01	<0.01	5 Max	15 Max
23	Cr+6	mg/l	<0.01	<0.01	<0.01	<0.01	0.05Max	No Relaxation
24	E. Coli	Per 100ml	Absent	Absent	Absent	Absent	--	--
25	Alkalinity	mg/l	171.0	98.8	72.2	205.2	200 Max	600 Max
26	Total Coliforn	MPN/100ml	< 2.0	< 2.0	< 2.0	< 2.0	10 Max	--
27	F. Coliform	MPN/100ml	Absent	Absent	Absent	Absent	--	--

Note: Permissible Limit is applicable in the absence of Alternate source
Unobj: Unobjectionable; Agr: Agreeable; NR: No Relaxation; BDL: Below Detectable Limit

Table 4.7 b Water Quality - Physico-chemical Analysis of Surface Water

Sl. No	Parameter	Units	Ganga River(Near Haridwar) **(SW1)**	Near Najibabad **(SW2)**	Near Dhampur (Sherkot river) **(SW3)**	Near jaspur **(SW4)**	Test Method
1	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	IS 3025 P-5
2	Temperature	^{o}C	25^{o}C	25^{o}C	25^{o}C	25^{o}C	
3	pH Value	--	7.59	7.62	7.65	7.63	IS 3025 P-11
4	Conductivity at 25^{o}C	µmhos/cm	210.4	230	410	410	IS 3025 P-14
5	Total Dissolved Solids	mg/l	128.5	141.9	251.1	250.2	IS 3025 P-16
6	Total Suspended Solids	mg/l	15.60	12.72	2.52	2.40	IS 3025 P-17
7	Dissolved Oxygen (D.O)	mg/l	7.9	7.9	7.9	7.4	IS 3025 P-38
8	Biochemical Oxygen Demand (BOD) @27°C 3days	mg/l	<2.0	<2.0	<2.0	<2.0	IS 3025 P-44
9	Chemical Oxygen Demand (COD)	mg/l	<4.0	12.0	<4.0	<4.0	IS 3025 P-58
10	Phosphate (as PO_4)	mg/l	0.08	0.18	0.13	0.05	IS 3025 P-31
11	Total Coliform	MPN/100ml	$2.5x10^3$	$2.6x10^3$	$1.7x10^3$	$1.5x10^3$	IS 1622-1981
12	Faecal Coliform	MPN/100ml	$2.7x10^2$	$2.2x10^2$	$1.4x10^2$	$1.7x10^2$	IS 1622-1981
13	Appearance	Per 100ml	Clear	Clear	Clear	Clear	APHA 2110
14	Nitrate (as $NO_{3)}$	mg/l	2.30	1.09	<1.0	<1.0	IS 3025 P-34

Unobj: Unobjectionable; Agr: Agreeable

Results & Analysis of Water Quality Sampling

- As per IS: 10500 drinking water standards, the pH value shall be between 6.5 and 8.5. The pH in all the 4 water samples collected in the study area, ranged between .7.61 and 7.64. the pH value was 7.64 at both Haridwar and kashipur
- As per IS: 2296 Surface water standards, the pH value shall be between 6.5 and 8.5. The pH in all the 4 water samples collected in the study area, ranges between 7.6 and 7.7.
- The turbidity value was below 1.
- TDS for all the samples found be well within the permissible limits.
- The alkalinity values ranged between 98.8 and 2.2 mg/l. As per IS: 10500 the limits for alkalinity is 600mg/l.
- The chloride values ranged between 19.7 and 55.7mg/l.. and well were within the permissible limits
- The fluoride concentration in ground water ranges was found to be 0.08 and 0.17 mg/l.
- The nitrate concentration in ground water ranged <1.0 mg/l.
- The sulphates concentration in ground water was found to be 14.2 and 28.2mg/l at kashipur and Haridwar respectively..
- The Magnesium concentration in ground water was found to be 8.3 and 14.7.The desirable limit for Magnesium as per IS: 10500 are 30mg/l.
- The iron concentration in ground water was found to be 0.13 and 0.24 mg/l respectively.
- Coliforms were found to be below 2 MPN/ml in Ground water. And in surface water, they were found to be between $1.5x10^3$ and $2.6 x10^3$.

Summary

Ground Water

The results for all the samples were found to be well within the prescribed IS: 10500 limits. The total dissolved solids were within the desirable limits and were well below the permissible limits.

Surface Water

All the results for surface water samples are found to be well within the prescribed IS: 2296 limits, but for the faecal coli forms were very high in all the three surface water sources. Relatively low dissolved oxygen high BOD values were observed in the surface water samples indicating that the Ganga river water at Haridwar and its tributaries is grossly polluted. High MPN counts of Fecal and total coliform in the samples indicate that the waters are grossly contaminated and can only be used with conventional treatment including disinfection for domestic purposes.

4.3.5 Noise

The monitoring of the ambient noise quality for the various land uses along the project corridor was carried out with the help of hand held noise level meters.

Selection of Sampling Location

Locations for noise monitoring along the corridor are identified based on the criteria same as those used for air monitoring. In case of noise monitoring locations, sensitive land use gains more importance due to ill effects of noise on schools and hospitals. The noise monitoring locations are shown in **Figure 4.9.**

Methodology of Noise Measurement

Spot noise measurement was used for this purpose. The sound pressure meter consists basically of a microphone and an electronic circuit including an attenuator, amplifier, weighting networks or filters and an indicating display unit. It measures the root mean square sound pressure with the aid of a microphone, which converts the sound signal to an equal electrical signal. The signal is passed through a weighting network, which provides a conversion and gives the sound pressure level in dB. The A-weighting network is the most useful one on the sound level meter for measuring human response. It indicates the A-weighted sound level, abbreviated dB (A). Sound level meter has a provision to take reading in slow, fast and impulse modes. Traffic change with time, and slow mode was used to average out the readings over 24 hourly longer periods. Readings were taken in auto mode, which continuously update automatically to show the maximum Sound Pressure Level of each (previously) second.

Keeping in view of various land use patterns and residential areas in villages 8 noise level measurement locations were identified for assessment of existing noise level status.

At each monitoring station, the noise levels recorded continuously for 24 hours. Hourly data has collected from each sampling point for 24 hours and day and night values were given separately in Tables.

L_{day}, L_{night} and L_{dn} values

Hourly noise levels are recorded at each site and the measured noise levels are computed for finding out L_{day}, L_{night} and L_{dn} values.

The L_{eq} is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because sound from noise source often fluctuates widely during a given period of time.

This is calculated from the following equation:

$$L_{eq}=L_{50}+(L_{10}-L_{90})^2/60$$

L_{day} is defined as the equivalent noise level measured over a period of time during day (6 am to 10 pm). L_{night} is defined as the equivalent noise level measured over a period of time during night (10 pm. to 6 am).

A noise rating developed by Environment Protection Agency, USEPA for specification of community noise from all the sources is Day-Night Sound Level, (L_{dn}).

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A noise rating developed by Environment Protection Agency, USEPA for specification of community noise from all the sources is Day-Night Sound Level, (L_{dn}).

Day–Night Sound levels (L_{dn})

The noise rating developed for community noise from all sources is the Day-Night Sound Level, (L_{dn}). It is similar to a 24hr equivalent sound level except that during nighttime period (10pm to 6am). A 10dB (A) weighting penalty is added to the instantaneous sound level before computing the 24hr average. This time penalty is added to account for the fact that noise during night when people usually sleep is judged as more annoying than the same noise during the daytime.

The EPA has adopted L_{dn} as the rating method used to describe community noise exposure. To arrive at a recommended outdoor L_{dn} criterion, the EPA recommends that an L_{eq} of 45dB(A) should not be exceeded indoors in residential buildings: this allows freedom from speech interference. If the outdoor and indoor attenuation is taken, on average, as 12dB(A) with the windows partially open, this implies an outdoor criterion of L_{eq} = 60dB(A). The EPA applies correction to this account for other annoyance factors, including the 10dB(A) nighttime penalty and a 5dB(A) margin of safety, to arrive at a recommended criterion of L_{dn} = dB(A) as a desirable maximum outdoor noise level for residential areas. It should be noted; however that majority of urban and suburban areas are currently subjected to noise levels greater than this value.

The L_{dn} for a given location in a community may be calculated from the hourly L_{eq}'S, using the following equation.

$$L_{dn} = 10 \log \{1/24 [16(10 L_d/10) + 8 (10 L_n + 10) /10)]\}.$$

Where L_d is the equivalent sound level during the daytime (6am to 10pm) and L_n is the equivalent sound level during the night time (10pm to 6am).

Results & Analysis of Noise Monitoring

The noise monitoring survey shows that daytime noise levels are high in urban areas. In some cases the noise levels are higher than the prescribed limit for commercial area. This may be due to mix activities as well as vehicular movement on the road. In the village areas the ambient noise levels were observed within the prescribed limit for rural and residential areas during both day and night time as limited activities were observed within rural areas. The high levels of noise are due to activities like crushing, heavy vehicle movement etc. However, all the rural, semi urban and urban locations couldn't be categorized as residential locations as they are all establishments along the State highway and are prone to activities of commercial and industrial nature. Noise, though is a major area of concern, at locations of sensitive receptors (educational establishments like schools and colleges, hospitals)

identified quite close to the road. **Table: 4.8, Table 4.9 &Table 4.10** shows Noise monitoring locations, Noise levels measured and Noise levels standards respectively.

Figure 4.9 Map Showing Noise Monitoring Locations

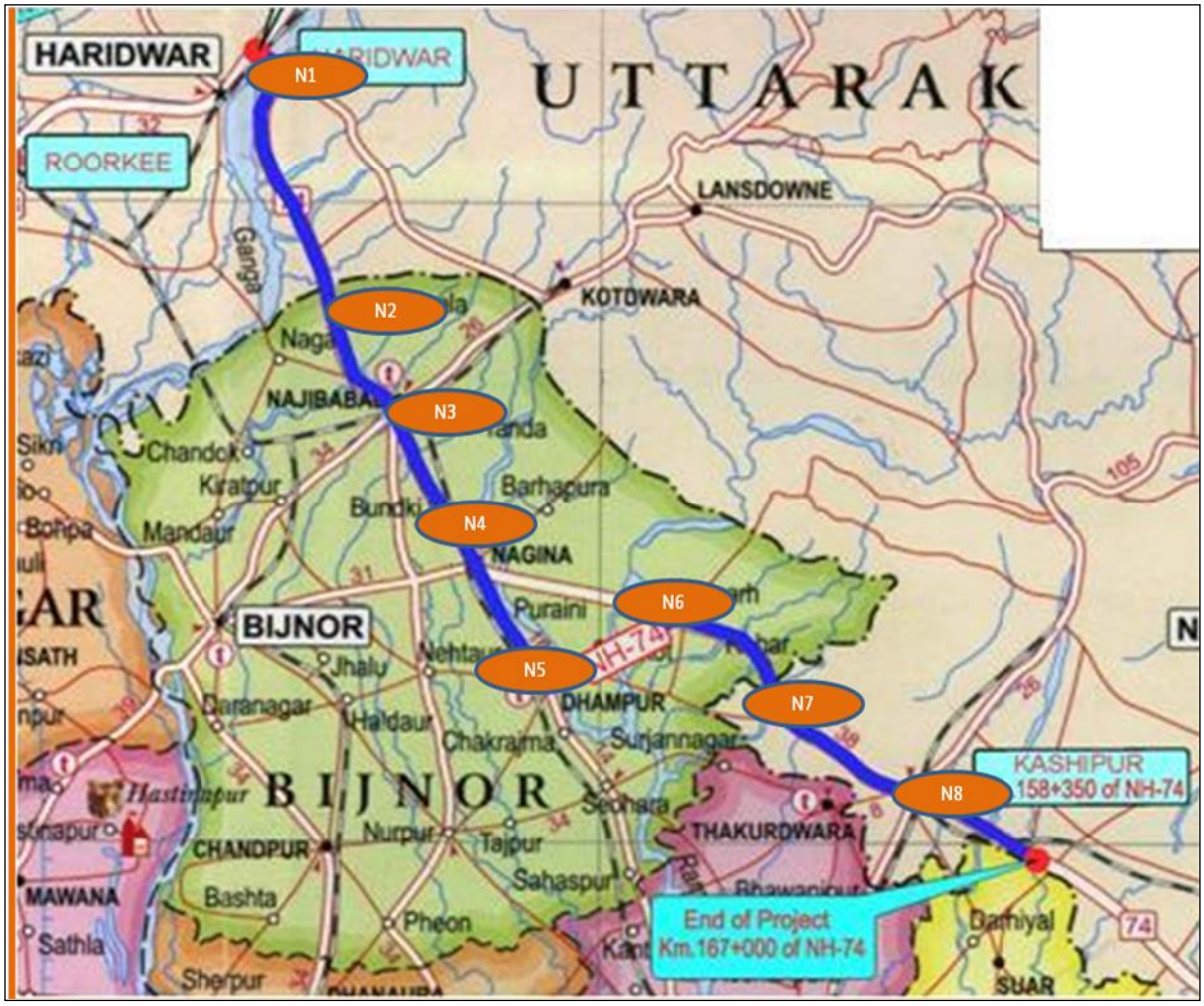


Table 4.8 Details of Noise Monitoring Station

Sl. No.	Location Code	Location
1	N1	Haridwar
2	N2	Bhaguwalla Village
3	N3	Najibabad
4	N4	Nagina
5	N5	Dhampur
6	N6	Afzalgarh
7	N7	Jaspur
8	N8	Kashipur

Table 4.9 Observed Noise Levels along Road

Sl. No	Test Parameters	N1	N2	N3	N4	N5	N6	N7	N8	Units
Noise Levels										
1	L min	44.5	47.6	43.2	43.3	44.8	42.6	44.5	40.5	dB(A)
2	L10	74.5	71.3	55.4	72.0	65.3	61.5	71.8	70.5	dB(A)
3	L50	68.3	61.3	50.3	54.3	55.2	57.4	58.8	61.0	dB(A)
4	L90	51.7	49.5	44.6	45.3	46.9	44.2	46.1	44.1	dB(A)
5	Leq	75.4	69.4	57.7	66.6	62.8	59.7	66.9	66.2	dB(A)
6	Lmax	87.3	80.3	56.3	73.4	73.4	71.2	75.2	74.5	dB(A)
7	Leq- Day	77.0	71.0	52.8	68.2	64.1	61.0	68.5	67.8	dB(A)
8	Leq- Night	63.9	55.0	47.4	50.6	57.5	54.4	55.1	55.4	dB(A)

Note: The area categorization has been done by the consultants based on the sensitive features and not by the authorities

Table 4.10 Noise Levels Standards dB (A)

S.No.	Standard For	DAY	NIGHT
1	Industrial Area	75	70
2	Commercial Area	65	55
3	Residential Area	55	45
4	Silence Zone	50	40

CONCLUSION

The maximum levels during day time (L_{day}) is 77.0 dB (A). The maximum night time value (L_{night}) is 63.9dB (A). Among the monitoring points in the study area, high noise levels are recorded at 87.3 dB (A) at Haridwar and 80.3dB (A) at Bhaguwala. Noise levels for all the locations were found to be below the limits as compared with prescribed limits for commercial area. The noise levels are more in Haridwar due to the heavy vehicular traffic at the highway and it is the centre for both the National High ways. But all the values are found to be within the limits.

4.3.6 Soil Quality

Soil formation is influenced mainly by climate, geology, relief and other biotic interactions. Agricultural economy and rapid industrialization go hand in hand; hence it is essential to identify the impacts of the project operation in the study area on the soil characteristics, which would affect the agricultural, and afforestation potential. Accordingly, an assessment of the baseline soil quality has been carried out at 10 locations. Soil sampling locations with details are shown in **Figure 4.10** & **Table: 4.11** and Physico-chemical characteristics of soil are shown in **Table: 4.12.**

Data Generation

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the project area. These have been identified with the following objectives:

- To determine project the baseline soil characteristics of the study area;
- To determine project the impact of proposed activity on soil characteristics; and
- To determine project the impact on soils more importantly from agricultural productivity point of view.

Table 4.11 Details of Soil Quality Monitoring Station

Sl. No.	Location Code	Location	Area Category
1	S1	Haridwar	Urban Area
2	S2	Bhagowalla Village	Rural Area
3	S3	Najibabad	Urban Area
4	S4	Nagina	Rural Area
5	S5	Dhampur	Rural Area
6	S6	Afzalgarh	Rural Area
7	S7	Jaspur	Rural Area
8	S8	Kashipur	Urban Area

Results and Discussions

- The soils collected in the study area are varying such as sandy clay & Silty loam.
- The pH values are ranging from 7.82 to 8.32

Summary

pH

pH for samples collected at Haridwar,Dhanpur and Jaspur was found to be strongly alkaline, where pH for the remaining samples found to be moderately alkaline.

Electrical Conductivity

Electrical Conductivity observed in all the samples is found to be average.

Phosphorus

The amount of Phosphorus is observed to be less & medium.

Potassium

The amount of potassium observed in all the samples is found to be less.

Figure 4.10 Soil Sampling Locations

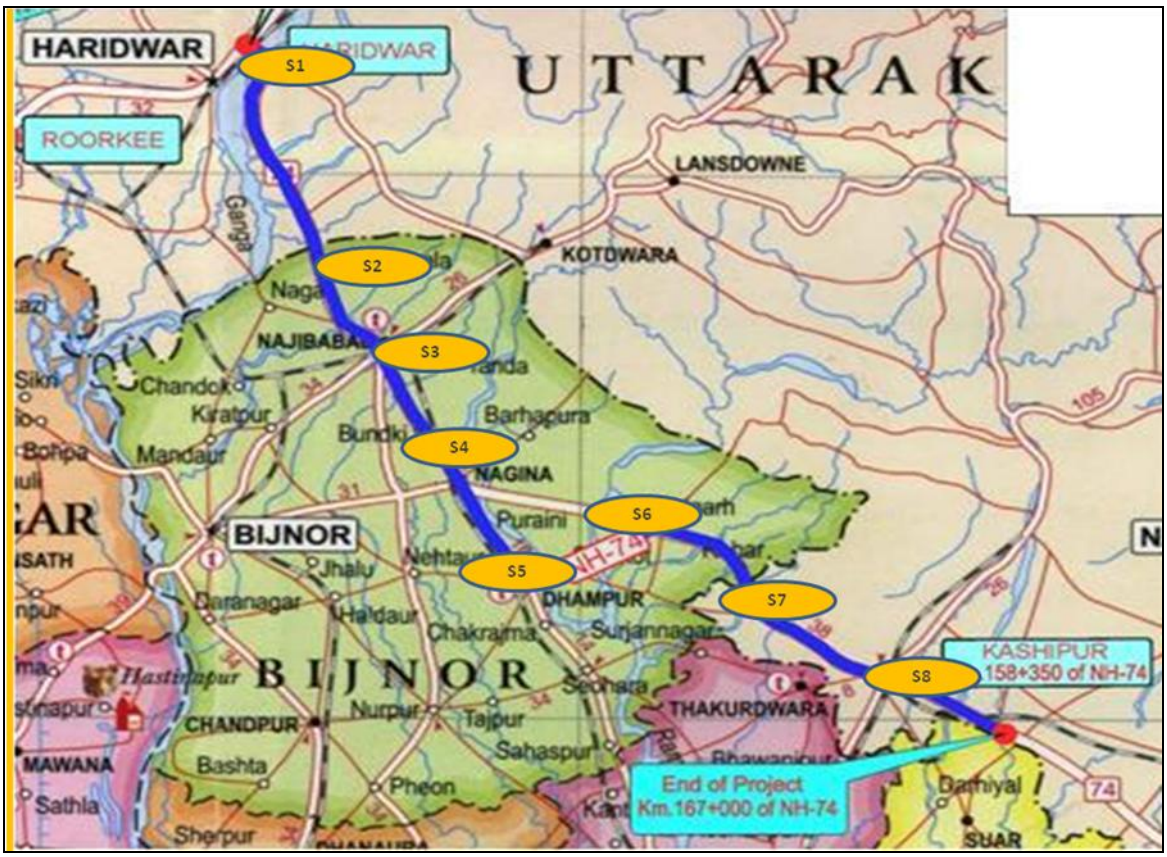


Table 4.12 Physico-chemical Characteristics of Soil Samples

Sl. N0	Parameter	Units	Haridwar (S1)	Bhagowala (S2)	Najibabad (S3)	Nagina (S4)	Dhampur (S5)	Afzalgarh (S6)	Jaspur (S7)	Kashipur (S8)
1	Colour	--	Brown	Light Brown	Brown	Brown	Light Brown	Brown	Brown	Brown
2	pH	-	8.32	7.84	8.14	7.95	8.23	7.82	8.20	7.56
3	Conductivity	µS/cm	472.3	512.3	468.1	483.4	562.6	468.5	586.8	546.4
4	Sodium (as Na)	mg/Kg	296.3	292.6	294.5	287.4	299.6	289.5	296.3	310.5
5	Potassium as K	mg/Kg	48.3	46.2	37.4	45.1	299.6	42.6	58.6	65.3
6	Phosphorus	mg/Kg	48.6	49.1	49.5	65.6	43.5	68.7	69.6	65.6
7	Soil Type	--	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy	Sandy
8	Cation Exchange Sulphate	Meq/100gm	12.1	11.9	10.8	10.1	13.2	10.8	12.4	13.8
9	Water holding capacity	% by mass	22.4	19.45	23.32	25.4	22.45	28.73	21.34	29.34
10	Bulk Density	gm/cc	1.24	1.19	1.3	1.32	1.30	1.34	1.28	1.47
11	Porosity	%	17	16.79	16.4	15.4	16.45	14.7	15.95	13.45
12	Sodium Absorption Ratio (SAR)	--	0.26	0.32	0.32	0.36	0.31	0.23	0.31	0.36
13	Texture									
	A. Sand	% by Mass	78.34	79.43	76.4	75.6	76.34	73.45	77.73	72.34
	B. Silt	% by Mass	15.45	16.73	16.4	13.4	19.46	14.43	14.73	15.45
	C. Clay	% by Mass	6.21	3.84	7.2	11.0	4.2	12.12	7.54	12.21

Note: *SAR: Sodium Absorption Ratio, CEC: Cation Exchange Capacity*

4.4 Biological Environment

4.4.1 Forest Areas

The proposed ROW is passing through the patches of Protected Forest different patches all along the 3 districts and Reserve forest (km 3025.000 to km 318.400 on left,Right and on both sides) in Shayampur RF, In Chidyanpur RF(km 19.200 to km 30.300 on on left,Right and on both sides) & Rampur RF(km 30.000 to km 130.900 on on left,Right and on both sides and 142.400 to 143.000) There is no endangered flora and fauna found in these Protected Forests and RF.

Uttar Pradesh

Flora

Near the snow line there are forests of rhododendrons and *Betula utilis* (bhojpatra). Below them are forests of silver fir, spruce, deodar, chir and oak. On the foothills and in the terai-bhabhar area grow the sal and gigantic haldu. Along river courses the shisham grows in abundance. The Vindhyan forests have dhak, teak, mahua, salai, chironji and tendu. The hill

forests also have a large variety of medicinal herbs. Sal, chir, deodar and sain yield building timber and railway sleepers. Chir also yield resin, the chief source of resin and turpentine. Sisso is mostly used for furniture while khair yields kattha, which is taken with betel leaves or pan. Semal and gutel are used as matchwood and kanju in the plywood industry. Babul provides the principal tanning material of the state. Some of the grasses such as baib and bamboo are raw material for the paper industry. Tendu leaves are used in making bidis (Indian cigarettes), and cane is used in baskets and furniture.

Species of grasses have been collected from the Gangetic plain. Herbs include medicinal plants like *Rauwolfia serpentina*, *Viala serpens*, podophyllum, hexandrum and *Ephecra gerardiana.*

Fauna

Corresponding to its variegated topography and climate, the state has a wealth of animal life. Its avifauna is among the richest in the country. Animals that can be found in the jungles of Uttar Pradesh include the tiger, leopard, wild bear, sloth bear, chital, sambhar, jackal, porcupine, jungle cat, hare, squirrel, monitor lizards, and fox. These can be seen in all but the highest mountain ranges. The most common birds include the crow, pigeon, dove, jungle fowl, black partridge, house sparrow, peafowl, blue jay, parakeet, kite, mynah, quail, bulbul, kingfisher and woodpecker.

Certain species are found in special habitats. The elephant is confined to the terai and the foothills. The gond and para also found in this region. The chinkara and the sandgrouse prefer a dry climate, and are native to the Vindhyan forests. The musk deer and the brown bear is found in the higher Himalayas. Among the game birds resident in the state are the snipe, comb duck, grey duck, cotton teal and whistling teal.

Uttarakhand

Uttarakhand has about 65% of the land under forests. Most of it is managed by the Forest Department. The variation in the landscape has created great diversity of flora and fauna, and consequently, resources. The Department has added to these resources through plantation activities. The resources pertaining to forest areas are briefly mentioned below.
Timber resources: The plains have plantations raised for commercial use. These include teak, sal, eucalyptus, poplar etc. Hills too provide timber from conifers like Deodar.

(B) Non Timber Forest Produce: These include resin from Chir Pine, bamboos, fuel and fodder for use by local people, etc. Jatropha curcas is also being raised primarily as a potential substitute for petroleum.
The proposed ROW NH-73 from Roorkee-UP/Haryana border is passing through the trees Planted by Saharanpur Forest Department in Uttar Pradesh State. There is no endangered flora and fauna found in these forests. Even at 10 m buffer on either side of the ROW the forest trees are found to be very less and there is no endangered species of animals are found.

4.5 Social Environment

4.5.1 Land Use & Land Cover Mapping Study

4.5.1.1 Introduction

The knowledge of land use and land cover is important for many planning and management activities as it is considered an essential element for modeling and understanding the earth system. The term land use relates to the human activity or economic function associated with a specific piece of land, while the term land cover relates to the type of feature present on the surface of the earth (Lillesand and Kiefer, 2000). Land cover maps are presently being developed from local to national to global scales. The use of panchromatic and medium scale aerial photographs to map land use has been an accepted practice since the 1940s. More recently, small scale aerial photographs and satellite images have been utilized for land use and land cover mapping. The satellite remote sensing technology has found its acceptance worldwide for rapid resource assessment and monitoring, particularly in the developing world. National Aeronautical and Space Administration (NASA) of USA has made most significant contributions with satellite based remote sensing techniques. Since 1972, after the Landsat-1 was launched, remote sensing technology and its application has undergone a tremendous change in terms of sensing development, aerial flights with improved sensors, satellite design development and operations including data reception, processing, interpretation, and utilization of satellite images. All these advancement have widened the applicability of remotely sensed data in various areas, like forest cover, vegetation type mapping, and their changes on a regional scale. If satellite data is judiciously used along with the sufficient ground data, it is possible to carry out detailed forest inventories, monitoring of land use, and vegetation cover at various scales.

4.5.1.2 Objective

The objective of the present study is to prepare the Essential (Thematic) Maps to be provided to the Ministry of Environment & Forests as part of the EIA/EMP Report, for obtaining the Environmental Clearance (EC),as per Environmental Impact Assessment Guidance Manual for Highways,2010.

1.Highway alignment plan with the help of latest available cloud free satellite imagery of Project alignment in 1:25,000 scale, and surrounding area covering 10 Km distance on either side of the proposed right of way showing the details of

(i) Protected areas notified under the Wildlife (Protection) Act, 1972;

(ii) Critically polluted areas as identified by the Central Pollution Control Board from time to time;

(iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986,

(iv) Inter-State boundaries and international Boundaries

2. Alignment plan, with details such as nature of terrain (plain, rolling, hilly), details of villages, tehsils, districts and states, latitude and longitude for important locations falling on the alignment shall be submitted.

3. A map derived from the recent satellite imagery covering aerial distance of 15 Km from the proposed alignment delineating environmental sensitive areas as specified in Form I of EIA notification dated 14th Sep 2006.

