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सविस्तर प्रकल्प अहवाल

प्रस्तुत पर्यावरणीय प्रभाव तपासणी

अहवालाचो कार्यकारी सारांश



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एन्.एच्.डी.पी.पावंडो - III (पॅकेज क्र.एन्.एन्./डी.एल्.2/10) खाला, गोंय राज्यांतल्या एन्.एच. - 4ए च्या पणजी - गोंय/कर्नाटक हद्द विभागाच्या 4-6 पदरीकरण प्रकल्पाखातीर संभवनीयताय अभ्यास आनी सविस्तर प्रकल्प अहवालाखातीरची सल्लागार - सेवा.

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Executive Summary

Environmental Impact Assessment report presents the Environmental Assessment of the proposed improvements in Goa/Karnataka Border - Panaji section of NH 4A and the mitigation measures to minimise and mitigate the impacts identified. Guidelines formulated by Ministry of Environment and Forests (MoEF) were referred for preparing EIA. Apart from these various Indian Acts and regulations were reviewed such as, Water (Prevention and Control of Pollution) Act, 1974 (amended in 1978 and 1988), Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986 and EIA Notification 1994. Following are the major tasks conducted as a part of EIA Study:

- Preliminary reconnaissance survey to identify environmentally sensitive issues relating to the project and base-line conditions;
- Assessment of potential impacts of the project on these base-line conditions;
- Formulation of mitigation measures to offset the identified adverse impacts;
- Formulation of Environment Management Plan (EMP) incorporating appropriate mitigation, and Monitoring Plan for monitoring and management measures; (EMP will assess the issues caused by severance and on other features deemed “sensitive” along the alignment)
- Estimation of cost for EMP and Monitoring Plan.

E1. Need for the Environmental Impact Assessment (EIA) study

For every aspect of road projects, there are associated some significant positive and negative impacts on nearby communities and the natural environment. Some of the major environmental impacts of this project include loss of productive agricultural lands, water bodies, green cover, change in land use, accelerated urbanization etc. Keeping in view of the above impacts, environmental assessment was carried out for the present assignment in order to identify the base-line environmental profile of the project's area of influence due to the proposed widening of the road and also to prepare Environmental Management Plan in order to mitigate the identified adverse impact on the environmental components during the design, construction and operation stages of the project road.

E2. Baseline Environmental Profile of the Project Area

In order to assess the impacts of the proposed improvements to the project road, field visits were undertaken by the Consultants to learn the Environmental Profile of the project influence area. This involved field inspections at all the sensitive locations, collection of secondary information for all the environmental components, conduct field monitoring to establish baseline for environmental parameters, and consultations were held with the officials, NGOs and local public. The baseline environmental status was assessed on the primary data collected during February-March, 2006 by field environmental monitoring and the secondary data collected from and discussions with various government agencies and institutions.

(i) Ambient Air: The baseline scenario was established based on the micrometeorology and Ambient Air Quality (AAQ) monitoring carried out during the month of February -

March, 2006. The ambient temperature during the monitoring season varied between 23.7°C and 27.8°C. Similarly, the predominant wind direction was from south-west direction. Along the project alignment six locations were identified for the ambient air monitoring, Mollem, Dharbandoda, Tisk, Ponda, Khorlim and Chimbel. SPM (Suspended Particulate Matter) in these locations ranged from 129 to 266 µg/m³, RSPM ranged from 46 to 88 µg/m³, Nox (Nitrogen Oxide) ranged from 22.6 to 32.5 µg/m³, SO_x (Sulphur Oxide) ranged from 12.4 to 19.6 µg/m³. Higher SPM level of 266 µg/m³ and 218 µg/m³ is noticed at Dharbandoda and Mollem respectively. However, all the concentrations in ambient air were within the recommended NAAQ (National Ambient Air Quality) limits.

(ii) Water Environment: The proposed alignment passes through hilly, rolling and plain terrain and crosses various cross drainage nullahs and rivers namely Khandepar, Bansatari and Mandovi backwaters (all tributaries of Mandovi River). While the water for irrigation is sourced from the existing river systems, the requirement for the domestic needs is partly sourced from ground water sources. In order to assess the quality of the water sources in the study area, water samples were collected from 5 surface water and 5 ground water sources along the stretch and analysed. In general, the surface water was more polluted than the ground water. The groundwater showed acceptable water quality when compared to the Indian Standard Specifications for Drinking water IS: 10500.

(iii) Noise: The ambient noise levels were monitored at 10 locations along this stretch. The locations were located to represent agricultural areas, institutional, residential and commercial areas. It is observed that at most of the locations the day-time noise level and the nighttime noise level exceeded the permissible limit of 55 dB (A) and 45 dB (A) specified by CPCB for residential areas. The sources of noise are mainly attributed to vehicular traffic and local domestic/commercial activities.