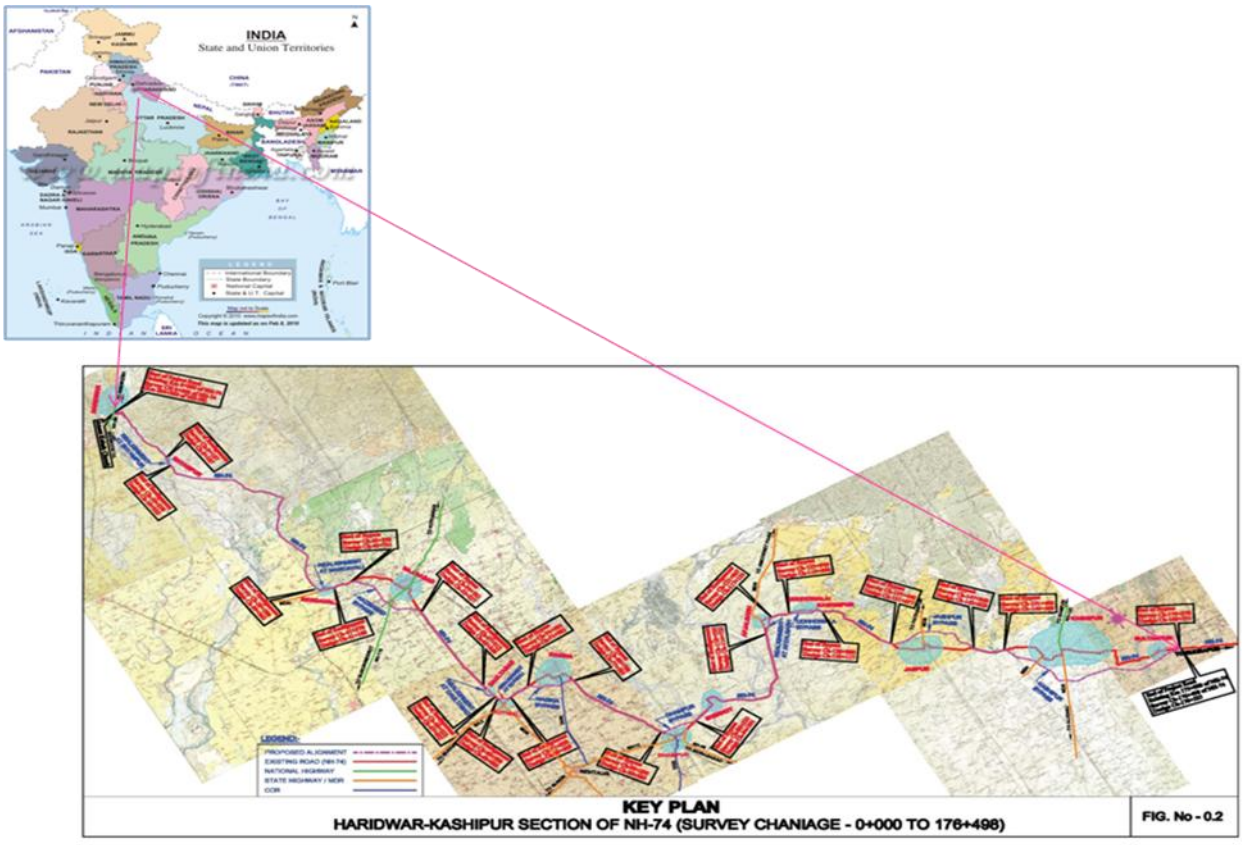
4. Land use map of the study area to 1: 25,000 scale based on recent satellite imagery of the Study area delineating the crop lands (both single and double crop), agricultural plantations, fallow lands, waste lands, water bodies, built-up areas, forest area and other surface features such as railway tracks, ports, airports, roads, and major industries etc.

5. Area drainage map covering 500 meters on either side of proposed right of way shall be clearly indicated. In case of any proposed diversion of nallah/canal/river either during the Construction phase or operational phase shall also be shown in the map.

4.5.1.3 Project Site Location

This section of project road is situated partially in Haridwar & Udham Singh Nagar districts of Uttarakhand and partially Bijnor district of UP. The stretch of road from km 0.000 to km 30.000 and km 132.000 to km 175.000 of NH-74 lies in Haridwar & Udham Singh Nagar districts of Uttarakhand respectively. The remaining stretch of NH-74 from km 30.000 to km 132.000 lies in Bijnor district of UP. Haridwar is located at 29°58' N and 78°09' E, Najibabad is located at 29°40'N and 78°20'E and the Kashipur is located at 29°15' N and 79°00' E.

Figure 4.11 Map Showing the Project Location with Study Area.



4.5.1.4 Role of Remote Sensing & GIS

Remote sensing and GIS are the modern techniques of Spatial Analysis which includes Land Use/Land Cover, Terrain Analysis and information generation. They not only ensure faster and easier analysis / interpretation but also help to modify / manipulate the data at will so as to meet the objective of the study.

4.5.1.5 Remote Sensing (RS)

Remote Sensing (RS) generally involves in processing of remotely sensed data in digital form using image-processing techniques. Remote sensing enables one to acquire information about an object or phenomena from a distance through detection or measurement of electromagnetic energy coming from the object. The use of remote sensing techniques for the study of natural resources has been found to be of considerable value. The information derived from the remote sensing is compatible with topographic maps of Survey of India on 1:50,000 or 1:25,000 scale. With the use of high-altitude sensor platform, it is now possible to record extensive areas on a single image, which covers a maximum of 34,000 sq. km (185x185km) and minimum of 3600-sq.km area. Thus one can have a synoptic view over large area and also an integrated picture of the landscape. By using the satellite imagery it is possible to conduct surveys in areas, which are difficult to access. Some of the advantages of utilizing remote sensing techniques are given below:

Satellite image serves as a permanent record of a landscape at a point of time from which land use changes can be monitored and evaluated.

Satellite data is cost effective when compared to conventional methods. It can be obtained quickly; its information is accurate, reliable and up to date.

Preparation of thematic layers by using satellite imagery is time saving when compared to conventional method.

Satellite data can be effectively integrated with the conventional data for analysis, planning and decision-making.

4.5.1.6 GIS

Geographic Information System (GIS) is a powerful set of tool, which can perform correlation. GIS is a system for manipulating and analyzing spatial data to provide information to support planning and decision-making. GIS can also be defined as “decision support system involving the integration of spatially referenced data in a problem solving environment’ (Cowen, 1988). It comprises facilities for the input, management, retrieval, manipulation, analysis and display of spatial data. Its functions can be grouped as data acquisition, data utilization, data management, output and display.

GIS technology is useful as planning / decision-making tool for resource management. The selective retrieval and analysis capabilities of GIS are used to manipulate the database and provide a variety of information for resource management. GIS is an aid to analyze the thematic maps prepared through remote sensing and field visits. It stores all the maps prepared and database attached to them in digital format, which permits rapid access and processing. Combination of Remote sensing and GIS technologies are very important for

assessment and management of natural resources, where integration of data from different sources is an essential requirement.

4.5.1.7 Data Products

The present study uses the data based on the source of acquisition of data. The data products, based on availability, are classified into four types namely, topographical data, thematic data, field data and collateral data. The details of these four types of data products are discussed below.

4.5.1.8 Data Sources

A heightened awareness of Natural resources problems has developed over the past several decades and this has spurred a need for reliable geospatial data to enable better understanding of Natural resource related problems and their impacts on environment. In view of critical role, digital data plays an important role in any kind of spatial modeling and analysis. Emphasis is given to new information gathering initiations for remotely sensed data and to advancements in integrating data from different sources with GIS. The availability of appropriate and adequate crop yield data, and other related data derived from collateral data and other field survey are important concerns. GIS and remote sensing function with a broad spectrum of geospatial data that are used for spatial analysis. These data generally come in different formats and from various sources and measurements. The examination and organization of data into a useful form produces information content, which is compatible to GIS and which enables appropriate analysis.

In the present study, four different sources are used to collect the required data products. The four sources are remote sensing satellite systems, survey of India toposheets, related government and private agencies for existing data products and field surveys for collection of primary data products. In transforming this raw data to data compatible to GIS, care is taken for appropriate level of data precision and accuracy. The data types, important features and corresponding data sources used in the present study are listed below.

4.5.1.9 Data Used

The data is used for the preparation of different maps to study the natural resources. The data is used by using the application of Remote Sensing and GIS technologies.

Table 4.13 Details of Sources & the Maps Prepared

Serial No.	Source	Maps Prepared
1	Survey of India's topographic maps and satellite imageries	Base Map
2	Satellite imageries	Land Use / Land Cover and other Thematic Maps

Table 4.14 Survey of India's Topographic Maps

Serial No.	Topographic Map No.	Scale	Year of Survey	Year of Publication
1	53K/I	1:50,000	1966-67	1970
2	53K/II	1:50,000	1966-67	1970
3	53K/I5	1:50,000	1966-67	1970
4	53K/7	1:50,000	1966-67	1970
5	53K/6	1:50,000	1966-67	1970
6	53K/I6	1:50,000	1966-67	1970

Table 4.15 Satellite Data of National Remote Sensing Centre

Sl. No.	Acquisition date	Sensor
1.	-	LISS III

4.5.1.10 Methodology for Land Use/Land Cover Mapping

The overall methodology adopted and followed to achieve the objectives of the present study involves the following steps:

- Collection of source data like satellite data of, SOI toposheets. These are the main inputs for the preparation of thematic layers.
- Satellite data of IRS P6 LISSIV data geometrically corrected and enhanced using principal component method and Cubic Convolution resampling technique. Finally after map composition satellite imagery is printed in FCC in 1:50,000 scale.
- Preparation of basic themes like base map, transport & settlement mapand from the source data. Then updating of base map, transport map and drainage map from the satellite image by visual interpretation.
- Thematic maps (related to natural resources) like land use / land cover map are prepared by visual interpretation of the satellite imagery. Visual interpretation is carried out based on the image characteristics like tone, size, shape, pattern, texture, location, association, background etc. in conjunction with existing maps/literature.
- Preliminary quality check and necessary corrections are carried out for all the maps prepared.
- Field visits are carried out to check the delineated units of the maps prepared by visual interpretation of satellite imageries. Where ever necessary field photographs are taken. Primary data of land use and secondary data related to land use and ground water are collected.
- Field observations are incorporated in to the related thematic layers.
- Final quality check and necessary corrections are carried out for all the maps prepared.
- All the maps prepared are converted into soft copy by digitization. In that process editing, labeling, mosaicing, quality checking, data integration etc., finally land use / land cover areas are measured in Square Kilometers.

4.5.1.11 Spatial Data from SOI Toposheets

Creating a GIS spatial database is a complex operation, and is heart of the entire work; it involves data capture, verification and structuring processes. Because raw geographical data are available in many different analogue and digital forms such as toposheets, aerial photographs, satellite imageries and tables. Out of all these sources, the source of toposheets is of much concern to natural resource scientist and an environmentalist. In the present study, the thematic maps generated from toposheets are, base map, drainage map and Road network map, Terrain Map. These paper based maps are then converted to digital mode using scanning and automated digitization process. These maps are prepared to a certain scale and show the attributes of entities by different symbols or colorings. The location of entities on the earth's surface is then specified by means of an agreed co-ordinate system. It is mandatory that all spatial data in a GIS are located with respect to a frame of reference. For most GIS, the common frame of reference co-ordinate system is that of plane, orthogonal Cartesian co-ordinates oriented conventionally north-south and east-west. This entire process is called Georeferencing. The same procedure is also applied on remote sensing data before it is used to prepare thematic maps from satellite data.

4.5.1.12 Spatial Data from Satellite Data and Processing

The step-by-step procedure for preparing the spatial data derived from remote sensing satellite data for the entire study area is discussed as below:

Satellite data processing using image processing software

- Geo processing and Geo referencing
- Digital enhancement
- Generation of hard copy
- Generation of thematic maps

4.5.1.13 Geo-coding and Geo-referencing

The following standard techniques have been adopted for geo referencing of LISS III data covering the study area. ERDAS image processing software has been used for this work. 1:50,000 scale toposheets are scanned and raster file for study area is created. These are geo-referenced based on the longitudinal & latitudinal co-ordinates. After geo-referencing all the maps are edge-matched and a digital mosaic is prepared which depicts the continuity of the study area. The LISS IV data obtained from National Remote Sensing Centre (NRSC) is processed for initial corrections like drop outs, stripping and earth rotations etc. Sufficient numbers of well distributed ground control points are selected both on the maps and corresponding imagery. Care is taken to satisfy the condition on density of GCPs for image registration. Geo referencing is carried out using ERDAS image processing software. The geo-referenced image is further mosaicked and then feature matching is carried out. At the end of this process the digital data which is free from all distortions is available for digital image enhancement, classification for land use/land cover map preparation with the help of visual image analysis techniques.

4.5.1.14 Digital Image Enhancement of LISS III data

Image enhancement deals with the individual values of the pixels in the image. The goal of spectral enhancement is to make certain features more visible in an image by bringing out more contrast. Initial display of LISS IV data through ERDAS software revealed that the features like minor roads and streams are not clear/ visible as the contrast of the imageries very dull because of the raw data values fall within a narrow range. Therefore, an attempt is made to apply linear contrast stretch technique in order to improve the contrast of the image, which can be capable of expanding the dynamic range of radiometric resolution of LISS IV digital data. To perform this technique, Look up Tables (LUT) is created that convert the range of data values to the maximum range of the display device. Based on these LUT's an enhanced image is produced.

4.5.1.15 Hardcopy Generation

In order to derive spatial thematic data, a hardcopy of satellite image is generated through the following steps:

- Acquisition of satellite data from NRSC, Balanagar, Hyderabad and toposheets from Survey of India, Hyderabad.
- Geo-coding and geo-referencing of LISS IV digital data by extracting the Ground Control Points (GCPs) from SOI toposheets and GPS Points
- Digital image enhancement and application of correction models for making the digital data free from errors and distortions both radiometry and geometry of the satellite data.
- Satellite Image in FCC mode and is used for visual interpretation to extract the thematic data by applying both pre-visual interpretation, ground truthing and post visual interpretation techniques.
- A satellite hardcopy is generated for subsequent analysis.

4.5.1.16 Generation of Thematic Maps from Satellite Data

The thematic maps namely, land use/land cover are generated from satellite digital hardcopy. The standard basic elements and key elements for visual interpretation are applied on this satellite hardcopy digital image so as to extract the entropy or information extent in accordance with the above thematic maps. At the end of the interpretation process the above thematic maps in the form of paper based maps are ready for subsequent scanning and automated digitization and then created a digital database for GIS data analysis and modeling.

4.5.1.17 Spatial Database Generation and Organization

Mapping of different themes is carried out using the data derived from remote sensing data analysis, supported with ground truth studies on GIS platform. Spatial elements of GIS database, which depends upon the end use and defines the spatial data sets that will populate the database. The spatial elements are application specific and are mainly made of maps obtained from different sources. The spatial elements are categorized into primary elements, which are the ones that are digitized and or entered into the database, and

derived elements, those that are derived from the primary elements based upon GIS operation. To perform this study the spatial database is created with the help of scanning with automated digitization and GIS software. Thematic layers are generated for the study area using the data obtained from Survey of India toposheets, satellite digital data and ground observations. The step by step 4procedure for creating the spatial database is discussed in the following paragraphs.

Flow of operations in spatial database generation

Based on the design, the steps of database creation are worked out and a procedure lay down. The procedure for the spatial database creation adopted in general for preparation of all themes is described below:

Creating Spatial Frame work: The spatial framework of the GIS database can be organized in the GIS by specifying the registration GCP points for the total database and specifying the coordinate system of the database. Registration points for the total area are entered through key -board.

Master Template Creation: A master template is created as a reference layer and consisting of the boundary, drainage and base map features etc. This template is then used for the component themes digitization.

Thematic Map Manuscript Preparation: Based on the spatial domain, the different themes oriented information is transferred from the base map to a transparent sheet. Spatial data manuscripts are consisting features that are to be digitized. And the instructions like, registration point locations and identifiers, features codes as per the defined codes, feature boundaries, tolerance specifications and other relevant digitization / scanning instructions to be followed.

Digitization of Features: The features of the spatial data set are then digitized / scanned using the GIS package. The digitization / scanning is done for each map sheet of the spatial reference. The master registration reference points are used for the digitization. Each theme prepared, digitization is done as a component into a copy of the master template layer.

Coverage Editing: The digitized coverage is processed for digitization errors such as dangles, constituting the overshoots or undershoots and labels for polygons. And finally the coverage is processed for topology creation using GIS in Arc / Info workstation.

Attribute Coding Verification: The attribute codes for the different categories need to be then verified and additional attributes – feature name, description etc. are added into the feature database. After these operations the thematic coverage are ready for GIS analysis.

4.5.1.18 Spatial Data Generated From Toposheet(S)

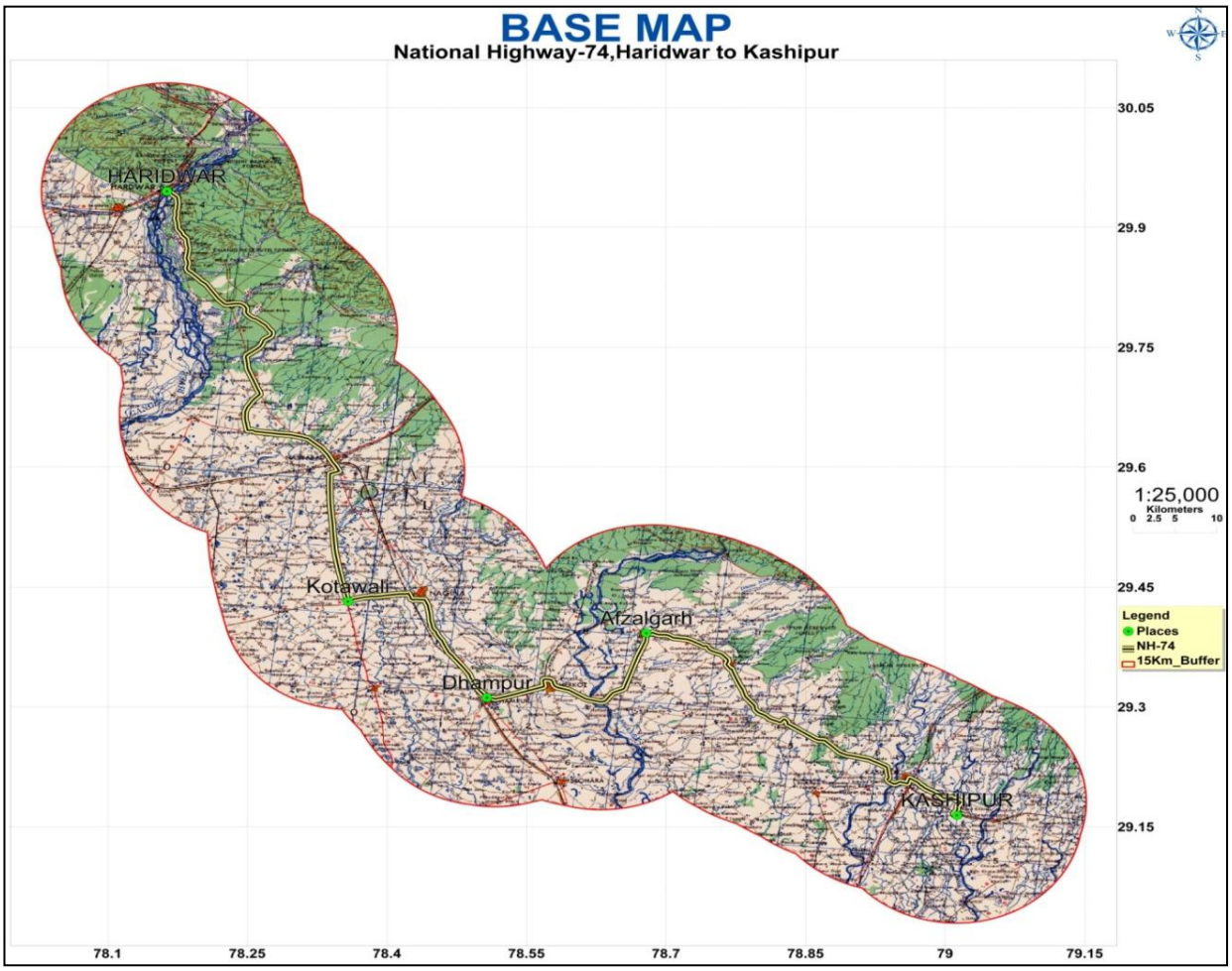
The spatial databases from toposheet(s) of Survey of India (SOI) relevant for this study are:

- Topographical Map
- Base map
- Road Network map
- Terrain Map

Base Map

Base Map is prepared by using Survey of India, Topographic Map sheets No. 53K/I , 53K/I I, 53K/I5, 53K/747CP/9 &10,56C/8, 53K/6 & 53K/I6 on 1:50,000 scale. All the settlements, road network, water bodies are taken into consideration. By comparing the Survey of India topographic maps with that of the satellite image the size of all the settlements are increased and updated.

Figure 4.12 Base Map of Haridwar-Kashipur Section (15km Buffer)



4.5.1.19 Spatial Data Generated From Satellite Data and Other Datasets

Before satellite images can provide meaningful measurements to user, the raw, unbiased reflectance values received by the satellite sensors require considerable mathematical processing. Manipulations are required both to register the grid of pixels to specific locations on the Earth's surface and to transform the data into useful information. Understanding the various algorithms operating on the raw data is usually beyond the ability of non specialists, and the resulting spatial data must be accepted on faith. Frequently the result of this manipulation is classified data in which pixel values indicate classes of an attribute (e.g., nominal data such as vegetation type or land use classes) rather than interval or ratio data classification algorithms and techniques are among the most highly disputed in the discipline

(Estes, 1995). Methods for statistically estimating the error resulting from the classification of satellite images have been developed and do provide some quality assurance (Burrough, 1998).

Remote Sensing Technology for Visual Image Interpretation

The procedure consists of a set of image elements or characteristics like color / tone, texture, pattern, size, shape and so on, which help in the recognition or interpretation of various land use /land cover features systematically on the enhanced satellite imagery during the classification of features (Lillesand, 2000). The land use/ Land cover classification system used in this project is the system which is pioneered by United States Geological Survey (USGS) and is modified by National Remote Sensing Centre (NRSC) according to Indian conditions. A preliminary image classification key is prepared for the fussed pictorial data and is used during interpretation process. Using the image interpretation key, preliminary interpretation of satellite imagery is carried out by transferring the features from base map on to the transparency. This transparency with base line data features is then overlaid on the satellite imagery. Then the features of LU/LC are extracted and transferred from the satellite pictorial data. The doubtful areas (due to similar spectral response and spectral signature) identified during the preliminary image classification are listed out before ground verification. After finalizing the ground traverse plan the doubtful area are physically verified and field observation about terrain condition and land use pattern are noted. Based on the ground information collected, corrections and modifications of miss classified land use/land cover details and doubtful areas are carried out on enhanced imageries for final land use/land cover classification. The final land use/land cover classes are separated by assigning standard colors with respect to each one of the land use/land cover classes.

4.5.1.20 Generation of Thematic Layers

Based on the physical characteristics of the study area, their sources, method of derivation of maps (IMSD Technical Guidelines, NRSA, 1995), suitability and environmental sensitivity, the following maps are generated.

- Drainage Map
- Forest Map
- Land Use / Land Cover Map

Land Use / Land Cover Map

Land use/land cover map is prepared by visual interpretation of high-resolution satellite data with the help of Survey of India Topographic maps on 1:50,000 scale.

Level-II classification of National (Natural) Resources Information System (NRIS) has been followed for the delineation of units.

Land use/ Land cover map of the study area is integrated with village map and analyzed with the help of GIS to get the village wise findings of the present land use of the study area, which is given elaborately in the following tables:

Land use refers to man's activities and various uses, which are carried on land. Land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformation. Although land use is generally inferred based on the cover, yet both the terms land use and land cover are closely related and interchangeable. Information on the rate and kind of change in the use of land resources is essential to the proper planning, management and regulation of the use of such resources.

Knowledge about the existing land use and trends of change is essential if the nation is to tackle the problems associated with the haphazard and uncontrolled growth. A systematic framework is needed for updating the land use and land cover maps that will be timely, relatively inexpensive and appropriate for different needs at national and state level. The rapidly developing technology of remote sensing offers an efficient and timely approach to the mapping and collection of basic land use and land cover data over large area. The satellite imageries are potentially more amenable to digital processing because the remote sensor output can be obtained in digital format. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels.

Basic Concepts of Land Use

Clawson has given nine major ideas or concepts about land. These are:

- Location or the relation of a specific parcel of land to the poles, the equator, and the major oceans and landmasses. There is also relationship between various tracts of land, as well as a political location.
- Activity on the land, for what purpose this piece of land or tract is used.
- Natural qualities of land, including its surface and subsurface characteristics and its vegetative cover.
- Improvements to and on the land. This is closely related to the activity.
- Intensity of land use or amount of activity per unit area.
- Land tenure, i.e. who owns the land, which uses it.
- Land prices, land market activity and credit as applied to land.
- Interrelations between activities on the land and other economic and social activities.
- Interrelations in the use between different tracts of land.

Aims of Classification

- The major aim of land use classification system is to provide a framework as broad as possible and would cover all the possible types of land use within the country that could be mapped within certain limitations.
- The second objective is to see the applicability of IRS P6 LISSIV satellite data for delineating various land use, land cover categories through computer analysis as well as visual interpretation techniques.
- The third objective is to provide a standardized land use, land cover classification system, which can be used with the satellite imagery available in India, at present.

Land Use / Land Cover Classification

The USGS devised a land use and land cover classification system for use with remote sensing data in the mid-1970. The basic concepts and structure of this system are still valid today. The USGS classification system was devised according to the following criteria:

- The minimum level of interpretation accuracy using remotely sensed data should be at least 85%
- The accuracy of interpretation for the several categories should be about equal
- Repeatable results should be obtainable from one interpreter to another
- The classification system should be applicable over extensive areas
- The categorization should permit land use to be inferred from the land cover types
- The classification system should be suitable for use with remote sensing data obtained at different times of the year
- Categories should be divisible into more detailed subcategories that can be obtained from large scale imagery or ground survey
- Aggregation of categories must be possible
- Comparison with future land use and land cover should be possible
- Multiple uses of land should be recognized

USGS specified the classification, which is principally of interest to users who desire information on a nationwide, interstate, or statewide basis. Levels III and IV can be utilized to provide information at a resolution appropriate for regional or local planning and management activities.

Objectives of Land Use / Land Cover Map

The main objectives of land use map are,

- The land use map will be utilized as a basic database, which provides the information for allocating new land use practices.
- It will incorporate demographic, economic and environmental impact, which has occurred in an area.
- Not only will the information indicate where intensive development has already taken place and where there is open land suitable for future expansion, but it will also make it possible to determine special areas, such as prime agricultural lands.
- Land use/ land cover map will serve as a basis for monitoring land use change.
- The land use map will serve as a base in the integrated overall planning of agricultural and industrial development of the region.

Land use refers to man's activities and various uses, which are carried on land. Land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformation. Although land use is generally inferred based on the cover, yet both the terms land use and land cover are closely related and interchangeable. Information on the rate and kind of change in the use of land resources is essential to the proper planning, management and regulation of the use of such resources. Knowledge about the existing land use and trends of change is essential if the nation is to tackle the problems associated with the haphazard and uncontrolled growth. A systematic framework is needed for updating the land use and land cover maps that will be timely, relatively inexpensive and appropriate

for different needs at national and state level. The rapidly developing technology of remote sensing offers an efficient and timely approach to the mapping and collection of basic land use and land cover data over large area. The satellite imageries are potentially more amenable to digital processing because the remote sensor output can be obtained in digital format. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels.

Table 4.16 USGS Land Use / Land Cover Classification System

Sl.No.	Level I	Level II
1.	Urban or built-up land	11 Residential 12 Commercial and service 13 Industrial 14 Transportation, communications and utilities 15 Industrial and commercial complexes 16 Mixed urban or built-up land 17 Other urban or built-up land
2.	Agricultural land	21 Cropland and pasture 22 Orchards, groves, vineyards, nurseries and ornamental horticultural areas 23 Other agricultural land
3.	Rangeland	31 Herbaceous rangeland 32 Shrub and brush rangeland 33 Mixed rangeland
4.	Forest land	41 Deciduous forest land 42 evergreen forest land 43 Mixed forest land
5.	Water	51 Streams and canals 52 Lakes 53 Reservoirs 54 Bays and estuaries
6.	Wetland	61 forested wetland 62 Non forested wetland
7.	Barren land	71 Dry salt flats 72 beaches 73 Sandy areas other than beaches 74 Bare exposed rock 75 Strip mines, quarries and gravel pits 76 Transitional areas 77 Mixed barren land
8.	Tundra	81 Scrub and bush tundra 82 herbaceous tundra 83 Bare ground tundra 84 Wet tundra 85 Mixed tundra
9.	Perennial snow or ice	91 Perennial snowfields 92 Glaciers

(Source: Lille sand, 2000)

Remote Sensing as Related to Land Use

Land is the most important natural endowment on which all the man's activities are based. The interaction between man and land (Soil), vegetation, water and other resources

culminates in the development of land use. A sequential development of land use with time results in different land utilization patterns and trends. Growing population and increased human activities are exerting pressure on limited land resources. This is evident by the decrease in per-capita available cultivable land from 0.48 ha. In 1951 to 0.22 ha. In 1991 the unprecedented demand on land for agriculture, urban and industrial, mining besides for forests and pastures (apart from land degradation and erosion) calls for an optimum utilization of land. This requires timely and up to date information about the spatial distribution, location, extent, type of different land use and its spatial pattern of changes over a period of time for scientific land use planning and management.

Ever since the remotely sensed data are available (Since the launch of ERTS-1 in 1972), the mapping of land use/land cover has gained importance. Earlier to this, the land use details have been collected by village officers and the surveys lacked. The spatial representation, reliability are time consuming. By the time the details are compiled and it reaches the planner, the data become obsolete. Remotely sensed data, due to its synoptic, unbiased, repetitive coverage provides reliable information on spatial distribution of land use. Further, this is the only source for the inaccessible areas. Organization like Central Arid Zone Research Institute (CAZRI) in Jodhpur, National Remote Sensing Centre (NRSC) in Hyderabad, Space Application Center (SAC) in Ahmadabad, National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) in Nagpur, All India Soil and Land Use Survey (AIS&LUS) in New Delhi and other state remote sensing centers have been engaged in land use mapping using remotely sensed data. NRSC has carried out land use surveys in some parts of the country using MSS, TM Pavam Terra and recently SPOT and IRS data. Wasteland mapping of the entire country on 1:1 M scale was completed using 1980-82 MSS false Color composites based on which around 53.3 million ha, (16.2%) of the total geographical area of the country was categorized as wastelands under eight different categories. Presently land use/land cover mapping of all the states and union territories is being carried out on 1:250,000 scale, based on IRS P6, LISS-IV image on 1:50,000 scale, besides other collateral data as available in the form of maps, charts, census records, reports, and Survey of India topographical maps.

Some of the characteristics of remote sensing which are related to land use may be inferred from the criteria given by Anderson. These important characteristics are: The interpretation from one interpreter to another will vary greatly for certain types of interpretation where insufficient guidelines or poorly constructed and defined classes are used. Terrain appearance and the size of similar features change from place to place and the level of available detail may therefore change for similar imagery scales. Terrain appearance varies from season to season. Land use cannot be read directly from imagery. What can be obtained from the imagery is dependent on scale. Land cover must be used to infer land use.

Application of Remote Sensing Techniques for Land Use/ Land Cover

Remote sensing techniques provide reliable, accurate baseline information for land use mapping. Generalized delineation of land use classification for large area and spatial distribution of land use categories is possible by satellite imagery as it provides synoptic view. Satellite Remote sensing techniques are helpful to study changes at regular intervals.

Rapid small scale land use mapping for state and national series on 1:1,000,000 and 1:250,000 is possible by satellite remote sensing techniques. Satellite remote sensing provides data in different bands of the electromagnetic spectrum. Also we can have the coverage of the same area on different dates. We can combine data in different bands to produce a color composite. Land use mapping both by visual interpretation and computer aided interpretation is possible by satellite remote sensing technique.

Methodology for Land Use/ Land Cover Mapping

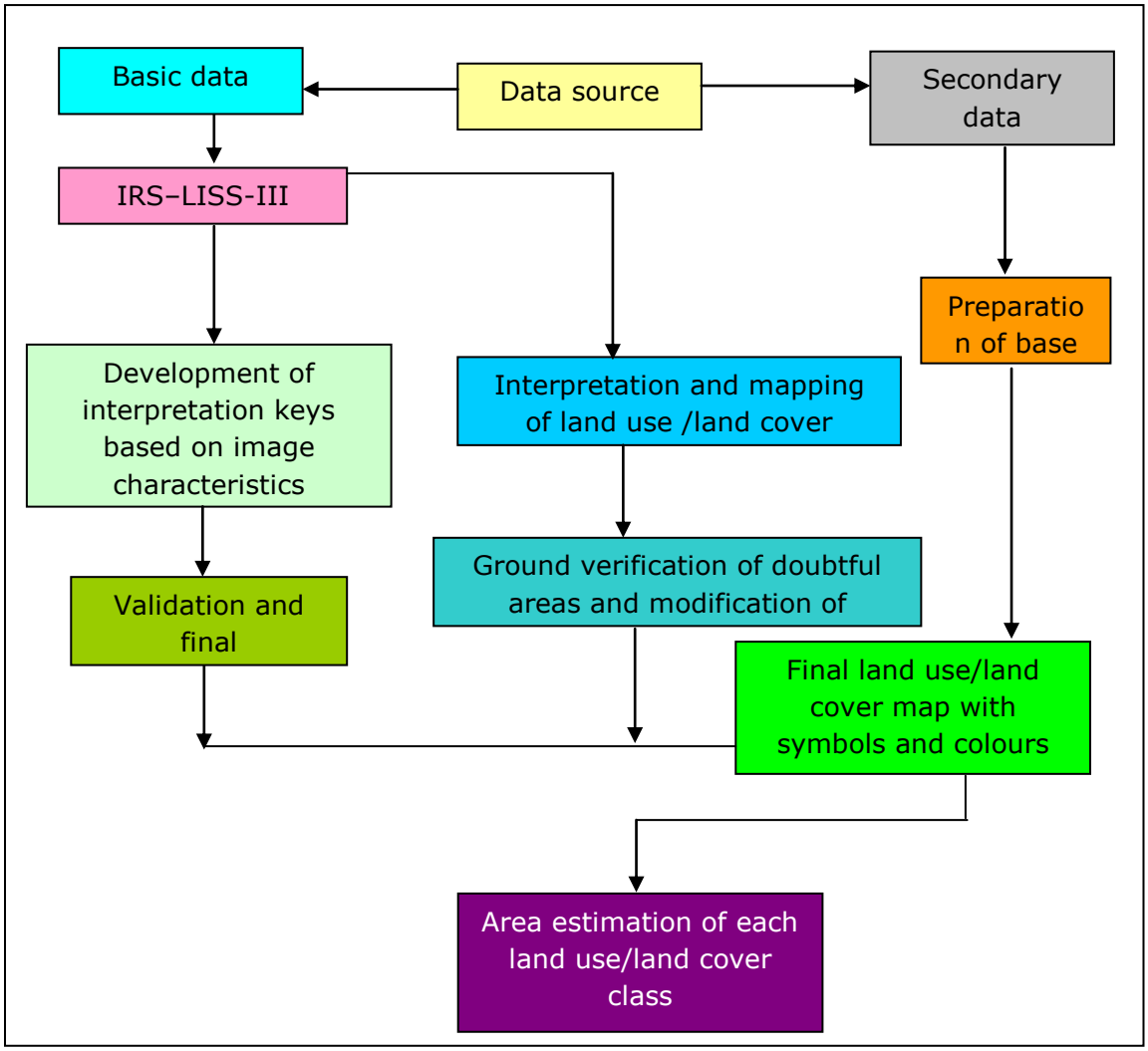
- Land use and land cover mapping of the Study Area was carried out by following standard methods of analysis of remotely sensed data, like Digital Image Processing (DIP) supported by ground truth collection. For this purpose digital data on CDROMs was procured from National Remote Sensing Centre (NRSC), Hyderabad. DIP of the satellite data, preparation of various thematic maps, and their interpretation were achieved.
- Before digitally processing of any image for image enhancement, transformation or classification, pre-processing was done for band separation. Different bands were loaded into the workstation using ERDAS Imagine 9.1. The images were checked for occasional shortcomings in the quality of radiometric and line dropouts. Band separation and windowing of the study area with the help of Survey of India (SOI) toposheets was performed. The registration of image was performed using the nearest neighbor resampling algorithm (Jensen, 1996). The scene was geometrically corrected with toposheets using proper identification of GCPs with a root-mean-square (RMS) error of0.0002 to 0.003 pixels. Indian Remote Sensing data was radiometrically corrected using dark pixel subtraction technique. They were then co-registered with SOI toposheets using UTM Zone - 44 N WGS84 projection systems. Geo-referencing of the composite image was done using digital vector layer of drainage, road network, water bodies, and other permanent ground features extracted from SOI toposheets. Distinguishable Ground Control Points (GCPs) both on image and vector database were identified. By using these GCPs the image was resampled and geo-coded. Sub-pixel image to map registration accuracy was achieved through repeated attempts. The image enhancement techniques like edge detection, filters, manipulation of contrast and brightness, histogram equalization etc. was performed by using different combinations for best image contrast. Standard false colour composite (FCC) image of the catchment area was prepared using bands 2, 3 and 4 of IRS-P6 and discrimination of features was made by visual interpretation on this image. The interpretation key was based on the relationships between ground features and image elements like texture, tone, shape, location, and pattern.
- In order to provide higher resolution of base image (IRS-P6 LISS III), panchromatic (PAN) image was fused with MSS LISS-III image. In this process, a portion of high resolution PAN band, which corresponds to an area of interest (AOI) in the multi-spectral LISS - III image was extracted. Thereafter, both the images were co-registered and LISS-III image was resampled for merging with PAN image. Merging or image fusion was done by special enhancement module in Erdas Imagine 9.0.

- The digital vector layers like Settlements, Industrial area, National Highways, Major Roads, Minor Roads, Railway, Lakes/Ponds, Drainage, Canals, Rivers/Nalas, Single Crop, Double Crop, Plantation, Fallow Land, Forest, Vacant/Waste/Other Land.etc. of the study area were prepared by overlaying the Satellite Imagery on SOI toposheets in 1:50,000 scale.
- In the preliminary analysis, image classification was done by unsupervised classification method by performing ISODATA training. It helped in assigning the classification of the image into land use categories. However, the boundaries of water bodies were separately mapped from SOI toposheets for image classification. The doubtful areas or wrongfully interpreted areas owing to various physical features controlling the study area were marked for ground truth collection. After ground truth collection, supervised classification was assigned for the final image classification. The classified map was regrouped and merged.

The classified raster map thus, prepared was then converted to vector format for GIS analysis and the preparation of required thematic maps using Arc GIS 9.3.

The overall methodology showing under below:

Figure 4.13 Flowchart for LU/LC Mapping Methodology



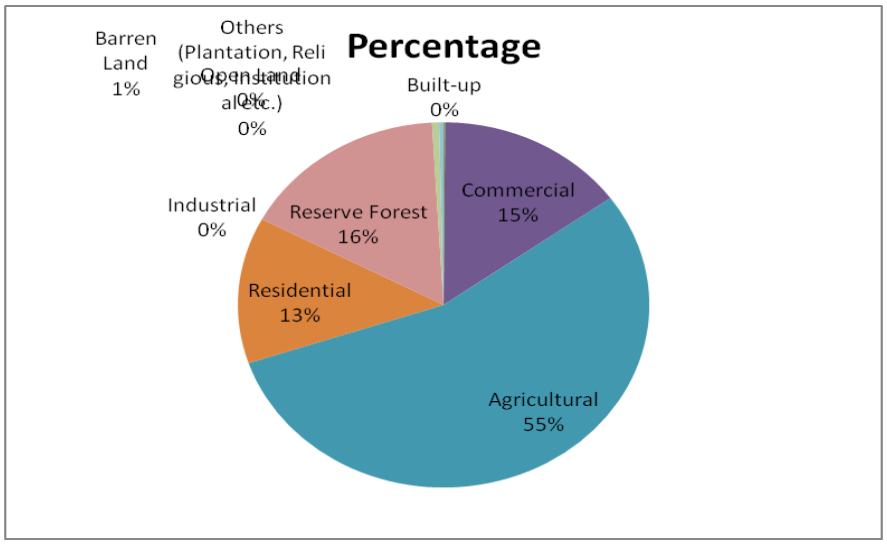
Study Area Land Use / Land Cover Classification System

Using the standard land use classification system proposed by NRSC (about five classes of level I, twelve of level II and four of level III) land use / land cover classes were identified and mapped using satellite data in the present study. The imagery is interpreted and ground checked for appropriate corrections. The land use / land cover Map is shown in **Figure 4.14 and in Table 4.17.**

Table 4.17 Land Use/ Land Cover Statistics of Study Area

Land Use	Percentage
Built-up	0.1145
Commercial	14.7145
Agricultural	55.456
Residential	12.743
Industrial	0
Reserve Forest	16.086
Barren Land	0.543
Open Land	0
Others (Plantation, Religious, Institutional etc.)	0.343
Total	100

Figure 4.14 Land Use/ Land Cover Statistics of the Study Area



4.5.2 Settlements

There are major and minor settlements varying in size and populations along the project corridor.

4.5.3 Educational Institutes

There are schools (both primary and secondary) and colleges (including private and government) along the project corridor. These sensitive receptors are exposed to dust and noise from the road. Some of these educational institutions are located on the edge of the road and is a serious concern from the point of safety and Signage and Safety measures are required.

4.5.4 Medical Facilities

There are some Health facilities located along the project road. None of these though are directly impacted.

4.5.5 Cultural Properties

The project highway traverses through a number of settlements and there are some religious and cultural properties which though not of archaeological significance are nevertheless, significant to the community. Cultural properties along the project highway were identified and documented based on site surveys and during strip mapping.

4.6 Human and Economic Development

4.6.1 Census Profile

Population

Uttarakhand

The total population of the State according to the 2001 Census, is 84.89 lacs of this, 80 percent of the people live in rural areas and 20 percent live in urban areas. The State has a low density of population, about 151 persons per square kilometre. The sex ratio for the State is 962 females per 1,000 males. In rural Uttarakhand, however, there are more women than men, and the ratio is 1,007 women per 1,000 men, while in urban Uttarakhand the ratio is 845 women.

Table 4.18 Uttarakhand Census Details

Population	Total	Urban	Rural
Male	4325924	1181334	3144590
Female	4163425	997740	3165685
Total	84,89,349	2179074	6310275

Population According to Category (in percent)

Category	Percent
Scheduled Castes	17.87
Scheduled Tribes	3.01
Other communities including Backward Classes	79.11

Uttar Pradesh

The total population of the State according to the 2001 Census, is 16, 61, 97,921 crores of this, 79.21 percent of the people live in rural areas and 20.78 percent live in urban areas. The State has a high density of population, about 689 persons per square kilometre. The sex ratio for the State is 898 females per 1,000 males. In rural Uttar Pradesh, however, there are more women than urban, and the ratio is 904 women per 1,000 men, while in urban Uttar Pradesh the ratio is 876 women.

Table 4.19 Uttar Pradesh Census Details

Population	Total	Urban	Rural
Male	87,56,5,369	1,84,07,899	6,91,57,470
Female	7,86,32,552	1,61,31,683	6,25,00,869
Total	16,61,97,921	3,45,39,582	13,16,58,339

Population According to Category (in percent)

Category	Percent
Scheduled Castes	21.14
Scheduled Tribes	0.06
Other communities including Backward Classes	78.78

Geographical Area & Demographic Profile

The project road falls in two states i.e. Uttarakhand and Uttar Pradesh. Uttarkahand is a state in the northern part of India. Uttrakhand extends from 28º 43' N to 31º 27' N longitude and 77º 34' east to 81º 02' E latitude. Uttarakhand is surrounding by Nepal in the East, China in the North, Himachal Pradesh in the west and U.P. in the South. Uttarakhand has a total geographic area of 53,566 km², of which 93% is mountainous and 64% is covered by forest. Most of the northern parts of the state are part of Greater Himalaya ranges, covered by the high Himalayan peaks and glaciers. Uttar Pradesh is a state located in the north western part of India. With an area of 93,933 sq mi (243,290 km^2), Uttar Pradesh covers a large part of the highly fertile and densely populated upper Gangetic plain. It lies between lat. 23º 52' and 31º 28' N and long. 77º 5' and 84º 38' E. The state can be divided into three

physiographic regions viz. the northern mountains of Himalaya, the southern hills and plateau and the vast alluvial Gangetic plains between the two It shares an international border with Nepal to the north. Other states along Uttar Pradesh's border include Uttarakhand, Haryana and Delhi to the north and northwest; Rajasthan on the west; Madhya Pradesh on the south; Chhattisgarh and Jharkhand on the south east; and Bihar on the east.

4.6.2 Settlements Along the Project Road

The project road is pasing through the many no. of urban, semi urban, towns and villages and the details of Towns/villages have been shown in the below **Table 4.20.**

Table 4.20 Towns/Villages Along the Project Road

Sl. No.	Existing Chainage (km)		Town/Village
	From	To	
1	0+000	2+400	Haridwar
2	5+500	6+100	Kangadi
3	9+700	10+000	Shyampur
4	17+900	18+000	Rishyabad
5	20+417	21+010	Gandikhata
6	32+700	34+000	Bhaguwala
7	35+537	35+654	Mohanpur
8	37+000	37+500	Karauli
9	38+700	39+800	Meerampur
10	39+800	41+000	Mandawali
11	43+512	44+187	Rahatpur
12	46+518	47+000	Sahanpur
13	47+388	48+400	Puranpur
14	49+000	52+200	Nazibabad
15	55+900	56+800	Pajalpur
16	58+600	59+000	Guniyapur
17	60+700	61+000	Makhbara
18	62+800	63+800	Sikandarpur
19	64+100	64+800	Akbarabad
20	67+000	67+500	Daultabad
21	68+200	68+900	Kiratpur
22	69+100	70+100	Kotwali
23	71+300	71+800	Roshanpur
24	75+900	77+300	Nagina

Sl. No.	Existing Chainage (km)		Town/Village
	From	To	
25	80+300	80+600	Aligarh
26	82+700	83+700	Puraini
27	84+800	85+600	Mankawala
28	88+700	88+900	Habibwala
29	92+800	96+000	Dhampur
30	99+890	102+715	Sherkot
31	105+700	106+550	Mubarakpur
32	110+700	111+200	Bhutpuri
33	113+100	113+400	Alampur
34	114+960	116+000	Bhajjawala
35	118+500	119+800	Afzalgarh
36	121+400	122+750	Zigari (Bhawanipur)
37	123+150	124+000	Udhowala
38	124+100	125+600	Kasimpur
39	126+500	127+300	Bhadigarh
40	129+000	129+600	Rehar
41	131+683	132+913	Raipuri
42	133+300	134+000	Dharampur
43	135+300	135+700	Kishanpur
44	137+230	141+875	Jaspur
45	142+000	142+645	Dhyan nagar
46	143+000	144+000	Narayanpur
47	145+250	145+575	Govindpur
48	146+000	148+435	Jagatpur Patti
49	149+407	151+200	Kunda
50	152+000	152+700	Missarwala
51	153+160	155+700	Sarwarkhera
52	155+700	161+150	Kashipur
53	161+820	162+640	Kachnal
54	162+900	164+200	Hempur Ismail
55	164+475	165+700	Tarakhera

Sl. No.	Existing Chainage (km)		Town/Village
	From	To	
56	166+100	167+000	Dabhaura Mustahkam
57	171+000	172+700	Sultanpur Patti
58	173+100	173+700	Pipliya
59	173+900	174+400	Jagannathpur

4.6.3 Cropping Pattern and Crop Productivity

Uttarkhand

About 90 per cent of the population of Uttarakhand depends on agriculture. The total cultivated area in the State is 7,84,117 hectares.

Uttaranchal is an agrarian state. About 80% of the population of the state is dependent on agriculture for its livelihood. 12% of the available land is irrigated and 64% are fed by natural springs. The topography of Uttaranchal is characterized by sandy soils which do not retain water for long time. Due to unavailability of moisture in the soil the crop productivity is not very good in the region. Also, due to variation in altitude the rainfall also differs from place to place affecting the crop production.

The major crops produced in the state include Rice, Wheat, Barley, Corn, Mandua, Hangora etc. The state is a major supplier of fruits like Apple, Leachy, Pulam, Naashpati, and Maalta etc. There are various organizations which are involved in the state to help in improving the productivity as well as to promote the cultivation of medicinal plants in the state. One such project is functioning near Pinder Valley in Chamoli district of the state which aims to produce fruits and vegetables by utilizing poly houses.

Uttaranchal's distinct agro-climatic condition is favourable for the development of Horticulture. The soil conditions are good for the production of fruits and vegetables. The climatic and soil conditions allow growing sub-tropical and temperate fruits, vegetables and ornamentals. The various fruits grown in the state include mango, citrus, litchi, guava and jackfruit etc.

Uttar Pradesh

Agriculture is the main occupation of 66 per cent of the population of the state. The net cultivated area in the state is 167.50 lakh hectares. On an average annually the state produced 255.67 lakh metric tonnes of wheat, 130.22 lakh metric tonnes of rice, 23.80 lakh metric tonnes of pulses and 6.44 lakh metric tonnes of oil seeds and 1127.54 lakh tones sugar cane.

CHAPTER - 5

ANALYSIS OF POTENTIAL ENVIRONMENTAL IMPACT & MITIGATION MEASURES

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological and cultural environmental components along the project corridor and their mitigation measures as well. For the assessment of impacts, the baseline information based on the field visits and the primary surveys of the various environmental components carried out. The description of the impacts on the individual components has been structured as per the discussion in Chapter 4: Description of the Environment.

The existing alignment of NH- 74 has a two lane carriageway with varying widths. From the environmental point of view there exists numbers of small & big trees on either side of the existing Road.

The improvement works will mainly consist of:

- Raising the formation level where ever required.
- Upgrading/ improving road geometrics
- Widening & improvement of existing 2 lane to 4 lane
- Pavement strengthening,
- Improving cross drainage
- Road stretches crossing urban areas may also require alternative new alignments or realignments, or provision for drains, sidewalks and parking along existing road.
- Construction of bridges and their approach roads
- River training works
- Replacement of culverts and construction of new culverts:
  The replacement / rehabilitating of culverts will accommodate full lanes for the full formation width.

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

- Planning and design stage;
- Construction stage; and
- Operation stage.

Table 5.1 presents the general environmental impacts expected due to the proposed up gradation of the project road. Impacts have been assessed based on the information collected from the screening & scoping of environmental attributes at feasibility stage. The quanta of all the impacts on Natural Environment are discussed in details in subsequent paragraphs. The description and magnitude of impacts for the various environmental components as visualized for the project are presented in the following sections.

5.1 PHYSICAL ENVIRONMENT

5.1.1 Meteorological Parameters

Seasons

The project area experiences typical Mountain climate. The moderating effects of the nearby mountains and the fairly high amount of relative humidity in the atmosphere have restricted the variability.

The four seasons that are normally observed in the area are as follows:

Winter	:	November – March
Pre-monsoon (summer)	:	March – May
Monsoon	:	June – September
Post-monsoon	:	Oct - Nov.

Haridwar

Due to its location away from any major water body and its close proximity to the Himalayas, Haridwar has an extreme and erratic continental climate. Summers start in late March and go on up till early July, with average temperatures around 29^{o}C. The monsoon season starts in July and goes on up till October, with torrential rainfall, due to the blocking of the monsoon clouds by the Himalayas. The post monsoon season starts in October and goes on up till late November, with average temperatures sliding from 24^{o}C to 13^{o}C. Winters start in December, with lows close to freezing and frequent cold waves due to the cold katabatic winds blowing from the Himalayas. The total annual rainfall is about 2400 mm.

Kashipur

This region experiences a tropical to sub tropical climate. The mean monthly temperature in summer is 43^{0}c, while that in winter is 22^{0}c and the total annual precipitation is about 210 cms.

Temperature

Seasonal variations in temperature follow closely the course of the Sun. The month of January is invariably the coldest and May the warmest month. With the onset of monsoon in early June, there is a reversal of temperature curve and the temperature during the period of monsoon remains very uniform at about 25ºC. During post-monsoon season, the temperature slightly increases above 25ºC, but gradually falls by the start of January. On an average, the temperature during summer months varies from 25ºC to 44ºC, while in winter it ranges from 6ºC to 24ºC.

Relative Humidity

The Relative Humidity ranges between 70% and 90% in the monsoon period. Between November and January i.e. during winter months, the relative humidity varies from 64% to 83%. The relative humidity generally is higher than 49% throughout the year.

Rainfall

Monsoon generally sets in around the second week of June and continues till late September. July and September are the wettest month all over the region. There is hardly a day without rain during these three months. Towards the later part of the season, as the frequency of rain decreases, the project area experiences oppressive hot weather associated with high relative humidity. It receives the maximum rainfall during southwest monsoon season. After this North-east monsoon starts. The average rainfall received ranges from 1500 mm to 2100 mm in a year. About 76 to 85 % of the rainfall is through monsoons.

5.1.2 Land

Physiography

Pre Construction and Construction Stage

Road construction activities involve alterations in the local physiography and drainage patterns. The impacts on physiography may include destabilization of slopes due to cut and fill operations. Cut-and-fills will be designed for improvement to the road geometry, and parallel cross drainage structures will be added to improve drainage. There would be no grading of the roadside area and the work would consist of raising the pavement embankments. The highway stretch falls is a gentle rolling plain terrain. In some stretches, some amount of cuts and fills would be necessary to accommodate the new pavement. There may be an impact on the topography as a result of accelerated erosion on the cut-profiles.

Table 5.1 General Impacts on Environment

Env. Component Affected	Planning and Design / Pre construction Phase	Construction Phase							Road Operation	Indirect effects of Operation or Induced Development
	Project Activity									
	Land acquisition	Removal of structures	Removal of trees and Vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & Machine Operation & maintenance	Asphalt & Crusher plants	Sanitation & waste (labour campus)	Vehicle operation	-
Air	-	Dust generation during dismantling	Reduced buffering of air & noise pollution, Hotter, drier microclimate	Dust generation	Asphalt odour	Noise, dust pollution	Noise, soot, odour, dust pollution	odour/Smoke	Noise, dust pollution	Other pollution
Land	Loss of Productive Land	Generation of Debris	Erosion and loss of top soil	Erosion and loss of top soil	Reduction of ground water recharge area	Contamination by fuel & lubricants compaction	Contamination compaction of soil	Contamination from wastes	Spill from accidents Deposition of lead	Change in cropping pattern

Env. Component Affected	Planning and Design / Pre construction Phase	Construction Phase							Road Operation	Indirect effects of Operation or Induced Development
	Project Activity									
Water	Loss of water resources	Siltation due to loose earth	Siltation due to loose earth	Alteration of drainage, break in continuity of ditches Siltation, Stagnant water pools in quarries	-	Contamination by fuel & lubricants compaction	Contamination by asphalt leakage or fuel	Contamination from wastes Overuse	Spill Contamination by fuel, lubricants & washing of vehicles	Increased Contamination of ground water
Noise	-	Noise pollution	Noise pollution due to machinery	Noise pollution	-	Noise pollution	Noise pollution	-	Noise pollution	Noise Pollution
Flora	-	Loss of Biomass	-	Lowered productivity loss of ground for vegetation	-	Removal of Vegetation	Lower productivity Use as fuel wood	Felling trees for fuel	Impact of pollution on vegetation Lowered productivity Toxicity of vegetation	-
Fauna	-	-	Disturbance habitat loss	Disturbance	-	Disturbance	Disturbance	Poaching	Collision with traffic	Distorted habitat
Agricultural land		Change in land use	Loss of land economic value	Loss of standing crops	Loss of productive land					Conversion of agricultural land
Buildings and built-up structures			Loss of structures, Debris generation, noise and air pollution		Noise vibration may cause damage to structures		Noise vibration - damage to structures		Vibration and Noise	Change in building use and characteristics
People and community	Anxiety and fear among community		Displacement of people psychological impact on people loss of livelihood	Loss of shade and community trees, loss of fuel wood and fodder, loss of income	Noise & air pollution	Odour and dust	Noise & air pollution collision with pedestrians livestock and vehicles	Community clashes with migrant labour	Noise pollution, Risk of accidents	Induced pollution
Cultural assets			Displacement of structures from Row	loss of sacred trees	Noise vibration may cause damage to structures		Damage from vibration and air pollution		Damage from vibration and air pollution	
Utilities & amenities			Interruption in supply				Damage to utility and amenities	Pressure on existing amenities		
Labour's health & safety					Increase of stagnant water and diseases	Asphalt odour and dust	collision with pedestrians livestock and vehicles	Increase in communicable diseases	collision with pedestrians livestock and vehicles	

Geology and Seismology

The project area falls in zone IV of seismic zone, in accordance with seismic zoning map, Fig. 4-1. Suitable seismic factor, as per the India Meteorological Department (IMD), would be adequate and considered for design purpose for Civil Engineering structures and while finishing civil designs.

⊙ *Pre-Construction, Construction and Operation Stage*

Quarries and Crushers

The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect long - term adverse impacts on the environment. The impacts of quarrying operations could be significant at various stages of road construction and are described stage wise.

⊙ *Pre Construction Stage*

Existing quarries that are already in operation with the required environmental clearances have been recommended for this project. No new quarries are proposed and hence no major impacts, which arise in making new quarries operational, are likely. In case the contractor decides in opening new stone quarries he shall follow the guidelines stipulated in **Annexure 5.1.**

A huge quantity of sand would be required for the cement concrete rigid pavement and for the cross-drainage structures proposed. Sand required for the construction will mostly be procured from the river quarries as identified. As an alternative to borrowing of sand from river bed, the possibility of using stone crusher dust has been explored. Stone dust from crusher can be used for the construction works provided the quantity and the quality produced is certified by the Consultant/NHAI to be satisfactory for all construction works, else river sand shall be used from the identified quarries.

None of the sand quarry sites would require any preventive environmental measures. However, the long leads mean that care would have to be taken to prevent spillage of material and damage to the haul roads during transportation. No additional adverse environmental impact, except those resulting from spillage during transportation, is expected to occur.

⊙ ***Construction Stage***

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being a health concern also reduces visibility thereby increasing safety concerns. As no new quarry needs to be opened for this project (majority of the material shall be from cut operations, reuse of old materials and existing quarries within the site itself), therefore, no new impacts are likely to arise due to quarrying operations. A properly enforced EMP could improve the working conditions of workers in the existing quarry areas selected for the project.