(iv) Land: The landuse along the proposed road in the Goa Border - Panaji section is generally forest land, agricultural with interspersed settlements. The soil in the study area is predominantly of alluvial and clayey loam type. The pH of the soil ranged from 3.3 to 5.0, indicating that the soil is extremely acidic in nature.

(v) Terrestrial Ecology: From km 84+000 to km 95+100, the alignment passes through Western Ghats region, termed as a 'biodiversity hotspot' and harbours tropical and semi-tropical evergreen forests. The alignment in this section passes along Mollem National Park on RHS and Bhagwan Mahavir Wild Life Sanctuary on LHS. As reported by Goa Forest Department a large number of protected and endangered floral and faunal species are found in this protected area. The alignment also passes near mangrove areas at Banastari and Chimbel.

E3. Environmental Impacts and Mitigation Measures

The proposed project passes along environmental sensitive forest areas and protected forests of Mollem National Park and Bhagwan Mahavir Wild Life Sanctuary. The major environmental impact is expected due to widening in the reserve forest areas where large number of tree cutting is envisaged causing major impact on the sensitive areas affecting the fauna of the region. Also earth cutting and filling operations in hilly sections along the alignment might

result in destabilizing the earth structure. Compensatory plantation, control on using polluting machinery in reserve forest areas, engineering measures for landslide zones and sufficient provision of cross drainage points is suggested in the EMP. Based on the results from the field monitoring surveys, the impacts on the surrounding environment during construction and operational stages were identified and compared with the permissible limits of the CPCB. Mitigation measures are suggested to eliminate or minimise the adverse environmental impacts. The EMP also suggests a monitoring plan during construction and operation stage of the project road. The impacts on the surrounding environment during construction and operational stages along with the various mitigation measures suggested for minimizing the adverse environmental impacts are summarized in **Table E.1**.

Table E.1. Environmental Impacts and Mitigation Plan

Activity	Environmental Impact	Mitigation Measures	Responsibility
PRE-CONSTRUCTION PHASE			
Land Acquisition, clearing encroachments and R&R	Loss of buildings	The land acquisition would be in accordance with the RAP and entitlement framework. All R&R activities are to be completed before starting the construction.	NGOs, PIU
Relocation of Utilities and common property resources (CPR)	Damage to utilities, Inconvenience to Public	All the utilities and common property resources being impacted due to the project will have to be relocated with prior approval of the concerned Departments/Agencies before construction starts.	Contractor, PIU
Debris disposal site identification	loss of productive lands or natural habitats	Selection of the disposal sites will be carried out in consultation with the State Pollution Control Board, Revenue Department and Forest Department in order to ensure that no natural drainage, productive lands or natural habitat is adversely impacted due to disposal. Preferably, debris disposal site has to be identified in barren, infertile land.	Contractor, PIU
Establishment of Stone Crushers, Batching Plants, Hot-mix plants	Air, water, noise and soil pollution	Specifications of Stone crushers, hot mix plants and batching plants to be established for the project should comply with the requirements of the relevant State/Central Pollution control Board legislations.	Contractor
Selection of construction vehicles, machinery and equipments	Air and noise pollution	All the vehicles, machinery and equipments to be engaged for the construction work should be attached with the latest, advanced pollution control measures available in the country and those should conform to the relevant Indian standards.	Contractor, PIU
Materials (Sand, earth and aggregates) sourcing	Loss of productive land, noise and air pollution	Contractor should procure materials from licensed sources. Every detail (Location, ownership, agreement, redevelopment Plan) of the material sourced should be intimated to CSC for periodic inspections so that appropriate measures are implemented at site towards safe operation and minimizing impacts.	Contractor , PIU