Though the quarry materials are to be transported over long distances to the construction sites, almost all the quarries identified have proper access roads, therefore, no major impacts during the hauling of materials is envisaged. The issue of dust generation etc along

the haul roads needs to be addressed through proper enforcement of dust suppression measures.

Borrow Pits

Significant borrowing of earth is required for the embankment fill material, and for the construction of the pavement.

⊙ ***Pre Construction Stage***

As the borrowing is to be carried out in accordance to the guidelines laid out in IRC-10-1961, no major adverse impacts are anticipated. Also, productive agricultural areas have been avoided for borrowing. However, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes just after monsoon. It is expected that the implementation of the mitigation measures for borrow area redevelopment proposed as part of the project will reduce these impacts to acceptable levels.

⊙ ***Construction Stage***

Cartage of the borrow materials to the construction sites can be of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures need to be worked out for the minimising of such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated can be a major potential problem. In addition to visual blight, the other problems more down-to-earth are the safety issues. At borrow area locations where the owners are willing to create ponds for fisheries etc, proper protection measures for the drainage of the surrounding land and slope protection measures need to be worked out. The soils along the corridor are in general capable to produce high yielding agricultural produce and may be negatively impacted if unduly borrowed. The loss of productive topsoil due to road construction is a direct adverse long-term impact. The contractor should ensure that in all such locations topsoil must be stacked aside and replaced after the borrowing activity is over. The soil heaps should be periodically compacted and sprinkled with water to avoid loss. Emphasis should be laid on maximum use of the stripped topsoil in medians, road junctions, redevelopment of borrow areas and additional landscaping works in the road project. The project shall take enforcement measures to prevent / minimize the use of topsoil from other locations such as borrow areas, stockyards, lands for diversions.

The other problems more down-to-earth are the safety issues. At borrow area locations where the owners are willing to create ponds for fisheries etc, proper protection measures for the drainage of the surrounding land and slope protection measures need to be worked out. The soils along the corridor are in general capable to produce high yielding agricultural produce and may be negatively impacted if unduly borrowed. The loss of productive topsoil due to road construction is a direct adverse long-term impact. The contractor should ensure that in all such locations topsoil must be stacked aside and replaced after the borrowing activity is over. The soil heaps should be periodically compacted and sprinkled with water to

avoid loss. Emphasis should be laid on maximum use of the stripped topsoil in medians, road junctions, redevelopment of borrow areas and additional landscaping works in the road project. The project shall take enforcement measures to prevent / minimise the use of topsoil from other locations such as borrow areas, stockyards, lands for diversions.

Soil Erosion

⊙ *Pre Construction Stage*

The removal of roadside vegetation will cause erosion, and increased run-off would in turn lead to erosion of productive soil. The direct impact of erosion is the loss of embankment soil and danger of stability loss for the road itself. This impact is generally restricted to the ROW. The project has taken care of this issue at the engineering design stage itself, as at design gradients of 1:2, the slopes of the embankments are perceived to be stable for all stretches of road. These sections of the road embankment would need stone pitching or any other suitable turfing.

⊙ *Construction Stage*

Elevated sections of road in all sections, particularly all high embankments along the bridges, and the bridge approaches would be vulnerable to erosion and need to be provided proper slope protection measures to prevent erosion. Construction of new bridges involves excavation of riverbed and banks for the construction of the foundations and piers. If the residual spoil is not properly disposed off, increased sedimentation downstream of the bridge is likely. Though during construction period, drainage alteration and downstream erosion / siltation is anticipated, due to the improved design and added capacity of the cross-drainage structures, there should be an improvement in the drainage characteristics of the surrounding area.

Adequate slope protection measures are proposed as part of engineering design. Removal of trees to facilitate construction will cause erosion problems until the proposed compensatory afforestation plantation is established. Silt fencing to be provided to prevent eroded material from entering watercourses. The regular cleaning of the drains by the contractor will ensure that these structures will not be overloaded or rendered Ineffective due to overload.

⊙ *Operation Stage*

No soil erosion is envisaged when the road is in operation as all the slopes and embankments of the project road shall be stabilised through sound engineering techniques. The issue has been addressed at the design stage itself and all slopes have been 1:2, which shall ensure stability of the embankment. Appropriate landscaping measures such as pitching of slopes and turfing shall prevent soil erosion taking place.

Compaction of Soil

⊙ *Pre-Construction Stage*

Compaction of Soil will occur in the pre-construction stage (particularly during site clearance stage) due to movement of heavy machinery and vehicles. Transplantation of trees if carried out shall involve very heavy machinery to uproot trees and haul them to the site of transplantation. Similarly, compaction will take place during setting up of construction camps and stockyards. However, this is a short duration impact. Appropriate measures need to be specified in the Environment Management Plan to minimise the area of soil compaction.

⊙ *Construction Stage*

Compaction shall occur beyond the carriageway and within the vegetated area of the ROW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compactions. This impact is direct and will be the maximum in the ROW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the ROW, where vegetation can grow and rain infiltration will take place.

⊙ *Operation Stage*

During the operation period compaction will be restricted to the CW itself. Compaction cannot be said to be an impact of the operation stage as the pavement itself is a function of compacted base and sub base.

Contamination of Soil

⊙ *Pre-Construction Stage*

Contamination of oil in the pre-construction stage may be considered a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labour camp set up during pre-construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants etc. will come up in this stage.

⊙ *Construction Stage*

Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping being done near water body locations.

⊙ *Operation Stage*

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability as one of the main objective of the project is to reduce accidents, but potentially disastrous to the receiving environment should they occur. These impacts can be long term and irreversible depending upon the extent of spill. There should be a disaster management plan in case of such major spills occurring.

5.1.3 Air

- Air quality along the project corridor will be impacted both during the construction and operation stages of the project.
- Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the down wind direction.
- Operation stage impacts will not be as severe as the construction stage impacts and will be confined generally to a band of width ranging from 50 to 75m from the edge of the last lane on either side of the corridor.
- Both the construction and operation stage impacts can be effectively mitigated if the impacts have been assessed with reasonable accuracy in the design stage.

Generation of Dust

⊙ *Pre Construction Stage*

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

- Site clearance and use of heavy vehicles and machinery etc.;
- Procurement and transport of raw materials and quarries to construction sites;
- The impacts will mostly be concentrated in the ROW. If adequate measures such as sprinkling of water on haul roads around sites where clearance activities are on, covering material trucks especially those carrying sand and fly ash, then the impacts can be reduced to a great extent. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

⊙ *Construction Stage*

As the entire project corridor has a soil type with high silt content and the construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is likely to be generated due to the various construction activities including:

- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;
- Concrete batching plants;
- Asphalt mix plants due to mixing of aggregates with bitumen; and
- Construction and allied activities.

Generation of dust is a critical issue and is likely to have adverse impact on health of workers in quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction period. The Environmental Action Plan prepared by the contractor should lay emphasis on enforcement of measures such as provision of pollution masks, regular sprinkling of water to suppress dust along haul roads at quarries, crushers and borrow areas to mitigate this impact.

⊙ *Operation Stage*

- The negative impacts on air quality during operation stage shall not be significant as that of construction stage. This is due to the reduction of dust particles.

- No dust generation is envisaged during the operation stage as the all road shoulders are proposed to be paved and all slopes and embankments shall be turfed as per best engineering practices.
- The air quality shall also improve due to the plantation activity carried out in the ROW during the end of construction phase.

Generation of Exhaust Gases

⊙ *Pre Construction Stage*

Generation of exhaust gases is likely during the pre construction stage during movement of heavy machinery, oil tankers etc. This impact is envisaged to be insignificant during the pre construction stage.

⊙ *Construction Stage*

High levels of SO2, HC and hydrocarbons are likely from hot mix plant operations. Volatile toxic gases are released through the heating process during bitumen production. Although the impact is much localised, it can spread downwind depending on the wind speeds.The Environment Management Action Plan prepared by the contractor needs to ensure adequate measures are taken especially for health safety of workers such as providing them with pollution masks during working hours. Also, the contractor should ensure that hot mix plants, stockyards, etc. are away from residential areas and residential quarters of all workers. Contractors also should be asked to provide regularly Pollution under Control certificate for their equipments and machinery as per prevalent norms. If adequate measures are taken, then impacts from generated gases can be negligible.

⊙ *Operation Stage*

The major impact on air quality will be due to plying of vehicles. The impacts on air quality will at any given time depend upon traffic volume / rate of vehicular emission within a given stretch and prevailing meteorological conditions. Air pollution impacts arise from two sources: (i) inadequate vehicle maintenance; and (ii) use of adulterated fuel in vehicles. Enforcement standards to meet better vehicle performance in emissions and the improvement of fuel constituents can assist in improving regional air quality.

5.1.4 Water Resources

To facilitate the cross-drainage at water crossings, both slab and pipe culverts are proposed. The surface water bodies along the project road might be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project. The impacts on water resources have been summarized in **Table 5.2.** There are a number of rivers, Mahanadi River, irrigation canals crosses the project corridor.

Table 5.2 Likely Impacts on Water Resources during the Construction Stage

Impacts due to Construction	Indicators
Loss of water bodies	Area of water bodies affected
Loss of other water supply sources	Hand pumps, wells etc. affected
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of ground water recharge	Groundwater in Area rendered inaccessible & impervious
Use of water supply for construction	Quantum of water used
Contamination from fuel and lubricants	Nature and quantum of contaminators
Contamination from improper sanitation and waste disposal in construction camps	Area of camp / disposal site and proximity to water bodies / channels

Alteration of Drainage

Impacts of road construction, which lead to alteration of drainage, are generally widening at culvert or bridge locations. This requires river and or gully training for the period during which the bridge is to be constructed. Alteration of drainage can lead to soil erosion of adjacent areas, disturb local vegetation and impair local ecology.

⊙ *Pre Construction Stage*

No drainage modification of surface flow of rivers / streams is envisaged during pre construction period.

⊙ *Construction Stage*

Though the constructions along the watercourses are to be carried out in the lean flow periods, the river is perennial; the construction activities will necessitate the diversion of the waterway. This diversion of flow can significantly harm the aquatic habitat, if any. The waterway will be constricted, increasing velocity downstream of the bridge. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of micro flora. The impact shall be direct but short term in nature and shall last till the construction period.

Short-term increase in runoff during construction may occur due to the removal of trees, vegetative cover and compaction of the surrounding soil during pre construction. Thus the increased sediment load will be a significant impact that needs to be addressed for all water bodies along the corridor and adequate silt fencing measures need to be provided.

The design proposes the raising of the embankments from the existing levels to ensure that the finished pavement is above the maximum flood level so as to prevent any impacts due to any water seepage in the pavement. No significant impacts in the drainage pattern due to the raising of the road profile are likely, as the road design itself takes care of the cross-pavement drainage.

⊙ *Operation Stage*

One of the unavoidable aftermaths of road construction is the increased surface run off. The new lanes, which are essentially a paved impervious surface, will cause increased surface runoff along the roadsides. Increase in surface run-off is due to the creation of impervious

surfaces that prevent the flow of water into the ground. The project involves the construction of four lanes with paved shoulders on either side.

Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, as the proposed lanes has been designed with ditches on both sides to take care of surface runoff local flooding due to the proposed increased runoff shall be taken care of effectively. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.

Water Required for the Project

⊙ *Pre Construction and Construction Stage*

The most likely significant impact on water during construction is depletion of water table. The cement concrete construction works requires a considerable quantity of potable water for the various activities including construction of the pavement, dust suppression, curing etc. The peak water requirements for the various construction activities are presented in **Table 5.3.**

Table 5.3 Peak Water Requirement for Construction

Purpose	Peak Demand (KLD)
Maintain Hygiene in Labour Camps	100
Mixed with Cement in batching plant	100
Dust Suppression in Hot Mix plant	50
Curing of Structures	100
Rolling and Compaction	70
Domestic Chores	80
Drinking	100
Others	100
Total	700

The peak demand of water to be used during the construction phase will be around 700 KLD. The demand though is only indicative in nature and shall differ during the lean period of construction. The demand shall be met through both surface sources and ground water.

As per the ground Water levels scenario in the project districts however is between safe and semi critical scenario. To minimise the minor impacts of the project on the water resources, water harvesting structures and ground water recharge measures have been proposed.

⊙ *Operation Stage*

The depletion of water is predominantly restricted to the construction phase. The road operation does not make a demand on the available water resources apart from time to time requirement during works such as maintenance of road side tree plantations. However, it is more likely that water from these rivers not be tapped at all for this purpose.

Water Quality

⊙ *Pre Construction Stage*

Significant temporary impact to drainage is expected. With the construction of many culverts and bridges could lead to temporary impeding of natural drainage. This could lead to pollution from construction wastes, etc. Further unplanned construction methodologies can have catastrophic effects due to unexpected rain fall and resultant massive erosion of material.

Water sources including flowing and stagnant water sources are likely to be contaminated due to activities such as setting up workers camp near water sources or transportation of construction material such as sand, borrow material etc without covering it. Due to tree felling soils around the water bodies and surface drainage channels will be exposed during the pre construction stage, during which, the suspended sediments and the associated pollutants can be washed in to these water sources. As soil all along the corridor isn't of alluvial type, the impacts due to the increased sediment load will not be a significant impact that needs to be addressed for all water bodies along the corridor. Even then adequate silt fencing measures need to be provided.

Contamination of ground water is another unavoidable impact of road construction and allied activities. The ground water recharge areas may be reduced due to an increased in impervious layers due to the construction. The contamination of the groundwater resources due to the project is likely at the following locations:

- Along construction sites, camps involving moving of construction equipments and machinery.
- At the various community water bodies and sources of water supply such as hand pumps etc
- Along the entire length of the corridor especially around urban areas and productive lands.

The impact of contamination of water sources such as wells can be avoided if these sources are covered while site clearance is going on at the site. The Management Plan needs to ensure that proper precautions are taken to prevent / minimise contamination of all water sources.

⊙ *Construction Stage*

The impacts on water quality will be of greater concern during the construction stage. Increased sediment load during preparation of the site is the most likely adverse impact. The contamination by fuel and oil from construction vehicles or bitumen from hot-mix plants is less likely and in any case expected to be localised. Discharge from labour camps and vehicle parking areas will have to be treated before discharge into any watercourse. It is during the operation stage that the leakage or spillage from vehicles damaged, overturned or just badly maintained is more likely.

The construction activities around the surface bodies can affect the water quality due to the disposal of solid and liquid wastes from labour camps, fuel and lubricant spills or leaks from construction vehicles, fuel storage and distribution sites and from bitumen or asphalt storage at hot-mix plants.

- Concentration of suspended solids is likely to be highest during the construction stage and immediately after the construction when vegetation has not been fully established on the embankment slopes.

- Oil and grease form a film on the water surface and hinder the transfer of oxygen into water.
- Though the compounds of lead are suspected to be carcinogenic, it is unlikely that leads pollution to have significant effects as 90-95% of lead in run-off is inert, and will be further diluted in the receiving water bodies, where the lead concentrations are minimal.
- Discharge from labour camps and vehicle parking areas will have to be treated before Discharge into any water course. It is during the operation stage that the leakage or Spillage from vehicles damaged, overturned or just badly maintained is more likely. The existing levels of contaminants, which can trace their origin to road run-off, indicate that water quality degradation is not a significant impact. Normally groundwater is shielded from the effects of such degradation, but if the discharges from construction camps were disposed off using soak-pits / septic-tanks that were not adequately designed, the consequences would be disastrous since restoration of groundwater quality is a much slower process.

⊙ *Operation Stage*

No contamination of any water source is envisaged during the operation period.

Impact on other Water Supply Sources

The impact on the local water supply sources like hand pumps, natural and manmade water bodies, wells and concrete tanks will be significant as many are directly impacted. These though shall be replaced with new sources at locations near to the existing ones.

As part of the project preparation, the alignment has been carefully routed to avoid any direct impact on these water bodies, however, at some locations; the encroachment onto these water resources has been unavoidable. In such locations the relocations of all these water supply sources has been recommended and the cost of the relocation has been included as part of the project cost.

5.1.5 Noise levels

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

The baseline noise levels monitored at various locations along the project packages indicate the baseline levels is within the permissible limits for residential and rural areas and exceeds in some commercial areas. Even the night levels recorded at the various locations are close to or higher than the noise levels allowed during daytime. Thus, noise is a major area of concern, especially since a number of sensitive receptors (schools, colleges and hospitals) have been identified to be quite close to the road. The impacts on noise due to the project will be of significance in both the construction as well as the operation stages.

Table 5.4 Noise Impacts

Sl. No.	Phase	Source	Impact
1	Pre Construction	• Man, material and machinery movement • Establishment of camps, site office, stock yards, construction plants etc.	• Short duration • Localised impact • Negligible
2	Construction	**Plant site** • Crushing, hot mix plants, machineries, batching plants, excavation, grading, paving activities **Work zones** • Community residing near the work zones	**Plant site:** significant impact within 500m **Work zones:** temporary and negligible
3	Operation	Increase in traffic	Negligible impact

Though the noise levels are within the stipulated standard, the noise levels are a concern due to the number of sensitive receptors located along the project road. The impacts on the receptors shall basically relate to increase in noise levels, access and physical damage to the structure. Even though complaints of noise and vibration are common, most of the receptors are quite far away from the road and hence the noise is dissipated.

5.2 BIOLOGICAL ENVIRONMENT

5.2.1 Flora

5.2.1.1 Forest Areas

The proposed ROW is passing through the patches of Protected Forest different patches all along the 3 districts and Reserve forest (km 3025.000 to km 318.400 on left,Right and on both sides) in Shayampur RF, In Chidyanpur RF(km 19.200 to km 30.300 on on left,Right and on both sides) & Rampur RF(km 30.000 to km 130.900 on on left,Right and on both sides and 142.400 to 143.000) There is no endangered flora and fauna found in these Protected Forests and RF**.**Even at 10 m buffer on either side of the ROW the forest trees are found to be very less and there is no endangered species of animals are found.

5.2.1.2 Roadside Plantations

The principal impact on flora involves the removal of trees for the creation of a clear zone within the Corridor of Impact. Reason for clearing trees is threefold:

- To prevent single-vehicle collision with the roadside trees, trees very close to the road need to be cleared. Roadside trees are safety hazards, particularly those trees with strong and rigid stems. Some trees are safety hazards because they preclude clear sight distances. Some trees such as Tamarindus indica have a propensity to overturn when old and are potential safety hazards depending upon age and decay condition. All trees that are safety hazards need to be cleared.

- To ease construction of the embankment for the widened road formation and, to permit construction of adequate roadside drainage structure, trees located within the area between the pavement and the daylight line needs to be removed.
- Trees need to be cleared to facilitate construction of traffic detours. As the present project road is mainly two lanes, there shall be need for diversions especially except for construction of bridges.
- The stage wise impact on roadside trees and plantation has been described in the following sections.

⊙ *Pre Construction Stage*

The project has a significant, direct and long-term impact on Roadside trees in the Pre construction stage. The cutting of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people being deprived of tree products, such as wood, fruits, leaves etc. Removal of roadside tress will reduce comfort levels for slow moving traffic and pedestrians. This is the only impact considered important after the effect on the embankment stability has been considered. It may be pointed out that this may be marginal in case of a full fledge Highway, where the segregation of through (fast-moving) and local (slow- moving and pedestrian) becomes a major consideration. This negative implication needs to be taken into consideration by compensating with new plantation along the ROW of the project highway. The felling of trees need to be compensated for by compensatory afforestation, and wherever possible, the options of transplantation of significant trees need to be worked out and adequate provisions for the monitoring of the same need to be worked out.

A far less contentious issue, which normally takes the back seat, is the importance of the ecosystems supported by the roadside trees. Not only would the removal of trees lead to erosion, it would also mean that the micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost too. The only mitigation would be to ensure that the compensatory afforestation required as per the MoEF guidelines for the project is carried out with native species and proper care of the saplings is taken to ensure that the roadside plantation returns to its previous state as quickly as possible. Co-operation of locals to ensure that local cattle do not damage the saplings during the early stages of growth will be required.

The roadside plantations will need to be cleared for the project. Though the loss of these trees is an irreversible and long-term impact, the loss of the roadside plantations shall have to be compensated in accordance to the principles of the Forest (Conservation) Act.

⊙ *Construction Stage*

The construction of new road shall involve removal of topsoil and clearing of vegetation cover and felling of trees. These activities will exert wide-ranging impacts on the surroundings as summarized in **Table 5.5.**

Table 5.5 Likely Impacts on Flora

Activity	Impact
Cutting and removal of earth/rock Road Construction	Loss of vegetation cover (shrubs & grasses) canopies; Felling of trees of girth more than 30 cm; Reduced shade and shelter for roadside fauna Reduction in soil fertility, moisture and humidity
Workers Camps	Use of plants and trees as fuel wood

5.2.2 Fauna

Domesticated animals dominate fauna species. There are no endangered species reported within the study area. There is likelihood of slight impact to local domestic animals, which graze in the area especially after the road is constructed. Increased vehicle movement in the area might lead to accidents involving animals. In areas with high traffic volumes, road kill can be a considerable or even the predominant cause of mortality. To avoid such accidental kill, the project shall provide underpasses as part of the project. More over there shall be positive impact on the faunal species during the operational phase. The plantation activity carried out, as part of the project component shall provide shelter and food for the smaller avian and mammalian species, which in turn shall improve the overall food chain and food web and ultimately the ecology of the area.

5.2.3 Aquatic Ecology

The construction of new bridges will cause some contamination of the river water due to spillage of construction material, sediment loading & increased turbidity downstream of the bridge location. This change shall have some impact on the flora and faunal species and change the nature of the substratum resulting in decline in the number and diversity of plants and thus the food web. No negative impacts are envisaged on the aquatic ecology during the operational phase.

5.3 SOCIAL ENVIRONMENT

5.3.1 Human Use Values

Amenities and Facilities

Some of the infrastructures built to facilitate the basic needs of the communities in these areas may be affected by the project, the details of which are given in the RAP.

Change in Land Use

The development that the improved road will bring with it will induce a chain reaction towards change in land use. Change In land use will be sparked off as a result of land speculation. The road, which is flanked by agricultural fields, will witness overnight selling of these lands for the prices that they will fetch. Industrialization of fringe areas of cities is also a possible impact of a road development scheme. The availability of cheap labour and easy access to markets in the city will make roadside areas quite an incentive for the industrialist. Reduced transportation costs and availability of high-class transportation facilities for raw materials and products will be the most important advantage of the improved road. The mushrooming

of industrial areas on roadside will mean that the use of whatever infrastructure facilities that may be available will preferentially go to the 'deep pockets' of the industry. This will further strain these almost non-existent services.

Land Speculation

Better connectivity will also mean that the value of roadside properties will rise almost overnight. The encroachment onto the ROW for the road to cash in on this opportunity is an almost universal occurrence, to varying degrees. Encroachment will mean that the future expansion / widening of the road scheme will be problematic and the issues related with easement and eviction will become a real challenge for the NHAI that is already stretched to the limit. However, the damage to encroaching structure, whatever its status, in case of an accident will be far more visible and potentially dangerous impact of such activity. Strict planning laws in conjunction with continuous unbiased monitoring of the development are the only proven strategies against such illegal activities.

Cropping Pattern and Crop Productivity

The proposed project is likely to bring in its wake industrialization and change in land use. This translates into change of land currently under agriculture to more commercial use. It is envisaged that due to this proposed change the crop productivity in the agricultural belt immediately adjoining the ROW shall decrease. This impact is envisaged only to be valid for the agricultural land immediate to the ROW. Although the spatial impact is likely to be insignificant the impact will be irreversible in nature.

Exploitation of Resource Base

Development of a road in areas previously not easily accessible can work like a double-edged sword for the environmental resources in the area. While the road would unlock potential value in the area, stimulate growth and make the environment hospitable, the rapid depletion of natural resources, by means with which these areas cannot cope is a distinct possibility.

Development of such vital Infrastructure will lead to over exploitation of the environmental resources (e.g. too much groundwater pumping, indiscriminate wastewater disposal, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous. The severe depletion of ground water resources in certain areas and threats of saltwater ingress into aquifers in areas near the coast are likely if the expanded urban areas continue to use bore wells for their domestic water supply.

Road Safety

The improvement of the project road will entail doubling the existing carriageway to a two-lane section and improve its condition to allow vehicles at design speeds of 80-100 km/hr. Increased vehicular speed mean that the fringe areas of the road are at increased risk from speeding vehicles. The existing facilities and amenities along the road shall be subjected to adverse impacts of road operation. The possibility of accidents is likely to increase. The

possibility of this happening is a cause of concern as there are many educational, cultural and health institutes along the road.

5.3.2 Cultural Properties

Relocation of Cultural Assets

Cultural properties (shrines, sacred and archaeological structures) lying near the ROW are most susceptible to impacts due to pre construction and construction activities. Clearing of the site during movement of road construction machinery is likely to require a belt of about 4-5m from the edge of the carriageway, which is likely to adversely impact cultural properties. Cultural properties will be subjected to varying degree of impact depending upon their placement in the ROW.

5.3.3 Quality Of Life Values

Socio-Economic Profile

The detailed socio-economic analysis of people, structures and property likely to be impacted by the proposed project has been presented in the Resettlement Action Plan.

Public Health and Safety

Impacts on public health and safety may arise during the phases of pre-construction, construction and operation phases. During the pre-construction and construction phases, dismantling of the structures for ROW clearance and road construction activities may result in the following health hazards:

- Breaking and dismantling of properties during pre-construction has psychological impacts on their owners and others associated with them.
- Debris generated on account of the above-mentioned activities if not properly disposed might give rise to health problems in the area. However, the structures to be dismantled during pre-construction phase will mainly be of semi-permanent and temporary nature and much of the waste shall be salvageable.
- Dismantling of first row of structures (generally commercial) along the highway shall lead to exposure of second row of properties (generally residential) to higher dust, air and noise pollution levels. This is a long-term effect (might extend into the operation phase) and may increase the effected households' medical expenditure.
- In case of non-local labour (If so is arranged by the contractor), labour camps are set up at one or more sites adjacent to the alignment, and at some ancillary sites, like aggregate quarries. These labourers hired from outside can have clashes with the local population on account of cultural and religious differences. The influx of a large work force to an area, already hard pressed for basic services (medical services, power, water supply, etc.), can impose additional stress on these facilities.
- In and around forest areas if alternative fuels are not made available to the workforce, there is a likelihood that trees / branches will be cut down for cooking or heating purposes.

- During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas. Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities. Other problems perceived during construction period is inconvenience to the local people as well as the highway passengers due to traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.
- The traffic amount and speeds are likely to increase throughout the road corridors. The accident risk would tend to increase. Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas.

Extent of Loss to Private Properties

As a corollary to land acquisition, the project affects a number of families, and displaces some of them. These families are titleholders, and are distinct from the squatters and the encroachers. The details are being provided in the RAP report.

5.4 MITIGATON MEASURES PROPOSED

The negative impacts of road projects can be reduced or minimized only if proper safeguards are put in place during the design and construction stage itself. These can include reducing pollutant discharge from the harmful activities at source or protecting the sensitive receptor. An effective mitigation strategy will utilise a combination of both options to arrive at practically implementable measures. Conscious efforts have been worked out to minimize any adverse impacts on the various environmental and social components. Where the impacts on various environmental components have been unavoidable, mitigation designs have been worked out.

The mitigation / avoidance / enhancement measures for the various environmental components for the different project packages are described below. These measures have been fully and adequately incorporated in the Environmental Management Plan prepared. The measures are described in the same order as detailed out in the Chapter on Assessment of Impacts.

5.4.1 Meteorological Parameters

Avoidance measures, such as the minimizing of the number of trees to be cut etc, have been worked out as part of the design finalization. However, there will be a significant tree felling due to the project. Though no major change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal, loss of roadside plantations and the addition of increased pavement surface. Compensatory afforestation, planting along the median and landscaping proposed shall help in restoring the green cover along the corridor along with the microclimate conditions that exist before the removal of trees, within 2-3 years.

5.4.2 Land

Land acquisition along with soil erosion an its subsequent contamination have emerged as major sources for causing land impacts especially in urban areas and nearby water courses .Due to proposed road improvements there will be a net result in economic growth in the region over the time.

Table 5.6 Summary of Mitigation on Impact on Land

Sl. No	Particular	Impact	Reason	Mitigation / Enhancement
1.	Change in Geology	Direct, long term, negative Impact	Extraction of materials (borrow earth, coarse and fine aggregates)	• No blasting is envisaged. • Quarry Development Plan need to be enforced.
2.	Change in Seismology	No Negative Impact		Cross drainage structures are checked and complied with the seismological settings of the region (Zone)
3.	Loss of land	Direct, long-term negative impact	Land Acquisition, Change in land use pattern	• Land acquisition minimised. LA only at locations which require geometric correction • Design restricted to within ROW
4.	Generation of Debris	Negative Impact	May contaminate air, water and land, if not disposed properly	Disposed properly to avoid contamination.
5.	Soil Erosion	Moderate, direct, long-term negative impact	Road slopes and spoils	• Embankment protection through: • Stone pitching • Turfing
6.			Construction of new bridges and culverts Quarry and Borrow areas	• Residual spoil need to be disposed properly • Silt Fencing need to be provided • Quarries need to be reclaimed
7.	Contamination of Soil	Direct, long term negative impact	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix Production of hot mix and rejected materials Residential facilities for the labour and officers Routine and periodical maintenance	• Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. • Oil Interceptor will be provided for accidental spill of oil and diesel • Rejected material will be laid as directed by engineer. • Septic tank will be constructed for waste disposal.
	Soil quality monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	• Measures will be revised & improved to mitigate / enhance environment due to any unforeseen impact.

Change in Seismology

No negative impact on the seismological setting of the region is anticipated. Rather, as part of the project all the existing structures will be checked and constructed as per the seismological requirements of the region in conformity to the IS 1893(Part 1):2002.

Erosion

Incorporating appropriate type of treatments of slopes has reduced the potential for erosion of high embankments and bridge fills. The soil is assumed to have an angle of repose corresponding to 1V: 2H. Slope protection is normally required only for slopes steeper than this. The side slopes gentler than this will be turfed with shrubs and grasses as per IRC: 56-1974: Recommended Practices for Treatment of Embankment Slopes for Erosion Control.

Contamination of Soil

Contamination of soil can spoil the soil and can also contaminate the surface as well as ground water sources. Details of the activities from which the contamination can occur are presented below:

Table 5.7 Mitigation Measures for Soil Contamination

Potential impact	Mitigation
Scarified Bituminous Wastes	No scarification involved. In case contractor decides to scarify then the material to be reused in the GSB layer. Non reusable Bituminous wastes to be dumped in 30cm thick clay lined pits with the top 30cm layer covered with good earth for supporting vegetation growth over a period only after obtaining permission of Consultant.
Scarified Non Bituminous Material	Used in the normal GSB layer (not the drainage layer)
Cut material	Reused as embankment, median & shoulder fill materials Excess material to be used for filling up of borrow areas identified by the contractor and approved by the Consultant
Construction debris generated from dismantling of structures	**Annexure 5.2:** Guideline for Rehabilitation of Dumpsites, Quarries and Borrow Areas will be applicable **Annexure 5.3:** Guidelines for Existing Quarry Management
Soil Contamination due to accident spills	An emergency response team to be created. The team shall contain members of the district and police administration and also have specialist in remediation. Responsibility of Contractor to inform the team to take actions. The roles and responsibility of the members of the ram shall be framed in conjunction with all the parties to address the situation arising out of the accidental spills resulting in situation like water and soil contamination, health hazards in the vicinity of the accident spot, fire and explosions etc.

Potential impact	Mitigation
Soil contamination due to Highway run off	Improvements of design shall lead to less accidents and hence less spillage of oil and grease
	During construction, the contractor and the contractor's described previously. Fuel storage will be in proper bunded areas. All spills and collected petroleum products to be disposed off in accordance with MoEF and SPCB guidelines and as per the directions of the Emergency Response team. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies.
Operation of residential facilities for labour camps, Vehicle parking areas	Vehicle parking area will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly sloped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor (Fig 9-1)

Productive Top Soil

Efforts have been made to minimize the intake of productive lands. As the existing ROW is not sufficient at various locations to accommodate the proposed four-lane cross sections and the need for the provision of several bypasses along the corridor, acquisition of land is an alternative. To conserve the productive top soil the following measures have been proposed:

- The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150mm and stored in stockpiles. At least 10% the temporarily acquired area shall be earmarked for storing top soil.
- The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile be restricted to 2m. To retain soil and to allow percolation of water, silt fencing shall protect the edges of the pile.
- The stockpiles shall be covered with gunny bags or tarpaulin.
- Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on a areas as identified by contractor and approved by the Consultant in a layer of thickness of 75mm - 150mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes, medians, incidental spaces etc,

During construction, some land will be temporarily needed to create detours, store equipment and material, site construction workers' camp and other amenities. The top 150 mm of soil from these areas will be stripped off and stored in heaps of less than 2 m height. The slope of the pile will be maintained to lesser than 1:4 to reduce removal of sediment with runoff and to enhance percolation through stored soil. The stored soil will be used for:

- Covering all disturbed areas including for the rehabilitation of borrow areas

- Top dressing of the road embankments and fill slopes
- Distribution over barren / unproductive areas, for a depth of 75-100mm, to make these lands productive.

Borrow Areas

The soils to be used, as sub-grade, select sub-grade and shoulder materials need to be hauled from designated borrow areas. Similar to the identification of suitable quarries, suitable borrow areas for supply of soil to the new road formation were also identified. Based on the total requirement and availability of each soil type, estimates of soil quantity to be obtained from each of the borrow areas were worked out in accordance with IRC: 10-1961: Recommended Practice for Borrow Pits for Road Embankments constructed by Manual Operation.

A total of 47 borrow areas have been identified along the existing project corridor given in **Table 5.8**. In the selection of the borrow areas, care shall be taken taken to ensure that:

- Sufficient quantity of suitable soil is available from the borrow areas;
- The borrow areas are as close to the project road as possible;
- The loss of productive and fertile agricultural soil is minimum; and
- There is minimum loss of vegetation.

Table 5.8 Details of Borrow Areas Proposed

Sl No.	Borrow Area Sample No.	Village Name	Side	Location	Lead (m)
1	BA-01	Kangadi	Right	5+750	2000
2	BA-02	Bhaguwala	Left	30+200	200.0
3	BA-03	Bhaguwala	Left	30+800	200.0
4	BA-04	Bhaguwala	Left	31+100	300.0
5	BA-05	Bhaguwala	Left	32+250	250.0
6	BA-06	Mandawali	Left	40+000	5000.0
7	BA-07	Jetpur Village	Left	41+000	5000.0
8	BA-08	Rahatpur	Left	43+000	200.0
9	BA-09	Rahatpur	Left	44+000	200.0
10	BA-10	Rahatpur	Right	44+200	200.0
11	BA-11	Nazibabad Town	Left	53+200	250.0
12	BA-12	Rahatpur Village	Right	55+300	600.0
13	BA-13	Bijepur	Right	55+800	1500

Sl No.	Borrow Area Sample No.	Village Name	Side	Location	Lead (m)
14	BA-14	Bajopur	Right	56+200	4000
15	BA-15	Akbarabad	Left	66+000	400
16	BA-16	Dultabad	Right	67+800	500
17	BA-17	Kotwali	Left	70+200	1000
18	BA-18	Kotwali	Right	70+800	200
19	BA-19	Roshanpur	Right	72+100	200
20	BA-20	Roshanpur	Left	73+100	80
21	BA-21	Roshanpur	Left	73+600	100
22	BA-22	Aligarh	Right	80+100	100
23	BA-23	Aligarh	Left	81+200	200
24	BA-24	Kalyanpur	Left	85+600	200
25	BA-25	Habibwala	Left	89+000	250
26	BA-26	Dhampur	Left	92+500	600
27	BA-27	Dhampur	Right	97+600	200
28	BA-28	Ghausiya	Left	106+600	3000.00
29	BA-29	Bhatigarh	Left	127+000	1000
30	BA-30	Haraywala	Right	127+000	1500
31	BA-31	Rehad	Left	130+000	2000
32	BA-32	Rehad	Right	130+000	400
33	BA-33	Dehlawala	Left	131+000	2000
34	BA-34	Dehlawala	Left	131+600	200
35	BA-35	Dharampur	Left	132+900	100
36	BA-36	Fica River Bank	Left	135+200	150
37	BA-37	Shyamnagar	Left	147+000	4000
38	BA-38	Shivrajpur	Right	147+000	3000
39	BA-39	Shivrajpur	Right	148+500	75
40	BA-40	Dhanori	Left	166+450	3000
41	BA-41	Maheshpura	Right	177+800	600

For opening new borrow areas other than those identified the contractor. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields. Borrowing of earth shall be carried out at locations recommended as follows:

- **Non-Cultivable lands:** Borrowing of earth will be carried out to a depth of 1 m. The borrowing of earth shall not be done continuously and the slope of the edges shall be maintained at not more than 1:4.
- **Productive lands:** Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, the contractor has to obtain the prior permission of the Engineer. At such locations, the depth of borrow pits shall not exceed 45 cm and may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside and the topsoil shall be carried out and preserved.
- **Borrow Areas near Settlements:** Borrow pit location shall be located at least 0.8 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.
- To avoid any embankment slippages, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. The borrow pits will be redeveloped by filling and providing 150 mm thick layer of preserved top-soil; by creating shallow pond for water harvesting etc. Re-plantation of trees along the edges of borrow areas will be carried out.

Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills, which might result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day-time only, The unpaved surfaces used for the haulage of borrow materials will be maintained properly.

Using Fly Ash as Fill Material in Embankment

The proposed widening and construction of new alignment for the project, involves requirement of substantial amount of earthwork and large quantities of fill material. As per MoEF notification on fly ash, fill material required for the project should be filled up of fly ash. At certain locations near structures for example the embankment height might be feasible enough to use fly ash as per IRC. Fly ash for the proposed project will be taken from Captive Thermal Power plant at wadi, situated near by the project road.

5.4.3 Soil Quality Monitoring – Mitigation

The quality of the soil shall be monitored to find out the effectiveness of the mitigation measures and further improvement in designs if required. The monitoring plan shall be functional in construction as well as in operation stages. The soil quality shall be monitored at all the locations as given in Table 4.10.The frequency, duration and responsibility will be as per the **Annexure 5.4 Environmental Monitoring Plan.**

Air Quality – Mitigation:

Table 5.9 Summary of Mitigations for Impacts on Air Quality

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Meteorological factors and climate	Marginal impact	Due to production and laying of hot bituminous mix	• Comprehensive afforestation • Avenue plantation • Shrub plantation in the median / island
2.	Dust generation	Temporary and location specific	Shifting of utilities, removal of trees & vegetation, transportation of material	• Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Plant to be installed in down wind direction from nearby settlement.
3.	Gaseous pollutants	Moderate impact	Clearing and grubbing materials dumping brushing of the surface access roads to borrow area hot mix plants, Crushers paving of asphalt layers, Labour Camps	• Air pollution Norms will be enforced. • Labourers will be provided mask. • Local people will be educated on safety and precaution on access roads, newly constructed embankment etc.
4.	Air quality emissions	Moderate impact	Air pollutants from traffic	• Compliance with future statuary regulatory requirements
5.	Air quality monitoring		Effectiveness shortfall of any unforeseen impact	Measures will be revised & improved to mitigate enhance

Design / Pre construction Stage At critical sections especially along the congested stretches of the existing highway, removal of bottlenecks and relieving congestion in built-up stretches were incorporated through improved design and improving road geometry and widening of road to smoothen traffic flow.

Construction Stage

Reduction in congestion due to better highway design being one of the objectives, an improvement in ambient air quality is expected to be one of the outcomes of the proposed improvements. However, these may be offset by the projected increase in traffic. Since the project cannot directly influence the adverse impacts of the operation stage, the efforts are

concentrated in reducing air pollution during the construction phase. Several provisions can be incorporated within the contract, through the EMP, to ensure that the deterioration in air quality is limited to the maximum extent possible. During the construction stage, there are two major sources of Air pollution:

- Construction activities at working zones, which cause primarily dust emission and
- Operation of the construction plant, equipments and machinery, which causes gaseous pollutants.

The specific measures include:

⊙ *Dust Control*

All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants and other transportation of materials will be taken up including:

- Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered to reduce spills on existing roads
- Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.
- The hot mix plant will be fitted with dust extraction units.
- It shall be ensured that the dust emissions from the crusher and vibrating screen at the stone quarries do not exceed the emission standards set by Central Pollution Control Board by covering hoods and incorporation of cyclones.

⊙ *Emission Control*

To ensure the control of exhaust emissions from the various construction activities, the contractor and the contractor shall take up the following mitigation measures:

- The asphalt plants and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement.
- An adequate cyclone / scrubber to control emissions from the stack of hot mix plants will need to be provided in the event of the emissions exceeding the CPCB norms. Other potential measures include plantation around periphery of the hot-mix plants.
- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month during the period the plant is in operation.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the CPCB norms. A vehicle maintenance schedule prepared by the contractor and the contractor and approved by the Engineer shall be adhered to.

Operation Stage

During the operation stage, the mitigation that the project can carry out is related more to facilities for checking levels of pollution. Additional measures proposed are as below:

- Broad-leaved pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, shall be planted as they help settle particulates with their higher surface areas along with thick foliage, which can reduce the distance for which particulates are carried from the road itself. Cassia fistula (Amaltas), Ficus religiosa (Peepal), Ficus bengalensis (Banyan), Tamarindus indica (Imli), Polyalthia longifolia (Asok) and Azadirachta indica (Neem) are recommended.
- Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and upkeep, educating drivers about driving behaviour I methods that will reduce emissions are beyond the scope of the project but will be far more effective in reducing the pollutant levels.

⊙ *Air Quality Monitoring*

Apart from provision of the mitigation measures, ambient air quality shall be monitored. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The air quality shall be monitored at all the locations as given in Table 4.3. The frequency, duration and responsibility will be as per the **Annexure 5.4 Environmental Monitoring Plan**. All deviated results shall be reported to engineer, for remedial measures.

5.4.4 Water – Mitigation

The table below presents the adverse impacts on the water resources due to the project and the mitigation measures that are proposed.

Table 5.10 Summary of Mitigations for Impacts on Water

Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
1.	Loss of water bodies	Major, direct impact	Part or complete acquisition of source of water	Land acquisition to be minimized with provision of Retaining walls. Relocation of ground / surface water sources.
2.	Alteration of Cross Drainage	Very Low Impact	Major bridge constructions Widening of minor bridges and culverts.	Widening & construction of bridges, there will be an improvement in the drainage characteristics of the project area.
3.	Runoff and drainage	Direct Impact	Siltation of water bodies Reduction in ground recharge Increased drainage discharge	Silt fencing to be provided. Recharge well to be provided to compensate the loss of pervious surface. Continuous drain is provided, unlined in rural area and lined in urban area.

Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
4.	Water requirement for project	Direct impact	Water requirement for construction activity. Water requirement for labour	Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. This is required to avoid depletion of water sources. Water harvesting structures to be provided.
5.	Increased sedimentation	Direct impact	Increased sediment laden run-off after the nature and capacity of the watercourse	Silt fencing to be provided
6.	Contamination of Water	Direct adverse impact	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix Production facilities for the labour and officers. Routine and periodical maintenance	Hazardous wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel. Rejected material will be laid as directed by IC. Septic tank will be construction for waste disposal.
7.	Water quality monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

The cost of mitigation measures and the relocation cost of the water resources impacted have been included in the EMP. The exact location of relocated water utilities shall be finalized by the contractor in consultation with the local community.

Protecting Water Quality

To prevent any degradation of water quality of various surface and ground water resources, the contractor and the contractor shall work out the following mitigation measures during the construction period:

- Provision of necessary mitigation measures at the various locations proposed in the design to prevent contamination and degradation of water quality.
- Construction work close to the streams or water bodies must be avoided during monsoon.
- The discharge standards promulgated under the Environmental Protection Act, 1986 will be strictly adhered to.

- Impact on the river / nallah system can be minimized if the bridge construction is taken up during the lean flow season and construction work close to the water bodies avoided during monsoon.
- The fuel storage and vehicle cleaning area shall be stationed at least 500m away from the nearest drain / water body
- The slope of the embankments leading to water bodies shall be modified and re-channelled to prevent entry of contaminants into the water body.
- Provision of silt fencing and oil interceptors the details of which are given below

⊙ *Silt Fencing*

Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. It is expected a single person will be able to drive the angles by pressing from the top. The frame will be installed at the edge of the water body along which construction is in progress. The number of such units to be installed can be decided depending upon the length of the water body along the side of the road construction. This is based on the primary survey data and detailed discussions with structure engineers wherein it was found that the length shall be sufficient to cover all minor and major bridge locations and the road side water bodies. Depending on the length of the individual water body, the number of units of silt fencing to be installed is decided by the Consultant.

⊙ *Oil interceptor*

Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, vehicle parking areas of the contractor and the contractor s' camps. The arrested products shall be disposed as per MoEF and CPCB guidelines. The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain / water body.

Disruption to Other Users of Water During Construction

- The contractor shall arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.
- If new tube-wells are to be bored, due to the non availability of water required for construction, prior sanctions and approvals by the Ground Water Department has to be obtained by the contractor.

Wastage of water during the construction should be minimized.

- Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals should be carried out so as to minimize any disruption to the flows and to ensure that a high quality of water is maintained.

Water Quality Monitoring

Apart from provision of the mitigation measures, water quality shall be monitored to understand the effectiveness and further improvement in designs in reducing the concentration of pollutants. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The water quality shall be monitored at all the locations as given in Table 4.5. The frequency, duration and responsibility will be as per the **Annexure 5.4 Environmental Monitoring Plan.** All deviated results shall be reported to engineer, for remedial measures.

5.4.5 Noise - Mitigation

The contribution of project design towards mitigation of increased noise levels would be the improved riding surface and geometry, which will reduce vehicular noise generation, at least during the initial years after construction. The mitigation measures for noise are essentially aimed at protecting the receptor.

Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. During the construction stage, the most vulnerable population is the construction crew which is subjected to very high noise levels, albeit intermittently. Provision of Personal Protective Equipment (PPE) for the crew will be made a part of conditions of contract. Specifying construction timings will prevent disturbance to the local populations. The following mitigation measures as given in table below need to be worked out by the contractor and the contractor for the noise impacts associated with the various construction activities.

Table 5.11 Sources of Noise Pollution, Impacts and Generic Mitigation Measures

Source of Noise Pollution	Impacts	Generic Mitigative Measures
• Mobilisation of heavy construction machinery; • Acceleration / deceleration /gear changes by the vehicles depending on the level of congestion and smoothness of road surface; • Excavation for foundations and grading of the site; • Construction of structures and facilities;	Increased Noise Levels causing discomfort to local residents and workers	• All construction equipment, plants, machinery and vehicles will follow prescribed noise standards. All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB (A). If required, machinery producing high noise as concrete mixers, generators etc, must be provided with noise shields; • At construction sites within 500 m of human settlements, noisy construction shall be stopped between 9.00 PM and 6.00 AM; • Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum; • Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged

Source of Noise Pollution	Impacts	Generic Mitigative Measures
• Crushing plants, asphalt production plants; and • Loading, transportation and unloading of construction materials.		in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB (A) per 8 hour shift; • Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use and settlements; • All activities pertaining to procurement, storage, transport and handling of explosives and subsequent blasting will be carried out as per the statutory Indian Explosives Act 1984. Blasting shall be restricted only to daytime hours. Prior information of blasting operational times shall be given to people living near such blasting sites. • The project road designed is a divided raised carriageway all throughout. This design shall help in reducing the impact of highway noise. • Planting of trees, bushes and shrubs shall also to reduce noise levels. • Provision of noise barriers. Noise barriers will be most effective if they break the line of sight between noise source and the properties being protected, and if these are thick enough or adsorb or reflect the noise received.

Table 5.12 Specific Noise Mitigation Measures

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Sensitive receptors	Direct impact	Increase in noise pollution Man, material and machinery movements.	• Noise barrier to be provided • Traffic calming devises to be used. • No Horn Zone sign Post.
2a.	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Establishment of labour camps, onsite offices, stock yards and construction plants	• Area specific and for short duration. • Machinery to be checked and complied with noise pollution regulations. • Camps to be setup away from the settlements, in the

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
				down wind direction
2b.	Noise Pollution (Construction Stage)	Marginal Impact	Stone crushing, asphalt production plant and batching plants, diesel generators etc. Community residing near to the work zones.	• Camps to be setup away from the settlements, in the down wind direction. • Noise pollution regulation to be monitored and enforced. • Temporary as the work zones will be changing with completion of construction.
2c.	Noise Pollution (Operation Stage)	Marginal Impact	Due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles
3.	Noise Pollution Monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

To reduce noise and vibrations, noise barriers in the form of compound wall is proposed. In case of space crunch, the use of concrete screens is also suggested. However the contractor shall identify such areas where concrete screens shall be used. The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall up to a height of 2m above ground, plastering and coping as per the direction of the engineer and as laid in the specification. Creepers and paints shall be used in consultation with the affected community to give an aesthetic look. Shade and flowering trees shall be planted within the boundary of the sensitive receptor, between the building line and the compound wall, wherever space shall be available, 5m centre to centre.

Noise Pollution Monitoring – Mitigation

The effectiveness of mitigation measures and further improvement in designs to reduce the noise level due to construction and operational activity shall be monitored. The frequency, duration and monitoring plan shall be functional in construction as well as in operation stages as per the Environmental Monitoring Plan. Noise shall be monitored at all locations identified in Table 4.7. The frequency, duration and responsibility will be as per the **Annexure 5.4 Environmental Monitoring Plan.** Any value / result not within acceptable limits shall be reported to engineer, for remedial measures.

5.4.6 Biological Environment

Flora

The major adverse impacts on flora shall involve the removal of trees, shrub and ground cover from within the Corridor of Impact. As part of the project preparation, to minimize the loss of trees, clearance of only those trees identified from the design will be removed.

Table 5.13 Summary of Mitigations for Impacts on Biological Environment

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Forest area	Direct Impact	Diversion of forest area	• Diversion of forest land as per Forest Act • Plantation of trees as per Forest Department
2.	Wild Life	No Impact	No wild life habitat	• Nil
3.	Trees Cutting	Direct Impact	Increase in soil erosion, silting of water bodies. Dust and noise pollution Loss of shade and loss of tree products	• Compulsory tree plantation in the ratio of 1:2. • Option of compensatory afforestation through Forest Department. • Avenue plantation along corridor, where ever possible. • Identification of incidental spaces (ox bow areas) for group plantation. • Transplantation of trees also explored.
4.	Vegetation	Direct Impact	Increase in soil erosion, silting of water bodies, noise pollution, dust pollution	• Clearing and grubbing will be minimized, and sprinkled with water to reduce dust pollution. • Exposed surface like embankment slopes will be protected with stone pitching and turfing. • Open land in and around plant will be vegetated.
5.	Cattle Grazing	No impact	No cattle grazing found	• Nil

⊙ *Reserve Forest Areas - Mitigation*

Minimum forest land has been proposed for diversion. The acquisition of forest land has been are being taken up in accordance to the GoI requirements. For stretches of the corridor through the forest areas, the contractor shall ensure that the construction activities shall be limited to the proposed ROW, so as to avoid any impacts on the vegetation within the forest areas. The measures for avoiding / mitigating adverse impacts on the reserve forest stretches are given below:

- No construction camp shall be allowed within the designate limits of the forest areas and within 1km from their boundaries.

- No earthworks or surfacing permitted along stretches of road within these areas after sundown. No workmen allowed shall be allowed to stay within the areas after sundown except with adequate supervision.
- As far as possible, concreting along the stretch of road within the areas to be planned such that work after sundown is avoided or kept to the absolute minimum. Wherever this is unavoidable, the Engineer's Environmental staff shall remain present at site.
- No disposal of debris shall be allowed within these areas except at locations identified during project preparation.

⊙ *Compensatory Afforestation*

- Compensatory afforestation will be taken up as per the Forest (Conservation) Act, 1980.
- The directions of the Forest Department on the issue of compensatory afforestation shall be binding.
- Efforts though shall be to convince the department to plant trees in the affected project area to compensate the ecological loss due to felling of the trees.

⊙ *Avenue and Block Plantation*

- Avenue plantation along corridor, where ever possible given to compensate the loss of trees due to felling.
- Native indigenous trees species shall be used as far as practicable, strictly avoiding any exotic (but popular) species like Eucalyptus sp. that can have far-reaching adverse effects on the ecology and water regime of the area.
- Endeavour to initiate plantations before the construction is complete so that the trees are at least a year or two old when the project is completed.
- The contractor shall work out the number of trees to be planted around junctions and for enhancement purposes.
- Trees to be planted in the incidental spaces and along the project road inclusive of compensatory plantation.
- Pure avenue plantation with single species like Terminalia arjuna (arjuna), Magnifera indica (mango), Azadirachta indica (neem) only to be planted for a few kilometers (or, the stretch between two market places for example) to provide harmonious and pleasing look, and a regular and wavelike skyline. This row of trees forms the first and innermost line.
- Selection of tree species in outer rows (where multiple rows can be accommodated) has been considered from economic point of view. Therefore, trees that provide fuel and fruit as well as small timber for agricultural implements have been suggested.
- The plantation of trees has been done subject to availability of space in the ROW

Table 5.14 Species Recommended in Urban Areas (Within 1 km of Last Dwelling)

Scientific name	Common Name	Reason
Anthocephalus cadamba	Kadamba	Landscaping, flowering, pollution sink
Artocarpus heterophyllus	Jackfruit,	Economical, pollution sink
Azadirachta indica	Neem, Veepachettu	Noise barrier, Pollution sink, Economic & Medicinal Value
Bauhinia varigata, Bauhinia purpurea, Bauhinia racemosa	Kachnar	Landscaping, Flowering plant
Emblica officinalis	Amalaka	Economic & Medicinal Value
Ficus bengalensis	Banyan, Peddamarri	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus religiosa	Peepal, Ashwatha	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Magnifera indica	Mango, Maamidichettu, Maavi	Noise barrier, Pollution sink, Economic Value, Shade
Spondias pinnata	Ambate	
Tamarindus indica	Tamarind	

Table 5.15 Species Recommended in Rural & Semi Urban Areas

Scientific Name	Common Name	Reason
Albizia procera	Tellachinduga	Landscaping, Pollution sink
Anthocephalus cadamba	Kadamba	Landscaping, flowering, pollution sink
Azadirachta indica	Neem tree, Veepachettu	Noise barrier, Pollution sink, Economic & Medicinal Value
Bauhinia purpurea, B. racemosa, B. Variegata	Kachnar, Devakanchanamu, Kaanchanamu	Landscaping, Flowering plant
Butea monosperma	Flame of the forest, Mooduga, Palaasamu.	Landscaping, Flowering plant
Cassia fistula	Indian laburnum, Reelachettu, Vkoolaponna	Landscaping, Flowering plant
Dalbergia sisoo	Sissoo, Errasissoo	Economic Value
Delonix regia	Gulmohar, Seemasantkesula.	Landscaping, Flowering Plant
Emblica officinalis	Amla,Amalakama, Raatausirika	Economic & Medicinal Value
Ficus bengalensis	Banyan, Peddamarri	Noise barrier, Pollution sink, Shade, Supports other species, Religious

Scientific Name	Common Name	Reason
		values
Ficus glomerata	Atti, Medichettu	Noise barrier, Pollution sink, Supports other species
Ficus infectoria	Pakur, jatijuvi, Badijuvvi	Noise barrier, Pollution sink, Supports other species
Ficus religiosa	Peepal, Ashwatha	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus semicordata	Bommamarri	Noise barrier, Pollution sink
Jacaranda mimosaefolia	Neel Gulmohur, Jacaranda	Landscaping, Flowering plant
Magnifera indica	Mango, Maamidichettu, Maavi	Noise barrier, Pollution sink, Economic Value (fruit bearing)
Mimusops hexandra	Pala	Landscaping, Flowering plant
Polyalthia longifolia	Asokamu, Debdaru	Noise barrier, Pollution sink, Religious Values
Psidium guayava	Guava, Goyya	Economic Value (fruit bearing)
Putranjiva roxburghii	Kadrojuvi, Kudrajini, Putrajivika	Landscaping
Saraca asoka	Ashok, Asokamu	Noise barrier, Pollution sink, Religious Values
Spathodea campanulata	Indian Tulip Tree	Landscaping, Flowering plant
Syzygium cumini	Jaman, Neereedu	
Tamarindus indica	Tamarind, Chintachettu	Noise barrier, Pollution sink, Economic & Medicinal Value
Terminalia arjuna	Arjun, Yerramaddi	Noise barrier, Pollution sink
Terminilia chebula	Haritaki, Karakkaaya	Noise barrier, Pollution sink, Economic Value (fruit bearing), Religious values
Thespesia populnea	Indian Tulip tree, Gangaraavichettu	Landscaping, Flowering plant

Table 5.16 Species Recommended for Median Plantation

Scientific name	Local Name	Reason
Bauhinia acuminata	Kachnar	Landscaping, Flowering plant
Bouganvillea sp.	Bouganvillea	Landscaping, Flowering plant
Hibiscus rosa sinesis	Chinese Hibiscus, Dasanamu	Landscaping, Flowering plant
Lawsonig inermis	Henna, Gorinta	Landscaping, Flowering plant
Nerium indicum	Pink oleander, Karaviram	Landscaping, Flowering plant
Thevetia nerifolia	Pila Kaneer, Yellow oleander, Pachaganneru	Landscaping, Flowering plant

Fauna

As the entire corridor is subject to intense human habitation, there are no significant fauna species along the highway. The following measures need to be taken up during the construction stage by the contractor and the contractor.

- All works are to be carried out such that minimum damage and disruption to fauna is caused.
- Construction workers shall be instructed to protect natural resources and fauna, including wild animals and aquatic life.
- Hunting and unauthorized fishing shall be prohibited.
- During construction, at any point of time, if a rare / endangered / threatened fauna species is spotted, the contractor shall make all arrangements to intimate the wild life authorities and measures will be taken as for is conservation during the operation period also.

5.4.7 Social Environment

Entire corridor will acquire a pattern of urban and rural stretches. At certain stretches the concentration, density and level of urbanization will be much higher due to the overlapping and amalgamation of two to three settlements over time. All along the corridor length the urban and rural stretches have been identified. Within the urban settlements the areas with highest, high, medium and low concentrations have been filtered and accordingly suggested appropriate treatment to avoid further and future ribbon development

Loss of Land

As far as possible the land acquisition has been kept to the minimum, by restricting the geometric improvement within the existing right of way. However the land acquisition will be done at sections having width, insufficient to accommodate the approved cross-sections & geometric Improvements.

⊙ *Traffic Control during Construction*

Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of the project road by the contractor. These plans shall be approved by NHAI prior to execution. The traffic control plans will contain details of temporary diversions details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.

Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Engineer. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.

The Contractor will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water, if necessary.

The Contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. **Annexure 5.5 Traffic Control and Safety during Construction** gives the details of the road safety measured to be adopted during construction.

5.6 ENHANCEMENT

5.6.1 Generic Enhancement Measures for Cultural Properties

The project strives to improve the experience of highway travelling by strengthening the physical link between the corridor and the cultural properties falling along the road. Depending upon site-specific situations the project strives to improve the access to these properties by providing walkway to the property from the highway. Locally available materials like stone and bricks have been preferred for paving. CC flooring also shall be adopted for ground treatment. At places plantation shall be used in addition to hard landscaping measures to define precinct boundaries.

Annexure 5.1: Guidelines for New Quarry Management

Management Plan for New Quarry

The concessionaire shall prepare a quarry management plan for operation of new quarries and submit it to the IC for approval and necessary actions. The plan shall consist of the following:

Selection Details

1.1.1 *Location and Layout*

Sketch plans and photographs to be provided along with adequate details:

- A map and sketch plan of the area showing the location of the proposed quarry site with respect to the project road, nearby villages, crusher plants and worker accommodation locations along with indicative distances of the different sites from each other and from the road.
- A detailed sketch plan of the quarry area showing approach and haulage roads, location of the rock outcrops to be quarried, indicating which sites will be quarried in which year or phase, location of stock piles, location of guard house, perimeter fence, location of water sources, amenities, and any further details.
- Photographs of the site

1.1.2 *Selection Criteria*

- A brief statement as to how the site was chosen.
- Alternative sites that were considered to be mentioned.
- Record any public consultations involved while choosing and what the public concerns were, if any.

1.1.3 *Agreement with landowners*

- Statement of ownership of the land along with lease / purchase agreements.

1.1.4 *Licenses and permits*

- Concessionaire to state the licences and permits that are necessary for operation, and attach them as appropriate.

Operation

Method of extraction

- A brief method statement of extraction indicating the techniques to be used, use of explosives if any, if so how are the charges laid, how often the blasting shall be done, etc.
- Appropriate reference should be made to the concessionaire's safety manual.
- A copy of the operator's licence to handle explosives should be submitted to the IC.

Loading and haulage

- Concessionaire to describe the process in a few sentences of loading of rocks fragments; means of transportation to the crusher, and from the crusher to the site.

Crusher Plant

- Type, manufacturer, date of manufacture and principal specifications of the plant, details on testing and commissioning (by whom, to what standard, and when).

Storage of explosives

- Concessionaire to state where these are to be procured from, where they will be stored and how the supply of explosives will be kept secure (if they are to be kept off site, state what precautions will be given for transportation).

Products

- A list of aggregate sizes and any other products from the quarry. Make sure the sketch map states where these will be stock piled.

Testing and quality assurance

- Refer quality assurance plan of concessionaire if any.
- If not, concessionaire to provide details of sampling frequency, who takes the does the testing, which standards are to be complied with, and any further pertinent details.

Water sourcing

- Concessionaire to indicate the operations that shall need water, and its source (an indication on the sketch map will suffice).

Safety

- Concessionaire to divulge safety measures.
- Ensure that workers at the quarry sites are aware of the appropriate sections of the safety plan.

Workers Accommodation

- Concessionaire to provide details of how many workers will be accommodated on site and what the accommodation arrangements and standard will be.

Environmental Management

Environmental Management during Operation

Removal of trees and plants

- Concessionaire to describe briefly the floral species that have had to be removed (it will be helpful give local names if English or scientific names are not known), and roughly how many.

Overburden

- Concessionaire to state where this will be deposited (indicate on the sketch map), and what methods will be taken to contain it, if any.

Silt management

- Concessionaire to state how silt arising from quarry operations will be managed, e.g. provision of a silt retention pond, and show where this is on the sketch map. Say how the silt retention pond will be managed (i.e. how often it will be dredged).

Surface water drainage

- If it will be necessary to provide drainage channels, concessionaire to show on the sketch map where these are and confirm that they will be kept free of blockages.

Soil and water contamination

- Concessionaire to list sources of possible contaminants to the soil (fuel stores, etc) and what will be done to control it (minimise spillages, control leaks from plant, etc).

Air pollution

- What are the sources of air pollution?
- Details of air pollution control measures in each case.
- Details of worker protection equipment along with appropriate reference to the safety plan.

Noise

- Sources of noise, distance from settlement, labour camp and proposed mitigation to the population / workers exposed.

Traffic

- Impact of quarry operations on traffic and how this may be controlled.

Approach road

- Concessionaire to state whether this will be maintained, and if so in what condition.

Environmental Management at Closure of the site

Dismantling and removal of machinery

- Concessionaire to state whether and when this shall be done.

Slope stabilisation and / or protection

- Measures taken to protect the slope and to guard against any possible serious rockfall, or any measures to safeguard against hazards like this.

Rehabilitation

- Rehabilitation plan of the quarry.
- The concessionaire shall be responsible for the Redevelopment Plan prior to completion after five years, during the defect liability period. The NHAI shall be responsible for reviewing this case of redevelopment prior to the issuing the defect liability certificate.

Hand-over

- Terms of hand-over of the quarry site to the owner/authority at the end of its use.

Removal of debris and solid waste

- Confirmation of Concessionaire in removal of debris and solid wastes and disposal at a suitable site.

For each aggregate-cum-quarry sand source, the plan should be the same. The table below gives the format:

SI. No.	Item	Unit	Details	Remarks by NHAI, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved	m^2		
5.	Existing land use (verification from land records with revenue department)			
6.	Land use of the area surrounding the proposed site including a map			
7.	Access roads – existing conditions, proposed development and maintenance			
8.	Tree cutting and vegetation clearance if any, along with compensation measures	Nos.		
9.	Arrangement with the owner (agreement with land owner should be attached as an Annexure)			
10.	Quantity of material to be withdrawn vis-a-vis the material available	Cum		
11.	Particular areas to be quarried should be clearly identified			
12.	Machinery & equipment to be used			
13.	Drainage plans			
14.	Top soil management			
15.	Description of the operating practices to be adopted.			
16.	Health facilities			
17.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
18.	Monitoring plans for air, noise and water quality			
19.	Copy of the consents to establish and operate should be attached as an Annexure.			
20.	Copy of the license from Mining & Geology, Police & Fire dept.			
21.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
22.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
23.	Concerns of the local people living in the immediate / near vicinity should be identified and appropriates measures should be reflected			
24.	Photograph of the quarry prior to commencing operations.			
25.	Sketch of the layout of the quarry			

Attach Photograph of Proposed Site, Location Map, Consents, licenses, safety plan, tree compensation plan, restoration plan, drainage plan, monitoring plan, Agreement with land owner etc. as annexure

Submitted

Signature

Name

Designation

Concessionaire

Checked & Approved

Signature

Name

Designation

Annexure 5.2: Guideline for Rehabilitation of Dumpsites, Quarries and Borrow Areas

Dumpsites

The dumpsites filled only up to the ground level could be rehabilitated as per guidelines below and to be decided by the engineer and the supervision consultant

- The dumpsites have to be suitably rehabilitated by planting local species of shrubs and other plants so that the landscape is coherent and is in harmony with its various components.
- In cases where a dumpsite is near to the local village community settlements, it could be converted into a play field by spreading the dump material evenly on the ground. Such playground could be made coherent with the landscape by planting trees all along the periphery of the playground.
- Some of the dumpsites could be used either for plantation or for growing agricultural produce.
- Care should always be taken to maintain the hydrological flow in the area.

Quarries and Borrow Areas

The contactor and the concessionaire shall use materials from the existing and licensed quarry areas only. In case any new quarries are opened by the contractor, he shall secure permissions for the same and shall follow the rehabilitation plan.

- The objective of the rehabilitation programme is to return the borrow pit sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing borrow pits /quarry sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the quarry / borrow pit floor to approximately the access road level.
- It is important to plan restoration from the outset and coordinate restoration with quarrying activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework quarry rehabilitation often leads to the creation of wetlands and natural reserves or recreation areas.
- Special quarry / borrow pit rehabilitation plan should be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., the re-greening and replanting methods..
- Other criteria which should be followed for rehabilitation of quarry/ borrow pits are as given below:
- Quarries and borrow pits will be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the contractor shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; reestablishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the concessionaire and contractor shall restore the environment around the work site to its original splits.
- To create a safe environment under the terms of The Mines and Quarries Act the faces have to be reduced to a naturally stable slope or be adequately fenced to prevent access to the top and bottom of the faces. Such a fence must be of a height as prescribed under The Mines Act with a barbed wire top strand designed to exclude the public from the quarry area. Depending on the location of the site presence of a permanent lake is considered to be a satisfactory alternative to a fence.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

- The quarry or borrow pit immediate surroundings should be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming the open spaces. Walkways around the borrow site may be constructed. Provision for a future drive-in picnic area and car parking area may be developed.

Annexure 5.3: Guidelines for Existing Quarry Management

The Concessionaire will finalise the locations from the list given by Consultant's for procuring materials. The Concessionaire shall establish a new quarry only with the prior consent of the Consultant only in cases when: (i) Lead from existing quarries is uneconomical and (ii) Alternative material sources are not available. The Contractor shall prepare a Redevelopment Plan for the quarry site and get it approved by the NHAI.

The construction schedule and operations plans to be submitted to the NHAI. prior to commencement of work shall contain a detailed work plan for procuring materials that includes procurement, transportation and storage of quarry materials.

CONSTRUCTION STAGE

Development of site: To minimise the adverse impact during excavation of material following measures are need to be undertaken:

i) Adequate drainage system shall be provided to prevent the flooding of the excavated area

ii) lt the stockpiling locations, the Concessionaire shall construct sediment barriers to prevent the erosion of excavated material due to runoff

iii) Construction of offices, laboratory, workshop and rest places shall be done in the up-wind of the plant to minimize the adverse impact due to dust and noise.

i) The access road to the plant shall be constructed taking into consideration location of units and also slope of the ground to regulate the vehicle movement within the plant.

iv) In case of storage of blasting material, all precautions shall be taken as per The Explosive Rules, 1983.

QUARRY OPERATIONS INCLUDING SAFETY

i) During excavation, slopes shall be flatter than 20 degrees to prevent their sliding. In cases where quarry strata are good and where chances of sliding are less this restriction can be ignored.

ii) In case of blasting, procedure and safety measures shall be taken as per The Explosive Rules, 1983

iii) The contractor shall ensure that all workers related safety measures shall be dune as per guidelines for Workers and Safety.

iv) The Concessionaire shall ensure maintenance of crushers regularly as per manufacturer's recommendation.

Topsoil will be excavated and preserved during transportation of the material measures shall be taken to minimize the generation of dust and prevent accidents.

The NHAI shall review the quarry site for the management measures during quarry operation, including the compliance to pollution norms.

POST CONSTRUCTION STAGE

- The Concessionaire shall restore all haul roads constructed for transporting the material from the quarries to construction site to their original state.
- The NHAI. shall be entrusted the responsibility of reviewing the quarry site for the progress of implementation of Redevelopment Plan.
- The redevelopment of exhaust quarry shall be the responsibility of the agency providing the permit to ensure the implementation of Redevelopment Plan.

For existing quarry managed directly by a third party / contractor from whom the concessionaire is sourcing the materials, the plan should contain the following:

SI. No.	Item	Unit	Details	Remarks by NHAI, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved			
5.	Arrangement with the owner (agreement with the third party / contractor should be attached as an Annexure and should necessarily require the adaptation af good quarry management practices - a description af the requirements should be included)	Cum		
6.	Quantity of material to be withdrawn vis-a-vis the material available			
8.	Machinery & equipment to be used	Cum		
9.	Drainage plans			
10.	Top soil management			
11.	Description of the operating practices			
12.	Health facilities			
13.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
14.	Copy of the consents to operate from PCB, licences from Mining & Geology, Police & Fire dept should be attached as an Annexure.			
15.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
16.	Monitoing plans for air quality			
17.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
18.	Photograph of the quarry prior to commencing operations.			
19.	Sketch of the layout of the quarry			

Attach Photograph of Proposed Site, Location Map, consents, licenses and Agreement with land owner

REMARKS

Submitted	**Checked**	**Approved**
Signature	Signature	Signature
Name	Name	Name
Designation	Designation	Designation

Annexure 5.4: Environmental Monitoring Plan

Environmental Component	Project Stage	Monitoring						Institutional Responsibility	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Air	Construction Stage	SPM, RSPM, SO_2, NO_x, CO, HC, Fugitive emissions from Hot mix plants	High volume sampler to be located 50 m from the plant in the downwind direction. Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1994 & CPCB notification dated 16th November 2009	Hot mix Plant / Batching Plant, Quarry sites	Three seasons annually for three years	Continuous 24 hours / or for 1 full working day	Contractor through approved monitoring agency	Engineer, NHAI
	Construction Stage	SPM, RSPM	High volume Sampler to be located 40 m from the earthworks site downwind direction. Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1994 & CPCB notification dated 16th November 2009	Stretch of the road where construction is in progress near settlement / habitation area	Moves with progress of construction during the three years	Continuous 24 hours/or for 1 full working day	Contractor through approved monitoring agency	Engineer, NHAI
Water Quality	Construction Stage	pH, TSS, TDS, Turbidity, Cl, Hardness, Coliform, Fe, Fluorides BOD, COD, Oil & Grease and (initially) NO3,	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	At locations identified by the engineer	End of summer / before the onset of monsoon every year for 3 years	-	Contractor through approved monitoring agency	Engineer, NHAI
	Operation Stage	pH, TSS, TDS, Turbidity, Oil & Grease Cl, Hardness, Coliform, Fe, Fluorides BOD, COD	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	At locations identified by the engineer	End of summer / before the onset of monsoon in the first three alternate years	-	NHAI	NHAI
Noise Levels	Construction Stage	Noise levels on dB (A) scale	Free field at 1 m from the equipment whose noise levels are being determined.	Noise standards by CPCB	At construction yards	As required by the Engineer	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	Engineer, NHAI
		Noise levels on dB (A) scale	Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement within settlements	Noise standards by CPCB	As directed by the Engineer (At maximum 12 locations)	Thrice a year for 3 years during the construction period	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	Contractor through approved monitoring agency	Engineer, NHAI

Environmental Component	Project Stage	Monitoring						Institutional Responsibility	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Soil Erosion	Construction Stage	Turbidity in Storm Water Silt load in water courses		Soil quality standards by CPCB	At locations identified by the engineer	Pre-monsoon and post-monsoon seasons for 3 years		Supervision Consultant	NHAI
Construction Sites and Construction Camps	Construction Stage	Monitoring of: Storage Area Drainage arrangements Sanitation in Construction Camps	The parameters mentioned are further elaborated in the reporting formats. These are to be checked for adequacy.	To the satisfaction of the NHAI and the standards given in the reporting form.	As storage area and construction camps	Quarterly in the construction stage		Engineer	NHAI

Annexure 5.5: Traffic Control and Safety During Construction

A. TRAFFIC MANAGEMENT PRACTICES

The traffic on roads has increased manifold and most of the roads are expected to operate at their maximum capacity in the near future. Under the circumstances, the existing methods of maintenance and construction which compromise safety and cause delay are no longer acceptable and a change in work procedures and method has become inevitable. Under the existing method of maintenance and reconstruction, the traffic is invariably diverted over unprepared shoulders or forced to use part of the existing roads under maintenance. This results in the increase in vehicle operating cost and reduction in safety besides causing environmental pollution. Therefore, the existing work procedure and contract conditions are required to be changed to provide for proper management of traffic during the execution of work. The traffic management strategies to be used at traffic control zones must include the following fundamental principles:

(i) Make traffic safety an integral and high priority element of every project

(ii) Avoid inhibiting traffic as much as possible

(iii) Guide drivers in a clear and positive way

(iv) Perform routine inspection of traffic control elements and traffic operations

(v) Give care and attention to roadside safety

B. TRAFFIC CONTROL DEVICES

The primary traffic control devices used in work zones are signs, delineators, barricades, cones, pylons, pavement markings and flashing lights. The following general rules should apply to all traffic control devices within the traffic control zone.

(i) Comprehension: All traffic control devices should be capable of being easily understood. A particular device must convey one and only one meaning. Good and clean condition of the device aids comprehension.

(ii) Visibility and Stability: Devices should be within the cone of vision of the driver and be placed such that it allows adequate time at the average approach speed or the desired speed through the traffic control zone. All traffic control devices should be clearly visible by day and night, at these speeds and under the usually prevailing climatic conditions. They should be kept properly aligned and legible at all times. Foliage or any other obstruction should not be allowed to impede the view of these devices, nor should wind, road dirt or the like be allowed to obscure their face. The traffic control devices must be able to resist the local wind pressure, rain and the vibrations etc. of the passing traffic but these should not act as rigid obstacles in the event of a collision;

(iii) Installation and Removal: All traffic control devices should be installed for the minimum required time. Traffic control devices by their nature are a hindrance to the normal traffic flow and should be removed immediately after the need, being met by these is fulfilled. Existing devices like signs or lane markings should be removed during the temporary works and reinstated thereafter or covered while the temporary devices are in operation. The installation and removal of the temporary traffic control devices and the reinstatement of the pre-existing or new (where the scheme improves the road) traffic control devices must, therefore, be meticulously supervised to ensure the minimum period when there are no signs or markings

C. SIGNS

The road construction and maintenance signs fall into the same three major categories as do other traffic signs, that is Regulatory Signs, Warning Signs and Direction (or Guidance) Signs. The IRC: 67 (Code of Practice for Road Signs) provides a list of traffic signs. Where possible, the size, colours and placement of sign shall conform to IRC: 67. The main signs that would be utilized are shown below. This also covers signs that are not included in IRC: 67 but are considered desirable to aid drivers' comprehension of the route through the road works. Each sign should be well located so that its message is seen and is clear, which will be assisted if the surroundings are devoid of "unnecessary" signs and other clutter. These signs should be of retro-reflective sheets of high intensity grade or engineering grade depending upon the importance of the road as directed by the Engineer.

Preparation of Detailed Project Report for Rehabilitation and Upgradation of National Highway Stretches under NHDP-IVB, Group-B (Package No. UP/DPR/NHDP-IV/08)

BORROW AREA LOCATION AND QUANTITY AVAILABILITY FOR HARIDWAR-KASHIPUR SECTION OF NH-74

Sl No.	Borrow Area Sample No.	Village Name	Side	Location	Lead (m)	Quantity (m^3)
1	BA-01	Kangadi	Right	5+750	2000	200 x300 x2
2	BA-02	Bhaguwala	Left	30+200	200.0	100m x 100m x 2m
3	BA-03	Bhaguwala	Left	30+800	200.0	100m x 100m x 2.5m
4	BA-04	Bhaguwala	Left	31+100	300.0	150 x 100 x 1.5
5	BA-05	Bhaguwala	Left	32+250	250.0	500 x 300x2
6	BA-06	Mandawali	Left	40+000	5000.0	300 x 300 x 5
7	BA-07	Jetpur Village	Left	41+000	5000.0	300 x 150 x 2
8	BA-08	Rahatpur	Left	43+000	200.0	100 x 100 x 2
9	BA-09	Rahatpur	Left	44+000	200.0	100 x 150 x 1.5
10	BA-10	Rahatpur	Right	44+200	200.0	100 x 100 x 2.5
11	BA-11	Nazibabad Town	Left	53+200	250.0	100 x 100
12	BA-12	Rahatpur Village	Right	55+300	600.0	150 x 100 x 3
13	BA-13	Bijepur	Right	55+800	1500	100 x 100 x 3
14	BA-14	Bajopur	Right	56+200	4000	250 x 250 x 3
15	BA-15	Akbarabad	Left	66+000	400	150 x 150 x 2.5
16	BA-16	Dultabad	Right	67+800	500	100 x 100 x 2
17	BA-17	Kotwali	Left	70+200	1000	100 x 100 x 3
18	BA-18	Kotwali	Right	70+800	200	100 x 150 x 1.5
19	BA-19	Roshanpur	Right	72+100	200	300 x 300 x 2
20	BA-20	Roshanpur	Left	73+100	80	100 x 150 x 3
21	BA-21	Roshanpur	Left	73+600	100	150 x 100 x 3
22	BA-22	Aligarh	Right	80+100	100	100 x 100 x 2
23	BA-23	Aligarh	Left	81+200	200	300 x 300 x 2.5
24	BA-24	Kalyanpur	Left	85+600	200	150 x 200 x 3
25	BA-25	Habibwala	Left	89+000	250	100 x 100 x 3
26	BA-26	Dhampur	Left	92+500	600	100 x 300 x 2

Preparation of Detailed Project Report for Rehabilitation and Upgradation of National Highway Stretches under NHDP-IVB, Group-B (Package No. UP/DPR/NHDP-IV/08)

BORROW AREA LOCATION AND QUANTITY AVAILABILITY FOR HARIDWAR-KASHIPUR SECTION OF NH-74

Sl No.	Borrow Area Sample No.	Village Name	Side	Location	Lead (m)	Quantity (m^3)
27	BA-27	Dhampur	Right	97+600	200	150 x 150 x 2.5
28	BA-28	Ghausiya	Left	106+600	3000.00	200 x 200 x 3
29	BA-29	Bhatigarh	Left	127+000	1000	100 x 350 x 3
30	BA-30	Haraywala	Right	127+000	1500	200 x 100 x 3
31	BA-31	Rehad	Left	130+000	2000	500 x 500 x 2
32	BA-32	Rehad	Right	130+000	400	150 x 125 x 3.5
33	BA-33	Dehlawala	Left	131+000	2000	200 x 300 x 3
34	BA-34	Dehlawala	Left	131+600	200	200 x 300 x 4
35	BA-35	Dharampur	Left	132+900	100	150 x 100 x 3.5
36	BA-36	Fica River Bank	Left	135+200	150	250 x 150 x 4
37	BA-37	Shyamnagar	Left	147+000	4000	300 x 300 x 3.4
38	BA-38	Shivrajpur	Right	147+000	3000	500 x 500 x 1.5
39	BA-39	Shivrajpur	Right	148+500	75	100 x 125 x 3
40	BA-40	Dhanori	Left	166+450	3000	100 x 100 x 3
41	BA-41	Maheshpura	Right	177+800	600	300 x 200 x 3

CHAPTER - 6

ENVIRONMENTAL MONITORING PROGRAMME

6.1 ENVIRONMENTAL MONITORING PROGRAMME

The Environmental Monitoring Programme has been detailed out in **Annexure 5.4** Successful implementation of the Environmental Monitoring Program is contingent on the following:

- The NHAI is to request the Contractor to commence all the initial tests for monitoring (i.e. for Air, Water Quality and Noise Levels) early in the Contract to establish 'base' readings (i.e. to assess the existing conditions prior to effects from the Construction activities being felt).
- The NHAI is to request the Contractor to submit for approval a proposed schedule of subsequent periodic tests to be carried out.
- Monitoring by the NHAI's Officer of all the environmental monitoring tests, and subsequent analysis of results.
- Where indicated by testing results, and any other relevant on-site conditions, NHAI to instruct the Contractor to:

- Modify the testing schedule (dates, frequency)
- Modify (add to or delete) testing locations
- Verify testing results with additional testing as/if required
- Require recalibration of equipment, etc., as necessary
- Request the Contractor to stop, modify or defer specific construction equipment, processes, etc., as necessary, that are deemed to have contributed significantly to monitoring readings in excess of permissible environmental "safe" levels.

6.1.1 Monitoring of Earthworks Activities

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in **Annexure 5.1 & 5.2.** Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimize detrimental effects (e.g. erosion) due to run-off, and safety aspects related to Works implementation.

6.1.2 Monitoring of Contractor's Facilities, Plant and Equipment

- All issues related to negative environmental impacts of the Contractor 's Facilities, Plant and equipment are to be controlled through:
- The contractor 's self-imposed quality assurance plan
- Regular / periodic inspection of the Contractor ’s plant and equipment
- Monthly appraisal of the Contractor.

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the contractor’s operation. The officer is to review all monthly appraisal reports, and through the team leader is to instruct the contractor to rectify all significant negative environmental impacts.

CHAPTER - 7

ADDITIONAL STUDIES

As a part of the project preparation and to ensure that the community support is obtained and the project supports the needs of the people; public consultations were carried out as an integral component. A continuous involvement of the stakeholders and likely to be affected community was obtained. The feedback in the consultation sessions has led to substantial inputs for the project preparation – including, influencing designs. Consultations involve soliciting people's views on proposed actions and engaging them in a dialogue. It is a two-way information flow, from project authorities to people and, from people to project authorities. While decision making authority would be retained by the project authority, interaction with people and eliciting feedback allows affected populations to influence the decision making process by raising issues that should be considered in *designing, mitigation, monitoring and management plans and the analysis of alternatives.*

This chapter documents the issues that are close to the community and their aspirations and to address them by the project authorities. Information source for the chapter has been similar to the one like documentation as part of the RAP, with the social team conducting these sessions. The objectives of consultation sessions, the procedure adopted and the outputs of the consultations conducted have been briefly described in the following sections.

7.1 OBJECTIVES

The main objective of the consultation process is to create awareness among the locals about the project and to minimise the false/imaginary notions and to maximise the benefits from the project to the community. The objectives of public consultation as part of this project are:

- Promote public awareness and improve understanding of the potential impacts of proposed Project and allow locals to participate freely to provide views and suggestions, if any;
- Identify alternative sites or designs, and mitigation measures;
- Solicit the views of communities/individuals who are likely to be affected on environmental, social including culture and tradition aspects;
- Improve environmental and social soundness;
- Clarify values and trade-offs associated with the different alternatives;
- Identify contentious local issues which might jeopardize the implementation of the project;
- Establish transparent procedures for carrying out proposed works;
- Inform the likely affected populace about the entitlement framework and to settle issues with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

7.2 CONSULTATION SESSIONS

Consultations were held using various tools including, interviews with government officials, questionnaire-based information with stakeholders etc. These consultations were held at different times of the design period and were attended by experts of Environmental and Social Consultants.

Table 7.1 Public Consultation held at Different Stages of Project

Level	Type	Key Participants
Individual	Local level Consultation	People along the project corridor
Individual	Door to Door Personal Contact	People along the project corridor

7.2.1 Consultations During Design

Consultations were carried out at the design stages to identify:

- Location specific social and environmental issues to be addressed through designs;
- Socio-economic profile of community along the project route;
- Extent of likely social and environmental impact due to the project;
- Expectations and reservations of people towards project; and
- Resettlement and rehabilitation options.

7.2.2 Consultations for Specific Location Needs

Consultations were held with:

- Owners of property, land and building/structures or their tenants whose land or property is impacted;
- Locals for improvement of intersection and curves etc.
- Locals to identify the noise sensitive receptors etc and to address their issues.

7.2.3 Process of Consultation

Public consultation conducted at the screening stage played an important role in determining the level and extent of consultation that has taken up during the project preparation stage. Public consultations for this project have been carried-out at three levels as follows:

- Local level (village level) involving villagers whose properties, land, etc are being affected by the project;
- District level consultations involving various district level governmental departments and NGOs, officials of NHAI and PWD; and
- Institutional level consultations with Forest Department, State Pollution Control Board etc.

Public Consultation was done using various tools including, interviews with government officials and questionnaire-based information with stakeholders etc. A reconnaissance

survey was carried out informally drawing people into dialogue to obtain an overview of likely impacts and concerns of the community. These informal discussion and consultations were held at several locations along the project road alignment, covering settlements close to proposed alignment, thus covering the general public & property owners on the proposed ROW.

A checklist of questions was kept ready and responses were elicited from people and guidelines were issued to field assistants for the purpose. The questions were kept simple for people to comprehend and notes were made for the responses and viewpoints presented by the people.

7.3 DETAILS OF STRUCTURES TO BE AFFECTED

List of structures to be affected is shown in **Table 7.2 to 7.4**

Table 7.2 Total Structure in the Project Road

Sl. No	Type of Structures	LHS	RHS	Total
1	Residential	1102	900	2002
2	Commercial	2318	3500	5818
3	Squatters	65	64	129
4	**Total**	**3485**	**4464**	**7949**

Table 7.3 Type of Families Affected

Family Type	No. of Families
Joint	8500
Nuclear	5500
Total	**14000**

Table 7.4 Ownership of Structures

Type Ownership	No. of Structures
Religious	92
Society/Trust/others	23
Government	79
Total	**199**

Religious Structures

There are a total of 92 religious structures. All are temples and others. As far as possible, affect on religious structures shall be avoided by adopting suitable alternatives as these create emotive issues. If unavoidable, in consultation with village community, opinion leaders, trustee's etc. amicable solution shall be found by consensus.

Table 7.5 Number of Structures Affected on Both Sides of the Corridor

Side of the Structures	Number of Structures
Left	4500
Right	3724
Total	**8224**

7.4 PUBLIC HEARING

In accordance with the EIA Notification Dated14th September 2006, Public Hearing has to be conducted for "Widening & improvement of existing 2 laning to 4 laning of Haridwar to Kashipur section of NH 74 in the State of Uttar Pradesh and Uttarakhand" in each district through which project alignment passing by Uttar Pradesh State Pollution Control Board and Uttarakhand State Pollution Control Board respectively. Accordingly, SPCBs have been requested along with relevant information to conduct PH in line with the guidelines of the Notification.

7.5 IDENTIFICATION OF ISSUES

7.5.1 Issues Raised During Consultations

Table 7.5 summarizes the issues raised during the survey. Both specific issues of villages and common issues raised by the villagers have been described. Based on the community consultation the key environmental, health, safety and social issues identified were:

- Air Quality
- Noise levels
- Water pollution
- Drinking water sources, water scarcity in non-monsoon months, construction water requirements
- Roadside trees, tree plantation
- Health issues, such as water borne diseases.
- Possession of skills and the training needs
- Employment opportunity during civil works
- Location of labour camp and hot mix plant sites
- Location of dumping sites
- Safety issues
- Impact on property and land acquisition
- Resettlement Options
- Enhancement of common property resources
- Extension of Government Welfare schemes

Table 7.6 Addresses General Issues and Concerns Under the Project

Issue / Concern	Redress under the project
Dust and Air Pollution	• Plantation of trees and shrubs along the highway and on median • Turfing on earthen slopes and earthen shoulders • Water spraying to be adopted near the crushers during construction stage.
Increased noise levels	• Provision of Noise attenuating wall near sensitive receptors • No-horn signage near schools, colleges and hospitals • Tree plantation and development of green belts along the project corridor abutting settlements to attenuate traffic noise
Traffic Congestion	• Improvement of intersections • Provision of Flyovers, bypasses, underpasses and service lanes etc at suitable locations • Road widening itself will be a major factor to avoid traffic jams
Road safety	• Provision of Service lane to separate local traffic from through traffic • Proper highway signals provided • Widening of bridges to avoid accidents • Grade level pedestrian crossing • Proper lighting at accident prone locations
Cultural properties	• Care has been taken to preserve sites of cultural heritage as far as possible. • Where unavoidable the religious structures within ROW to be relocated only after consultation with local community.
Fauna and flora	• Tree clearing within ROW has been avoided beyond what is directly required for construction activities and or to reduce accidents • Compensatory afforestation would be done as per the directives of the forest department. • Fruit bearing trees and shade trees, to be planted on the roadside.
Roadside Drainage	• Rising of road sections and cross drainage structures in areas facing overtopping problems. • Location of structures based on hydrological study • Provision of proper drainage scheme for the settlements
Water bodies	• In unavoidable cases provision for increasing depth of water bodies to increase its capacity is made.
Road side amenities	• Provision of facilities like Rest Areas, Truck stoppage site (lay bye) and bus stops along the highway
Loss of Livelihood and income restoration option	• The PAPs will be compensated as per National R&R policy • RAP to detail out the assistance programme to the needy
Assistance to vulnerable groups	• Special provisions have been made in the entitlement framework for assisting vulnerable groups to improve their quality of life.
Employment of locals during construction	• Locals will be given preference for employment during the project implementation

7.6 KEY FINDINGS OF THE CONSULTATIONS

Based on the community consultation the key social issues identified were:

- Employment opportunity during civil works
- Location of labour camp and hot mix plant sites

- Location of dumping sites
- Health issues, such as water borne diseases, HIV & STD
- Safety issues
- Impact on property and land acquisition
- Resettlement Options

CHAPTER - 8

PROJECT BENEFITS

8.1 BENEFITS OF THE PROJECT

The main objective of the consultation process is to minimize negative impacts of the project and to maximize the benefits from the project to the local populace. The benefits of project are:

- Local people will get fulltime and part time jobs;
- Land value will increase along the project road.
- All villages along the road side will be benefitted by the means of economical growth.
- Amenities will be developed along the project road which can be beneficial to the local people
- Transportation facilities will be developed
- Easy access to the entire zone for marketing Agri products
- Project road development will be boosting the development of the region as well as the nation.
- Smooth moving of traffic will be reducing the fuel consumption of vehicles, which will indirectly save the Environment and Economy of the nation.

CHAPTER - 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

9.1 BUDGET

The environmental budget is being proposed for various components and for various environmental management measures proposed in the EMP is detailed in Table 9.1. There are several other environmental issues that have been addressed as part of good engineering practices; the costs need to be accounted for in the Engineering Cost. Various environmental aspects covered under engineering costs are listed below:

i) Turfing and pitching of slopes.
ii) Construction of slope protection works as retaining walls; toe walls, drains, and gabions.
iii) Construction of roadside amenities as bus stops etc

Table 9.1 Components for Environmental Budget

Component	Stage	Item
Mitigation & Enhancement		
Forest Diversion	Pre Construction	NPV Value for Forest Diversion of 73.735 ha.
		Compensatory afforestation as proposed by the Forest Department and maintenance for a minimum of 3 years in the land provided in lieu of diverted forest land.
Water	Pre Construction	Relocation and construction of hand pumps as per directions of the Engineer.
		Relocation and construction of affected water storage tanks as per directions of the Engineer.
		Relocation and construction of open wells as per directions of the Engineer.
		Relocation and construction of water taps as per directions of the Engineer.
Horticulture	Construction	Compensatory Re-plantation to offset the loss of trees due to widening of the project corridor in accordance to the relevant forest laws (Minimum of 2 trees planted for every tree cut) including Plantation and maintenance of trees.
		Planting and maintenance of flowering plants and shrubs in the central verge for the entire duration of the contract period
		Half brick circular tree guard as per design provided by the engineer and complete in all respect as per MoSRT&H Standard Data book for analysis of rates.
		Bamboo tree guard as per design provided by the engineer and complete in all respect as per MoSRT&H Standard Data book for analysis of rates

Soil		Providing Oil Interceptors as per design and drawing at vehicle parking areas and as per directions of the Environmental Specialist / Environmental Engineer of the Engineer.
Noise		1) Extension of the existing compound walls and 2) Dismantling and new construction of compound wall at govt. schools, health units etc. Identified in EIA report using brick masonry work including excavation, levelling, plastering, coping etc. up to a height of total 2m above ground level complete in all respect as per Technical Specifications and as per the direction of the Engineer.
Water Quality		Silt Fencing around soil stockpiled near water bodies and at areas identified by the engineer.
		Rainwater Harvesting Structures complete in all respect and confirming to the relevant specifications as directed by the Engineer and as per drawing approved by Engineer.
Air	Construction & Operation	Sampling and monitoring ambient Air Quality of SPM and gaseous pollutants as per CPCB Standard Procedures at 6 locations including approved hot mix plant locations, sensitive area and chainages as per direction by Environmental Specialist / Environmental Engineer of the Engineer of the Engineer for thrice a year for three years as per the Monitoring Plan given in **Annex 5.4.**
		Analysis charges of Ambient air from samples collected for SPM, PM 2.5, PM10, SO2, NOx & CO as per MoEF charges
Water Quality		Collection of grab samples of water quality at 5 locations for 3 years at the end of summer / before start of monsoon as per the Monitoring Plan given in **Annex 5.4.** and as per direction of Environmental Specialist / Environmental Engineer of the Engineer.
	Construction & Operation	Analysis of water quality at 5 locations as per the monitoring plan given in **Annex 5.4** for pH, Turbidity, total solids, turbidity, COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist / Environmental Engineer of the Engineer and as per MoEF rate list.

Noise	Construction & Operation	Monitoring Noise level at Equipment Yards, Sensitive area and Settlements using hand held noise meters at 8 locations as per directions of Environmental Specialist / Environmental Engineer of the Engineer for thrice a year for three years as per the Monitoring Plan given in **Annex 5.4**
Advocacy and policy making		Holding meetings for policy planning and subsequent review meetings with Revenue Department, Forest Department, local representatives, NGOs, etc. regarding development controls
Training		Training
Miscellaneous Items		Digital Camera for the Environment Cell
		Portable sound level meter

9.1.1 Budget Provisions

- The total civil cost of the project is about Rs. 1325.162 Crores.
- The approximate Environmental Management works to be about. Rs. 9.38 Crores.
- The cost of resettlement and compensation worked out to be about. Rs. 49.52 Crores.

Provision of 5% per annum as recurring cost of total capital cost of Environment Management is proposed.

CHAPTER - 10

ENVIRONMENTAL MANAGEMENT PLAN

10.1 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environmental Management Plan (EMP) is required to ensure sustainable development of the road during construction and operational phases. EMP is location and time specific. In general, NHAI with assistance from Contractor and Consultant is the responsible for ensuring that the mitigation measures are carried out. Mitigation measures for generic impacts are listed in Table 10.1.The list provide reference (NHAI specification), implementing organization and responsible entity.

10.1.1 Specific Activities by NHAI

The role of NHAI in the implementation of EMP involves the following activities:

- Clearance from Forest Department for diversion of 73.735 hectares of forest land.
- Permission from Forest Department for felling of trees.

10.1.2 Sensitive Features

- Noise barriers in the form of compound walls have been proposed.
- The educational institutes (mainly primary and high schools) and hospitals wherein no direct impacts of the road widening shall happen, the existing compound walls shall be raised to a height of 2m.
- In case where in there shall be partial impacts, new boundary wall which shall also act as noise barrier shall be constructed to a height of 2 m. The schools and hospitals where new compound walls are proposed.

101.3 Community Properties

- Some community properties are impacted. The relocation / rehabilitation shall be as recommended in the RAP.
- Govt. offices like panchayat buildings, police station etc. shall be provided access either in the form of service roads, median openings and zebra crossings. Advance signs shall be provided.
- Water resources to be impacted shall be relocated prior to construction works.

10.2 IMPLEMENTATION OF EMP

The Environmental Officer of the contractor should be available for the entire duration of the project. The Environmental Officer of the contractor shall be primarily responsible for compliance of EMP. The Environmental Specialist, who should ideally be deployed for the entire duration shall monitor the compliance of the EMP. The modifications to the MoRTH Specification. The key issues that require special attention along with the mitigations and enhancement measures to be implemented have been detailed in **Table 10.1.**

Table Error! No text of specified style in document.**10.1 Environmental Management Plan**

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3	Responsibility	
				Implementation	Supervision
DESIGN STAGE					
General consideration of Cross section Alternatives	As per design specifications.		During Design	Contractor	NHAI
Geometric Design	The proposed alignment is selected / adjusted (within IRC / NHAI specifications) To minimise land disturbance To avoid culturally & environmentally sensitive areas – cultural properties, water bodies etc.		During alignment Design	Contractor	NHAI
Issues from stakeholder Consultations	Various issues raised were examined & suitably incorporated based on merit & other road safety measures.		During Design	Contractor	NHAI
Impact on Cultural Properties	Provide access facilities and / or relocate the affected structure as per the mitigation measures recommended in chapter 8.		During alignment Design	Contractor	NHAI
Preservation of trees	No tree will be cut beyond toe line. Identify incidental spaces for plantation of trees		During alignment design	Contractor	NHAI, Department of Forest, A.P.
Orientation of Implementation Agency	A comprehensive tanning / orientation schedule has been prepared at different stages of NHAI.		During Design	NHAI	NHAI
Road safety issue due to poor geometrics	Design of Geometric improvements as per IRC codes and NHAI Specifications		During alignment design	Contractor	NHAI
PRE-CONSTRUCTION STAGE					
Implementation of	All requirements of the RAP shall be complete before	Right of Way	Before construction starts	NGOs,	NHAI

[1] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work.

[2] Unless otherwise stated, the Project Site covers area beyond ROW, such as borrow areas, access roads, service roads and equipment storage sites (MoSRT&H: 306.3).

[3] Time frame refers to the duration or instant of time when the mitigation measures will be taken.

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3	Responsibility	
				Implementation	Supervision
RAP and LA	start of construction stage. The activities broadly include acquisition of structures, cultural properties, relocation of utilities, common property resources etc The land acquisition will be done as per LA Act, 1894. Compensation will be paid to PAPs based on the RAP that includes the Entitlement Policy.	(ROW)		Collaborating Agencies, SLAO, NHAI, Grievance Redressal Cells (GRC), District Revenue authorities	
Relocation of Utilities	All community underground and overhead utilities will be shifted as per Utility Shifting Plan, prior permission will be required from regional offices of Electricity, Telecommunications, OFC, Water works etc.		Post design to Pre-construction	NHAI Officer, Contractor	NHAI
Loss of drinking water source	Private drinking water source replaced according to RAP and public water sources replaced. Temporary arrangements shall be provided, if the existing water supply is disrupted accidentally.		Post design to Pre-construction	Contractor	NHAI
Cultural Properties	Cultural properties affected to be relocated as per RAP and Public Consultation. Mitigation / enhancement measures have been suggested for each of the cultural property individually.		Pre-construction	Contractor	NHAI
Loss of existing bus stops and waiting shed facilities	Bus stops suitably relocated or integrated to the design. Bus lay byes and bus waiting shed designs are provided.		During design stage.	Design Consultants	
Mobilisation & Site Clearance					
Removal of Vegetation	Vegetation will be removed from the ROW before the commencement of Construction after obtaining necessary permissions from the CG forest Department.	ROW	Before construction Starts After centre line marking at site	Contractor	NHAI
Procurement of Crushers, Hot-mix plants & Batching Plants, other Construction Vehicles, Equipment and Machinery	Specifications of crushers, hot mix plants and batching plants, other Construction Vehicles, Equipment and Machinery to be procured will comply to the relevant Bureau of Indian Standard (BIS) norms and with the requirements of the relevant current emission control legislations		Prior to mobilisation at site	Contractor	NHAI

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3	Responsibility	
				Implementation	Supervision
Setting up of construction camps	The construction camps will be located at least 500m away from habitations & 1 km away from sensitive locations The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the NHAI	All areas in immediate vicinity of construction campsite chosen by the contractor and approved by the NHAI	During Establishment, Operation and Dismantling of Such Camps.	Contractor .	NHAI
Setting up of Hot mix Plants and crushers	Hot mix plants, crushers and batching plants shall be located at least 1000m away from the nearest habitation. The contractor shall obtain the consent to operate the plants from the SPCB and submit a copy to the NHAI	All Hot mix Plants Batching Plants	During erection, testing, operation and dismantling of such plants	Contractor	NHAI
Identification of dumping sites	Location of dumping sites shall be finalized based on the guidelines given in **Annexure 5.1** and the NHAI shall certify that : These are not located within designated forest areas. The dumping does not impact natural drainage courses Settlements are located at least 1 km away from the site.	Throughout the corridor	During mobilisation	Contractor	NHAI
CONSTRUCTION STAGE					
Clearances and approvals	Secure the following clearances prior to start of construction activity: Type of clearance — Applicability NOC and consents under Air, Water & Environment Act and noise rules from SPCB — For establishment of construction camp. NOC and consents under Air, Water & Environment Act and noise rules from SPCB — For operating construction plant, crusher, batching plant etc. Explosive License from Chief Controller of Explosives — For storing fuel oil, lubricants, diesel etc. Permission for storage of hazardous chemical from CPCB — Manufacture storage and Import of Hazardous Chemicals		Construction stage (Prior to initiation of any work). Time period in getting the permission is 2-3 months.	NHAI, SPCB, CPCB, Chief Controller of Explosives, District Collector State Department of Mines, State Ground Water Board, State Irrigation Department, Labour Commissioner Officer	The Contractor

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	Borrow Area, approval from District Collector, Consent letter, lease agreement with the Owner of land. — Borrow area for excavation of earth Quarry Lease Deed and Quarry License from State Department of Mines — Quarry operation (for new quarry) Permission for extraction of ground water for use in road construction activities from State Ground Water Board — Extraction of ground water Permission for use of water for construction purpose from irrigation department — Use of surface water for construction Labour license from labour commissioner office\ — Engagement of Labour Provide a copy of all necessary clearances to the NHAI: Adhere to all clearance terms and conditions Obtain written permission from private landholders to conduct construction activities on their land prior to commencing works.					
Land						
Soil Erosion and Sedimentation control	Main reason of soil erosion is rains. Contractor should plan the activities so that No naked / loose earth surface is left out before the onset of monsoon, for minimising the soil erosion following preventive measures to be taken such as: Embankment slopes to be covered, soon after completion. Next layer / activity to be planted, soon after completion of clearing and grubbing, laying of embankment layer, sub-	Throughout Project Corridor, Service roads and equipment storage sites, etc.	Upon completion of construction activities at these sites. During construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	grade layer, sub-base layer, scarification etc. Top soil from borrow area, Debris disposal sites; borrow area, construction site to be protected / covered for soil erosion. Debris due to excavation of foundation, dismantling of existing cross drainage structure will be removed from the water course immediately. Diversions for bridges will be removed from the water course before the onset of monsoon Along sections abutting water bodies, stone pitching needs to be carried out. At the outfall of each culvert, erosion prevention measure, such as the following, will be undertaken,					
Loss of agricultural top soil	All areas of cutting and all areas to be permanently covered will be stripped to a depth of 150 mm and stored in stockpile. The stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile is to be restricted to 2m. Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles will be covered with gunny bags or tarpaulin. It will be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. Top soil will be safeguard from erosion and will be reused as follows: Covering all borrow areas after excavation is over. Dressing of slopes of road embankment Agricultural field, acquired temporarily	All along Project Corridor, where productive land is acquired	During construction	Contractor	NHAI	
Compaction of Soil and Damage to Vegetation	Construction vehicles should operate within the Corridor of Impact avoiding damage to soil and vegetation. Diversions, access road used will be redeveloped by Contractor , to the satisfaction of the owner / villagers. Construction vehicle, machinery and equipment shall move or be stationed in the ROW only. While operating on temporarily acquired agricultural land for any	Throughout Project Corridor and all areas temporarily acquired.	During construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	construction activities, top soil will be preserved in stockpiles.					
Contamination of soil	Guidelines of "Hazardous waste (management and handling) rules, 1989 will be enforced. Vehicle / machinery and equipment operation, maintenance and refuelling shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An "oil interceptor" will be provided for wash down and refuelling areas. Fuel storage shall be in proper bunded areas. All spills and collected petroleum products shall be disposed off in accordance with MoEF and SPCB guidelines at designated locations. Plant to be set up 500 m away from surface water body. Oil interceptor will be installed at construction site. Septic tank will be constructed for safe disposal of waste.	At fuel storage areas – usually at construction camps, temporarily acquired site.	During Construction.	Contractor	NHAI	
1. Quarrying 2. Material sources	Quarry material shall be sourced from approved and licensed aggregate and sand quarries as given in Chapter 8. Copy of licenses to be submitted to the NHAI. For operating new quarries, the contractor shall obtain materials from quarries only after consent of the DoF or other concerned authorities and only after development of a comprehensive quarry' redevelopment plan. Adequate safety precautions shall be ensured during transportation of quarry material from quarries to the construction site. Vehicles transporting the material shall be covered to prevent spillage. Operations to be undertaken by the contractor as per the direction and satisfaction of the NHAI.	Table 8.3 & 8.4	During construction	Contractor	NHAI	
Generation of Debris	Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction as fill materials for embankments	Throughout Project Corridor.	During Construction	Contractor	NHAI	
Disposal of Debris	The disposal of debris shall be carried out only at sites identified for the purpose. The contractor shall carry out the disposal as described in **Annexure 5.2.** All arrangement for transportation during construction	Sites identified by the contractor and approved	During Construction	Contractor, NHAI.	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	including provision, maintenance, dismantling and clearing debris, where necessary will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the NHAI.	by the NHAI.				
Air						
Dust Generation	Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. Clearing and grubbing to be done, just before the start of next activity on that site. In laying sub-base, water spraying is needed to aid compaction of the material. After the compaction, water spraying should be carried out at regular intervals to limit the dust to below Road surface should be cleaned with air compressor and vacuum cleaners prior to the construction works. Manual labour using brooms should be avoided, if used labour to be provided masks. Embankment slopes to be covered with turfing / stone pitching immediately after completion. The Contractor shall take every precaution to reduce the level of dust emission from the hot mix plants and the batching plants up to the satisfaction of the NHAI.. All existing highways and roads used by vehicles of the contractor , or any of his sub-Contractor or suppliers of materials or plant and similarly roads which are part of the works shall be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles or their tyres. Plants, machinery and equipment shall be so handled (including dismantling) as to minimise generation of dust.	Throughout Project Corridor, all access roads, temporarily acquired sites.	Beginning with & throughout construction until asphalting is completed and side slopes are covered.	Contractor	NHAI	
Equipment Selection, Maintenance and Operation	The discharge standards promulgated under the Environment Protection Act, 1986 shall be strictly adhered to. All vehicles, equipment and machinery used for construction shall conform to the relevant Bureau of Indian Standard (BIS) norms. All vehicles, equipment and machinery used for	Throughout Project Corridor, all access roads, sites temporarily	During Construction.	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	construction shall be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of SPCB and the NHAI..	acquired and all borrow areas.				
Pollution from Crusher	All crushers used in construction shall conform to relevant dust emission control legislations. Clearance for siting shall be obtained from the SPCB. Alternatively, only crushers already licensed by the SPCB shall be used. Water will be sprayed during the non-monsoon months, regularly to minimise dust, in the whole crusher plant area. The suspended particulate matter contribution value at a distance of 40m from a controlled isolated as well as from a unit located in a cluster should be less than 500μg/m3. The monitoring is to be conducted as envisaged in the monitoring plan.	All Aggregate Crushing Plants.	During Erection, Testing, Operation and Dismantling of Such plants.	Contractor	NHAI	
Water						
Loss of water bodies/ surface / ground	No excavation from the bund of the water bodies. No debris disposal near any water body. Prior written permission from authorities for use of water for construction activity will be submitted to NHAI. Construction labours to be restricted from polluting the source or misusing the source. Shifting of source to be completed prior to disruption of the actual source. Alternate measures to be taken / ensured during disrupted period. Source to be replaced immediately, in case of accidental loss. Construction work shall be restricted to 3m – 4m width from the existing formation near ponds. The volume of water storage lost shall be compensated for by excavation of an equal volume of similar depth at closest possible location in the direction of flow and shall be done with the approval of the NHAI.	Near all water bodies	During construction	Contractor	Contractor	
Alteration of drainage	Diversions will be constructed during dry season, with adequate drainage facility, and will be completely	Throughout Project	Whenever encountered	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	removed before the onset of monsoon. Debris generated due to the excavation of foundation or due to the dismantling of existing structure will be removed from the water course. Temporary Silt fencing to be provided on the mouth of discharge into natural streams. Continuous drain (lined / unlined) is suggested / will be provided. Obstruction, if any, will be removed immediately.	Corridor, all access roads, temporarily acquired sites.	during construction			
Runoff and drainage	Throughout continuous drain is provided. Lined drain is provided at built-up locations for quick drainage. Increased runoff due to increased impervious surface is countered through increased pervious surface area through soak pits and rain water harvesting structures.		During Construction	Contractor	NHAI	
Water requirement for project	Contractor will provide a list of sources (surface / ground) for approval from NHAI.. Prior to use of source contractor will take the written permission from authority, to use the water in construction activity, and submit a copy to NHAI. During construction only permitted quantity (permission taken) from approved sources will be used. Contractor will ensure optimum use of water; discourage labour from wastage of water.	Throughout Project Corridor, all access roads, temporarily acquired sites.	During Construction	Contractor	NHAI	
Silting / sedimentation	Measures suggested under “Soil Erosion and Sedimentation control” will be enforced. Silt fencing is provided around water bodies. Construction activities will be stopped near water bodies during monsoon. Soil trap are suggested / will be provided in all ancillary sites and camps.		Throughout construction period	Contractor	NHAI	
Contamination of water	Measures suggested under “Contamination of soil” will be enforced. Construction work close to water bodies will be avoided during monsoon. Labour camps will be located away from water bodies. Car washing / workshops near water bodies will be	All areas in immediate vicinity of construction campsite chosen by the	Throughout construction period, During Establishment, Operation and Dismantling of	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	avoided.	contractor.	Labour Camps.			
Noise						
Noise from Vehicles, Plants and Equipment	Noise standard at processing sites, eg. Aggregate crushing plants, batching plant, hot mix plant will be strictly monitored to prevent exceeding of noise standards. Workers in vicinity of loud noise, and workers working with or in crushing, compaction, concrete mixing operations shall wear earplugs and their working time should be limited as a safety measure. In construction sites within 150 m of sensitive receptors construction will be stopped from 22:00 to 06:00. Machinery and vehicles will be maintained to keep their noise to a minimum. Construction of noise barriers at sensitive receptors. All vehicles and equipment used in construction shall be fitted with exhaust silencers. During routine servicing operations, the effectiveness of exhaust silencers shall be checked and if found to be defective shall be replaced. Noise limits for construction equipment used in this project (measured at one metre from the edge of the equipment in free field) such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB(A), as specified in the Environment (Protection) Rules, 1986.	Throughout Project Corridor, all access roads, sites temporarily acquired and all borrow areas.	Throughout construction	Contractor	NHAI	
Noise from Blasting or Pre-splitting Operations	Blasting shall be carried out only with permission of the NHAI. All the statutory laws, regulations, rules etc., pertaining to acquisition, transport, storage, handling and use of explosives shall be strictly followed. Blasting shall be carried out during fixed hours (preferably during mid-day), as permitted by the NHAI.The timing should be made known to all people within 500m (200m for pre-splitting) from the blasting site in all directions. People, except those who actually light the fuse shall be excluded from the area of 200m (50m for pre-splitting) from the blasting site in all directions at least 10 minutes before the blasting.	All Blasting and Pre-splitting Sites.	During Preparation, Operation and Closure of Such Sites.	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
Flora & Fauna						
Loss of trees and Avenue Planting	Plant trees as per the plantation strategy specially developed for the project. Cost of plantation to be included in the EMP Budget. Contractor has to make sure that no trees / branches to be fell by labourer for fuel, warmth during winter. Enough provision of fuel to be ensured.		After completion of construction activities	Contractor	NHAI	
Vegetation clearance	Clearing and grubbing should be avoided beyond that which is directly required for construction activities. Next activity to be planned / started immediately, to avoid dust generation and soil erosion during monsoon. Turfing / re-vegetation to be started soon after completion of embankment.		During cleaning operations. During construction	Contractor	NHAI	
Fauna	Construction workers must protect natural resources and wild animals. Hunting will be prohibited. Nesting grounds & migratory paths will be protected.		During construction	Contractor	NHAI	
Socio – Economic Environment						
Public Health and Safety	Debris generated will be disposed to the satisfaction of NHAI. Monitoring of air, water, noise and land during construction and operational phase.		During Construction	Contractor	NHAI	
Accidents	The contractor will provide, erect and maintain barricades, including signs marking flats, lights and flagmen as required by the NHAI.		During Construction	Contractor	NHAI	
Resettlement Action of People	A comprehensive resettlement action plan has been prepared to improve the standard of living of the affected population.		During Construction	Contractor , NHAI	NHAI	
Sensitive community and cultural facilities	Precaution to be taken for any accidental loss to community and cultural property Any loss made shall be the responsibility of the contractor and made good by him at his own cost Through access / identification to be maintained Endeavour towards enhancement of community and cultural property Community consultations for any relocation, mitigation measures adopted		During Construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
Temporary Loss of Access	The Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the NHAI. The works shall not interfere with or cause inconvenience to public or restrict the access to use and occupation of public or private roads, and any other access footpaths to or of properties whether public or private. Access across the work-zone will be provided for two slots every day during construction (2 hours in the morning and 2 hours in the afternoon). For this purpose the contractor shall maintain a strip of pavement across the work zone of such quality that light motor vehicles (LMV) can pass without difficulty or danger of breaking down.	All along the Project corridor	During Construction	Contractor	NHAI	
Road Safety And Construction Safety						
Traffic Delays and Congestion	Detailed Traffic Control Plans shall be prepared and submitted to the NHAI. for approval, 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. The Contractor shall ensure that the running surface is always maintained in running condition, particularly during the monsoon so that no disruption to the traffic flow occurs.	All along the Project Corridor.	During Construction	Contractor	NHAI	
Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the NHAI for the information and protection of traffic approaching or passing through the section of the highway under improvement. All signs, barricades, pavement markings shall be as per	Entire Project site.	During Construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	the MoSRT&H specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the NHAI.					
Risk from Operations	The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. No child labour shall be utilized in the project	Entire Project site.	During Construction	Contractor	NHAI	
Risk from Electrical Equipment	Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the NHAI.	Entire Project site.	During Construction	Contractor	NHAI	
Risk at Hazardous Activity	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any toxic chemical shall be strictly in accordance with the manufacturer's instructions. The	Entire Project site.	During Construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	NHAI shall be given at least 6 working day's notice of the proposed use of toxic chemical. A register of all toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.					
Risk caused by Force' Majure	All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.	Entire Project site	During Construction	Contractor	NHAI	
First Aid	At every workplace, a readily available first aid unit including an adequate supply of sterilised dressing material and appliances will be provided as per the Factory Act. Workplaces, remote and far away from regular hospitals will have indoor heath units with one bed for every 250 workers. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital. At every workplace and construction camp, equipment and nursing staff shall be provided.	Entire Project site.	During Construction	Contractor	NHAI	
Safety Measures During Construction	All relevant provisions of the Factories Act, 1948 and The Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 will be adhered to. Adequate safety measures for workers during handling of materials at site will be taken up. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.	All construction sites	During construction	Contractor	NHAI	
Hygiene	Latrines shall be provided with septic tank. The effluents can be diverted for horticulture inside the camps.	All Worker's Camps	During construction	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	The septic tank may be cleaned once in 6 months and filter cleaned after a year. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Garbage bins must be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner. Adequate health care is to be provided for the work force. Unless otherwise arranged for by the local sanitary authority, the local medical health or municipal authorities. On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, septic tank and other disposal pits filled in and effectively sealed off and the outline site left clean and tidy, at the Contractor 's expense, to the entire satisfaction of the NHAI.					
Clearing of Construction of Camps & Restoration	Contractor to prepare site restoration plans for approval by the NHAI. The plan is to be implemented by the contractor prior to demobilisation. On completion of the works, all temporary structures will be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the NHAI. Residual topsoil will be distributed on adjoining / proximate barren / rocky areas as identified by the NHAI in a layer of thickness of 75mm - 150mm.	All Workers' Camps		Contractor	NHAI	
Monitoring at critical locations	The monitoring of Air, land, water and Noise to be carried out identified critical locations as given in Chapter 4, besides locations identified by NHAI along the project corridor.			Contractor	NHAI	
OPERATION STAGE						
Water quality degradation due to road run-off	Silt fencing, Oil & Grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off. Monitoring shall be carried out as specified in the Monitoring plan	At sensitive water bodies identified. As specified in the	During Operational Stage	NHAI and / or SPCB	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
		monitoring plan				
Contamination of Soil and Water Resources from Spills Accidents	Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals. Spill of oil, fuel and automobile servicing units without adequate disposal systems in place to be discouraged. Accidental spills are potentially disastrous, but its probability is quite low as one of the objectives of this project is to enhance road safety. The Public will be informed about the regulations on land pollution. Land pollution monitoring program has been devised for checking pollution level and suggesting remedial measures.	Entire Project corridor.	During Operational Stage	Contractor	NHAI	
Traffic and Accident Safety	Depending on the level of congestion and traffic hazards, traffic management plans will be prepared. Traffic control measures including speed limits to be enforced strictly. Road control width to be enforced. Local government bodies and development authorities will be encouraged to control building development along the highway.	All along the Project corridor and surrounding areas.	During Operational Stage	Contractor, Local Government Bodies, Development Authorities.	NHAI / Contractor	
Accidents involving Hazardous Materials	Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 Creation of an Emergency Response team For delivery of hazardous substances, permit license, driving license and guidance license will be required. Public security, transportation and fire fighting departments will designate a special route for vehicles delivering hazardous material. These vehicles will only be harboured at designated parking lots. In case of spill of hazardous materials, the relevant departments will be intimated at once to deal with it with the spill contingency plan.	All along the Project corridor and surrounding areas	During Operational Stage	Contractor	NHAI, Motor Vehicles Department, District Administration	
Road side tree plantation	Trees planted along the corridor shall be maintained for a period of three years. Maintenance works include, watering of the saplings, and all necessary measures for survival of the sapling.	All along the corridor Immediately from the	During Operational Stage	Contractor	NHAI	

Environmental Impact / Aspect	Mitigation Measures1	Location 2	Time Frame3		Responsibility	
					Implementation	Supervision
	The avenue plantation should be completed, maintained and casualties to be replaced. Discouraging local peoples from cutting tree / branches for fuel, cattle food etc. Educating people about the usefulness of trees.	planting of sapling				
Monitoring at critical locations	The monitoring of Air, land, water and Noise to be carried out identified critical locations as given in Chapter 4, besides locations identified by NHAI along the project corridor.			Contractor	NHAI	
Noise	HORN PROHIBITED sign post will be enforced Maintenance of noise barriers Discouraging local people from establishing sensitive receptor near the road. The public will be informed about the regulations on noise pollution.	After completion of construction Throughout and after project development period	During Operational Stage	SPCB, State Police, Traffic Police, State Forest Dept., Transport Dept., Contractor and Planning Authorities	NHAI`	

10.3 EXISTING ENVIRONMENTAL CELL & NHAI

NHAI already has an organizational and institutional capacity at the headquarters created to meet the requirements for implementation of the environmental mitigation measures in the EMP. At present, the Environmental cell within the NHAI is headed by an Environmental Officer deputed from Forest Division. It is envisaged that the Environmental Cell will continue to:

- Monitor progress of the implementation of the EMP measures in consonance with the timeline for the project within the allotted budget;
- Maintain interaction with the various other statutory bodies like State Pollution Control Board and the SEIAA;
- Interact with the Environmental Expert of the NHAI on the state of the environment and mitigation and enhancement measures adopted;
- Occasionally inspect the environmental measures being implemented by the Contractor;
- Report progress of works, both in terms of physical progress and quality for transmission to statutory authorities such as the Ministry of Environment and Forests as well as the World Bank Group;
- Document and disseminate good practices, bottlenecks and their resolution during the implementation of environmental measures.

10.4 IMPLEMENTING ARRANGEMENTS

The NHAI is responsible for the implementation of the provisions made within the EMP through its site offices.

10.4.1 Contractor

Execution of works will be the responsibility of the contractor. The contractor may himself be the executioner of the project or might decide to outsource or hire contractor for highways and structures, who may in turn sublet some part of their work to petty contractors. In case the contractor decides to execute the work by himself then the responsibilities of the EO as given in Box 10.1 shall also be performed by the EO of the contractor. If the contractor decides to outsource the work then the contractors shall employ an Environmental Officer whose qualification and responsibilities shall be as per Box 10.1. The contractor shall be responsible for both the jobs done by the petty contactor (if Sublet) as well by him. In both the cases the contractor will implement the environmental measures (either through the contractors or themselves). This has been done with a view to ensure that road construction and environmental management go together.

Box 10.1: Qualification and Responsibilities of Environmental Officer of Contractor

Qualifications & Experience

- Postgraduate in Environmental Science / Environmental Management / Zoology / Botany / Ecology / Environmental Planning / Environmental Engineering.
- 5 years of experience with a minimum of 2 years in the implementation of EMP of highway projects and an understanding of environmental, health and safety issues.
- Prior practical experience in State and National Highways would be an advantage.

Roles & Responsibilities

- The Environmental Officer shall report directly to the Resident Construction Manager / Project Manager so that the pertinent environmental issues that he raises are promptly dealt with.
- He shall also have a direct interaction with the Environmental Expert and the Environmental Officer and the contractor respectively.
- Monitor / implement measures laid out in the EMP and or as directed by NHAI for the work executed both by petty contractors and the contractor.
- Provide key inputs in the development of the Contractors' implementation plan for all construction activities, including haulage of material to site, adhering to the requirements of the EMP and getting approval of contractor and the NHAI on the same before start of works.
- Ensure that the regulatory permissions required for the construction equipment, vehicles and machinery (given in the EMP) have been obtained and are valid at all times during the execution of the project.
- Prepare / fill up the environmental and safety related forms given in the EMP
- Prepare Safety Plans, Emergency Response Plans and Quarry Management and other safety, health and environment related Plans for approval of the contractor.
- Identify 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 site and obtain approval for the same from the contractor.
- Detail out site-specific environmental mitigation and enhancement measures and obtain approval of contractor and the NHAI for the same.
- Carry out the measurements of environmental mitigation and / or enhancement works and prepares bills for the same for approval and payment through the Contractor 's Environmental Officer.
- Ensure that the safety of the workers and other site users is not compromised during construction.

- Ensure that adequate monitoring facilities are available for collecting samples of all discharges from the Contractor's plants, equipment and camps.
- Verify the extent of environmental compliance at sites from where the Contractor is procuring the material – quarries, crushers or even sand and suggest appropriate mitigation measures, if required.
- Responsible for implementation of safety and health regulations if also acting as safety officer.

The environmental officer shall have a small environmental, health and safety team to help him in implementing the EMP. These team members may / may not report to him / her directly but shall apprise him of all the incidents and mark a formal report of any incident having an impact on the Health, Environment and Safety issues.

10.5 REPORTING SYSTEM

Reporting system provides necessary feedback for project management to ensure quality of the works and that the program is on schedule. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the Environmental Management Plan get implemented in the project. Reporting system for the suggested monitoring program operates at two levels as:

- Reporting for environmental condition indicators and environmental management indicators
- Reporting for operational performance indicators at the NHAI site level.

The reporting system will operate linearly – contractor who is at the lowest rung of the implementation system reporting to the Contractor, who in turn shall report to NHAI. All reporting by the contractor shall be on a quarterly basis, while the reporting time of the contractor shall be decided upon by the contractor. The NHAI Site Office will monitor the activities through its own staff or the consultant's Environmental Specialist after it has obtained the Contractor's report with the Consultant's remarks on it during the construction phase. During the operation phase, the supervision as well as reporting responsibilities will lie with the NHAI site office.

Table 10.2 Summary of Reporting of Environmental Components and Responsibilities

Format No.	Item	Timing	Consultant		NHAI Site Office
			Supervision	Reporting	Overseeing / Compliance
CONTRACTOR MOBILIZATION AND SITE CLEARANCE					
M1	Reporting by contractor for dumping locations & construction and labour camp site	Before start of construction	As required	Quarterly	As required
M2	Reporting by contractor to NHAI for construction and labour camp site	Before start of construction	As required	Quarterly	As required
M3	Target sheet for Tree cutting	Before start of work	As required	After cutting	As required
M4	Reporting for borrow areas	Before start of construction	As required	Quarterly	As required
CONSTRUCTION PHASE					
C1	Target sheet for Pollution Monitoring	As per Monitoring Plan	As required	After Monitoring	As required
C2	Top soil Conservation	Before start of work	As required	Quarterly	As required
OPERATION PHASE					
O1	Target sheet for Pollution Monitoring	During Operation	As required	After Monitoring	As required
O2	Redevelopment of Borrow Areas	After completion of usage of Borrow Area	As required	After Monitoring	As required
O3	Survival Rate of Trees	During Operation	As required	After Monitoring	As required

10.6 ENVIRONMENTAL CAPACITY BUILDING

Training of staff will be done at a number of levels. Some short-term training is required for the Environment Manager, other staff members of the Environment Unit and the contractor staff to raise their levels of environmental awareness. The training can be conducted by either some external agency or through the help of in-house expertise of the NHAI and the consultants and help of Pollution Control Board can be sought in this regard. In the long-term training, special environmental issues will be examined and likely solutions provided to the Environment Unit.

The proposed training should also allow the officials to enhance their skills for effective monitoring of project by understanding the formats developed for reporting. In addition, close interaction is required among members of the NHAI responsible for the Environmental and R&R activities since it is envisaged that the two aspects will have a considerable overlap. It is envisaged that the training as part of the project will include training on several issues important for both teams simultaneously. The following modules can be taken up:

Table 10.3 Modules for Training

Sl No.	Timing	Target Group	Mode of training	Short Description	Responsibility
1	After finalisation of Contracts for Civil Works	Members of the NHAI site office, Contractor and the Environmental staff of the Civil Contractor	Lectures, Presentations, Discussions	**Overview of responsibilities** • Reporting arrangements • Contractual obligations, Environmental Protection and Social Development	External Agency or NHAI
2.	During implementation	Members of the NHAI site office, Counterpart staff from other departments such as Revenue, Forests, etc.	Lectures, Discussions, Presentations, Role Play	**Inter-Departmental Co-ordination** • Clearance requirements and prescribed procedures • Expectations of other departments – documentation and follow-up • Developing formats for ease of reporting	External Agency, Consultants, NHAI

10.7 CORPORATE SOCIAL RESPONSIBILTY

Concessionaire will undertake many activities at the project Alignment surroundings under Corporate Responsibility for Environment Protection:

- Drinking water/sanitation facilities in schools nearby project road alignment.
- Solar street lights to nearby villages
- Afforestation in villages
- Environmental awareness programs in the nearby villages.

CHAPTER - 11

SUMMARY & CONCLUSIONS

11.1 PROJECT BACKGROUND

Road network is vital to the economic development, trade and social integration. It facilitates smooth conveyance of both people and goods. Due to India's steady growth rate (over 8%) during past few years, transport demand in India has been growing rapidly. In recent years this demand has shifted mainly to the advantage of road transport since it provides easy accessibility, flexibility of operations, door-to-door service and reliability.

NHAI has been entrusted to implement the development, maintenance and management of National Highways of the country under **NHDP** in phases for rehabilitation and upgrading of National Highways to 2-lane with paved shoulder standards at least by MoRTH, GOI. Accordingly, NHAI has taken up the project **"Widening & improvement of existing 2 lane to 4 laning of Haridwar to Kashipur section of NH74 in the States of Uttar Pradesh and Uttarakhand".** NHAI has appointed M/s. SAI Consulting Engineers as project consultants to assist NHAI in all aspects of project preparation for implementation in accordance with the objectives as detailed in its Terms of Reference. Consequence upon the application by NHAI for prior EC to the project, MoEF has issued ToR vide letter dated---March 6,2012--- to conduct EIA study as envisaged in September 14, 2006 EIA notification.

THE PROJECT ROAD & AREA

This section of project road is situated partially in Haridwar & Udham Singh Nagar districts of Uttarakhand and partially in Bijnor district of UP. The stretch of road from km 0.000 to km 30.000 and km 132.000 to km 175.000 of NH-74 lies in Haridwar & Udham Singh Nagar districts of Uttarakhand respectively. The remaining stretch of NH-74 from km 30.000 to km 132.000 lies in Bijnor district of UP. Haridwar is located at 29°58' N and 78°09' E, Najibabad is located at 29°40'N and 78°20'E and the Kashipur is located at 29°15' N and 79°00' E.

PROPOSED IMPROVEMENTS

The existing project highway is presently a 2-Lane undivided carriage. The project proposes to:

- Developing the carriageway into 4 lane divided carriageway by overlays / rehabilitation / reconstruction.
- In addition to strengthening the existing carriageway, the project would improve the geometric deficiencies through curve improvements and the improvement of the various intersections.
- The proposed improvement includes repair / rehabilitation of existing cross-drainage (CD) structures.
- Structures on the highway and provision of new CD structures.
- The project highway passes through many settlements.

- To minimise the adverse impacts on the various settlements and to minimize land acquisition, short realignments at two locations are proposed. The proposed ROW shall be limited to 25/40/60/80m. It is also proposed to have concentric widening to the extent possible to remove discrimination and local conflicts.
- Service roads are also proposed to be provided at a number of locations. These locations were proposed based on the proximity to cultural properties, educational and health units, and size of Settlements.
- Proper drainage, grade-separation, road furniture, utilities and amenities wherever required shall also be provided.

11.2 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY IN THE PROJECT

The Environmental Impact Assessment study of the project road has been carried out as per terms of reference given by MoEF,GOI.

The study methodology for EIA employs a simplistic approach in which the important environmental receptors were identified. Based on the identification baseline data was generated and then analyzed to predict the impacts and quantify them. Avoidance, Mitigation and Enhancement measures were then developed and these have been incorporated in the Environmental Management Plan (EMP), designs and / or Bills of Quantities as appropriate. Implementation arrangements including responsibilities of all facets have been streamlined and documented for guidance and implementation.

11.3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

11.3.1 Institutional Setting

The project has been initiated by the GOVT of Uttar Pradesh and GOVT of Uttarakhand and is being carried out by the NHAI. The primary responsibility of the project rests with the NHAI in providing encumbrance free ROW to the contractor, who shall implement the project.

11.3.2 Clearances

As part of the project preparations, NHAI shall seek forest diversion for 73.735 ha and tree felling permission from the respective Divisional Forest Officer, who is the designated officer under the WALTA act by GOVT of Uttar Pradesh and GOVT of Uttarakhand. The application for Forest diversion has also been processed and submitted to the Nodal Officer in the Forest Department.

As additional right of way requirement for improvement of the project road is less than 10-15m, this project come under the purview of the MoEF Notification (Sept 2006). The assessment of the additional right of way has been made considering the average additional land width requirement over the length of the corridor.

The contractor shall seek the following clearances, NOCs & licenses from the authorities prior to his work initiation:

- NOC And Consents Under Air , Water, EP Acts & Noise rules of SPCB for establishing and operating plants from SPCB

- NOC under Hazardous Waste (Management and Handling) Rules, 1989 from SPCB
- PUC certificate for use of vehicles for construction from Department of Transport
- Quarry lease deeds and license and Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for water extraction for construction and allied works from Ground Water Authority Apart from the above clearances, the contractor also has to comply with the following:
- Clearance of Engineer for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of Engineer for Traffic Management Plan for each section of the route after it has

  been handed over for construction.
- An Emergency Action Plan should be prepared by the contractor and approved by the Engineer for accidents responding to involving fuel & lubricants before the construction starts.
- Submit a Quarry Management Plan to the Engineer along with the Quarry lease deeds

11.4 BASELINE ENVIRONMENTAL PROFILE

11.4.1 Physical Environment

Meteorology

The study of Meteorological and micro meteorological parameters is significant in a road project as these parameters regulate transport and diffusion of pollutants released into the atmosphere.

Climate

Seasons

The project area experiences typical Mountain climate. The moderating effects of the nearby mountains and the fairly high amount of relative humidity in the atmosphere have restricted the variability.

Haridwar

Due to its location away from any major water body and its close proximity to the Himalayas, Haridwar has an extreme and erratic continental climate. Summers start in late March and go on up till early July, with average temperatures around 29^{o}C. The monsoon season starts in July and goes on up till October, with torrential rainfall, due to the blocking of the monsoon clouds by the Himalayas. The post monsoon season starts in October and goes on up till late November, with average temperatures sliding from 24^{o}C to 13^{o}C. Winters start in December, with lows close to freezing and frequent cold waves due to the cold katabatic winds blowing from the Himalayas. The total annual rainfall is about 2400 mm.

Kashipur

This region experiences a tropical to sub tropical climate. The mean monthly temperature in summer is 43^0c, while that in winter is 22^0c and the total annual precipitation is about 210 cms.

Temperature

Seasonal variations in temperature follow closely the course of the Sun. The month of January is invariably the coldest and May the warmest month. With the onset of monsoon in early June, there is a reversal of temperature curve and the temperature during the period of monsoon remains very uniform at about 25ºC. During post-monsoon season, the temperature slightly increases above 25ºC, but gradually falls by the start of January. On an average, the temperature during summer months varies from 25ºC to 44ºC, while in winter it ranges from 6ºC to 24ºC.

Relative Humidity

The Relative Humidity ranges between 70% and 90% in the monsoon period. Between November and January i.e. during winter months, the relative humidity varies from 64% to 83%. The relative humidity generally is higher than 49% throughout the year.

Rainfall

Monsoon generally sets in around the second week of June and continues till late September. July and September are the wettest month all over the region. There is hardly a day without rain during these three months. Towards the later part of the season, as the frequency of rain decreases, the project area experiences oppressive hot weather associated with high relative humidity. It receives the maximum rainfall during southwest monsoon season. After this North-east monsoon starts. The average rainfall received ranges from 1500 mm to 2100 mm in a year. About 76 to 85 % of the rainfall is through monsoons.

Seismicity

India has most tectonically active as well as most stable landmasses. India is divided into 5 zones according to the probability of the earthquake occurrence. Zone 1 is the least active and zone 5 is the most active zone. The project area falls in zone IV of seismic zone, in accordance with seismic zoning map. as per the India Meteorological Department (IMD), would be adequate and considered for design purpose for Civil Engineering structures and while finishing civil designs.

Air Quality

The air quality in the project area is generally pristine. The PM10, PM2.5 levels were found well within the prescribed standards of CPCB. The gaseous concentration such as SO2, NOX & CO was also within CPCB prescribed limits.

Noise Quality

It has been observed that noise levels exceed prescribed limits of CPCB in major locations, as normally observed in other State highways. The noise levels are below the stipulatory standards near rural and forest sections.

Water Hydrology and Drainage

To facilitate the cross-drainage at water crossings, cross-drainage structures are proposed. The water quality of the surface water bodies like Ganga River and amgangaen canal, when tested, indicates no biological contamination, making water from these sources suitable for drinking & bathing.

11.4.2 Biological Environment

Forest Resources

The proposed ROW is passing through the patches of Protected Forest different patches all along the 3 districts and Reserve forest (km 3025.000 to km 318.400 on left,Right and on both sides) in Shayampur RF, In Chidyanpur RF(km 19.200 to km 30.300 on on left,Right and on both sides) & Rampur RF(km 30.000 to km 130.900 on on left,Right and on both sides and 142.400 to 143.000) There is no endangered flora and fauna found in these Protected Forests and RF**.** Even at 10 m buffer on either side of the ROW the forest trees are found to be very less and there is no endangered species of animals are found.

Trees within ROW

Tree survey is being carried out along the proposed alignment. Most of the trees were planted along the roads in the past. From the environmental point of view there exists numbers of big trees on either side of the Existing Road. There are as many as 68791 trees in revenue & private land that are likely to be impacted.

Fauna

Domesticated animals mainly constitute the faunal population within the project area. Wild animals are not reported in the project vicinity. No endangered species of flora and fauna are found in the project area.

11.4.3 Social Environment

Settlement

There exist settlements varying in size and populations along the project corridor.

Cultural Properties

The project highway traverses through a number of settlements and there are some religious and cultural properties which though not of archaeological significance are nevertheless, significant to the community.

Census Profile

Uttar pradesh

According to the 2001 census of India, The total population of the State according to the 2001 Census, is 16, 61, 97,921 crores of this, 79.21 percent of the people live in rural areas and 20.78 percent live in urban areas. The State has a high density of population, about 689 persons per square kilometre. The sex ratio for the State is 898 females per 1,000 males. In rural Uttar Pradesh, however, there are more women than urban, and the ratio is 904 women per 1,000 men, while in urban Uttar Pradesh the ratio is 876 women.

Uttarakhand

The total population of the State according to the 2001 Census, is 84.89 lacs of this, 80 percent of the people live in rural areas and 20 percent live in urban areas. The State has a low density of population, about 151 persons per square kilometre. The sex ratio for the State is 962 females per 1,000 males. In rural Uttarakhand, however, there are more women than men, and the ratio is 1,007 women per 1,000 men, while in urban Uttarakhand the ratio is 845 women

Public Consultation

Public consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level. The issues of the most concern were related to rehabilitation and resettlements and have been dealt in social assessment report. It was also felt during the public consultation process that most of the people are aware about the project but they did not appreciate environmental problems associated with road projects. However, some people were concerned about environmental issues, mainly air and noise pollution. The other concerns raised at during public consultation were demand for submergence of project road and safety problems. The issues raised by the public have been duly incorporated in project design.

11.5 POTENTIAL ENVIRONMENTAL IMPACTS

The environmental components are mainly impacted during the construction and operational stages of the project and have to be mitigated for and incorporated in the engineering design. Environmental mitigation measures represent the project's endeavour to reduce its environmental footprint to the minimum possible. These are conscious efforts from the

project to reduce undesirable environmental impacts of the proposed activities and offset these to the degree practicable. Enhancement measures are project's efforts to gain acceptability in its area of influence. They reflect the pro-active approach of the project towards environmental management.

11.5.1Impacts on Climate

Impact on the climate conditions from the proposed road project widening will not be significant as no major deforestation and / or removal of vegetation is involved for the project

11.5.2 Impact on Air Quality

There will be rise in SPM levels during the construction activities, which shall again be within prescribed limit after the construction activities are over.

11.5.3 Impact on Noise Levels

The impact of noise levels from the proposed project on the neighbouring communities is addressed. It has been concluded that both day and nighttimes equivalent noise levels are within the permissible limits right from start of project life. Noise sensitive receptors have been identified along the project road.

11.5.4 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants. This will be more prominent in case of locations where the project road crosses rivers, canals distributaries, etc. Mitigation measures have been planned to avoid contamination of these water bodies.

11.5.5. Impact on Ecological Resources

There is no major loss of vegetation hence adverse impact in terms of availability of nesting sites for the bird doesn't arise. Furthermore, there is no sensitive ecological area along the existing project roads, so the impact will be insignificant during construction period. But on the long run the project shall have a positive impact due to the compensatory forestation and avenue plantation.

11.5.6 Impact on Land

During the construction of the proposed project, the topography will change due to excavation of borrow areas, stone quarrying, cuts and fills for project road and construction of project related structures etc. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project. Benefits in the form of land levelling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

11.5.7 Impact on Human Use Values

The PAPs shall be compensated as per the RAP. Accidents are bound to increase coupled with ribbon development. There shall also be some impacts on cultural or religious properties along the corridor.

11.6 ANALYSIS OF ALTERNATIVES

Detailed analyses of the alternatives have been conducted taking into account both with and without project scenario and the available alignment options. The analysis also dealt with the justification of selections of the proposed alignment and the modifications on it due to environmental considerations, realignment and bypasses and the minimization of negative impacts. Based on all these alternative studies the present alignment was proposed.

11.7 MITIGATION AVOIDANCE AND ENHANCEMENT MEASURES

Both generic and site specific mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 500m away from habitations. The construction yard, hot mix plants, crushers etc. will be located at 500m away from habitations and in downwind directions. Adequate cross drainage structures have been planned to maintain proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:2 i.e. for every tree to be cut, two trees will be planted. The project shall also witness the plantation of trees for providing aesthetic beauty and shade. As the space for compensatory afforestation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for three years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies, enhancement of cattle market etc. In order to avoid contamination of water bodies during construction sedimentation chambers, oils and grease separators, oil interceptors at storage areas and at construction yard have been planned.

11.8 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

The responsibility of implementing the mitigation measures and all activities under environmental management plan (EMP) lies with the contractor (selected through International Competitive Bidding) through the contractor. All construction activities being taken up by the contractor and shall be scrutinized by NHAI.

The implementation of RAP shall be as per the details given in the RAP report. In the pre-construction phase of the project the consultant as appointed by NHAI shall review the EMP and RAP to identify environmental and social issues and arrive at a suitable strategy for implementation.

For effective implementation and management of the EMP, The Contractor shall establish a Safety, Health and Environment (SHE) Cell headed by an Environment Officer to deal with the environmental issues of the project. This officer shall interact with the contractor, NHAI and other departments to ensure that the mitigation and enhancement measures mentioned

in the EMP are adhered. The Environmental officer of the contractor shall be the interface between the Environmental Specialist of IC and the Environmental Officer of the contractor. His prime responsibility shall be to appraise the Environmental Specialist about the ground conditions. He shall also procure the requisite clearances and the NOCs for the project and shall also strictly supervise that the contractor adheres to the EMP. The officer shall also participate in training programmes and assist NHAI in preparing documentation for good practices in environmental protection.

The reporting system will operate linearly – contractor who is at the lowest rung of the implementation system reporting to the Contractor, who in turn shall report to NHAI. All reporting by the contractor shall be on a quarterly basis, while the reporting time of the contractor shall be decided upon by the contractor. The NHAI Site Office will be responsible for setting the targets for the various activities anticipated during construction phase and obtaining agreement from the Contractor after mobilization but before beginning of works on site. The contractor will report from then on regarding the status on each of these. The NHAI Site Office will monitor the activities through its own staff or the consultant's Environmental Specialist after it has obtained the Contractor's report with the Consultant's remarks on it during the construction phase. During the operation phase, the supervision as well as reporting responsibilities will lie with the NHAI site office.

11.9 ENVIRONMENTAL MANAGEMENT PLAN

Project specific environmental management plan have been prepared for ensuring the implementation of the proposed measures during construction phase of the project, implementation and supervision responsibilities, sufficient allocation of funds, timeframes for anticipated activities etc. has been dealt with in this document, which will eventually form a part of the Contract documents between the NHAI and the Contractor.

11.10 CONCLUSIONS

Based on the EIA study and surveys conducted for the Project, it can be safely concluded that associated potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the EIA Report. Adequate provisions shall be made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs as suggested in environmental budget. The proposed project shall improve Road efficiency and bring economic growth, social inclusion and environmental sustainability.