Activity	Environmental Impact	Mitigation Measures	Responsibility
Haul roads maintenance	Air and noise pollution	During the inception of the project, Contractor should identify the network of roads (especially the village roads) to be used for haulage of construction materials. Strategy for the maintenance of identified haul road stretches is to be prepared so that regular maintenance is carried out to those stretches by the Contractor for easy plying of construction vehicles as well as the regular local commuters.	Contractor, CSC, PIU
Selection of Borrow areas	Air, water and noise pollution, loss of productive lands	Compliance to all the State norms towards operation and environmental protection of borrow areas is the sole responsibility of the Contractor. CSC will inspect locations intended for operation and mitigation measures will be instructed towards satisfactory redevelopment. Inspection to the borrow areas will be carried out by raising Request for Inspection (RFI) by the Contractor for each of the borrow areas and obtain subsequent approval from CSC.	Contractor and CSC
Selection of Stone Quarries	Air and noise pollution, loss of productive lands	Contractor will identify the stone quarries in consultation with the Mining Department. A comprehensive Quarry Management Plan need to be prepared incorporating Environmental and Safety Management Plan with special emphasis to Quarry redevelopment for approval from CSC.	Contractor
CONSTRUCTION PHASE			
1. Impact on Soil Quality			
Removal of vegetation cover, Excavations of borrow pits	Increased soil erosion, loss of top soil.	Turfing of road embankment slopes, development of compensatory afforestation and Borrow area rehabilitation has to be done as preventive measures for soil erosion. Further Top soil from borrow areas has to be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2 meters with proper covering. This shall be restored for rehabilitation of borrow pits. In borrow pits, the depth of the pit should be regulated so that the sides of the excavation will have a slope not steeper than 1 vertical to 4 horizontal from the edge of the final section of bank The device for checking soil erosion include the formulation of sediment basins, slope drains etc. Such works and maintenance thereof will be deemed as incidental to the earthwork. Cutting of trees will be carried out in phases and compensatory afforestation to start at the earliest with sufficient protection measures.	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
Acquiring of extra RoW and construction of realignments, Use of productive lands for storing, stock yards and workers camp, Borrowing of earth	Loss of productive topsoil	The topsoil from all areas of cutting and areas of storing and stock yards and workers camp have shall be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2 meters with proper covering. The stored topsoil will be spread back to restore the productivity of the exhausted borrow areas. Also the accumulated soil will be utilized for developing median plantation and raising turfs in the embankment slopes. The exhausted borrow areas could be developed into water bodies for local use, practicing fishery. Borrow areas will be opened preferably from barren, infertile lands.	Contractor and CSC
Movement of Heavy Vehicles	Compaction of productive top soil	Construction vehicles, machinery and equipment shall move, or be stationed in pre-identified designated areas only. If operating from temporarily hired land, it will be ensured that the topsoil for agriculture remains preserved & not get compacted.	Contractor and CSC
Spillage of fuel, lubricants and hazardous chemicals	Contamination of soil and negative impact on the growth of the floral vegetation and faunal distribution.	Vehicles and machinery are maintained and refilled in such a fashion that fuel spillage does not contaminate the soil. Fuel storage and refilling sites should be kept away from cross drainage structures and important water bodies. All spills shall be disposed off as desired and the site shall be fully cleaned before handing over. Soil quality monitoring should be conducted as per Environmental Monitoring Plan to ascertain level of contamination.	Contractor and CSC
Disposal of construction wastes	Loss of productive lands	The construction wastes should be dumped in selected pits, developed on infertile land. All applicable waste disposal norms to be followed. Waste land to be preferred for construction debris disposal.	Contractor and CSC
2. Impact on Water Quality			
Surface runoff from the construction site, dumping of construction debris in or nearby water bodies	Increased turbidity of water. Deterioration of Water quality of community water sources.	No labour camps, stone crushers, hot mix plants and other heavy machinery should be located near to water bodies. No discharge from such establishments should follow their path into nearby water bodies. Dumping of debris in or nearby water bodies to be strictly avoided. Waste products must be collected, stored and taken to approved disposal sites as per prevailing disposal norms.	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
	Adverse impact on aquatic ecosystem.	Runoff from the construction site should be passed through silt traps. Pitching, stabilisation of soil and slope protection measures should be taken up to reduce erosion of soils. Water quality monitoring should be conducted as per Environmental Monitoring Plan so that appropriate measures are taken up towards abatement of pollution.	
Spillage of fuels and lubricants, spillage of hazardous chemicals	Deterioration of water quality of community water sources. Adverse impact on aquatic ecosystem.	Appropriate drainage arrangements with catch drains and catch pits designed to safely drain out the hazardous chemicals should be provided. To avoid spillage of fuel and lubricants, the vehicles and equipment shall be properly maintained and repaired. Maintenance to be carried out on impervious platforms with spill collection provisions. Surface run off from vehicle parking, washing and fueling areas and hot mix plant areas has to be passed through oil interception chambers and the oil will be skimmed off manually from the chamber and will be disposed off in approved landfill sites. Water quality monitoring should be conducted as per Environmental Monitoring Plan to detect any contamination or spillage.	Contractor and CSC
Acquisition of water sources like wells, tube-wells & ponds	Loss of drinking water and irrigation water sources.	Any source of water for the community such as ponds, wells, tube-wells etc. lost incidentally shall be replaced immediately.	Contractor and CSC
Construction of bridges across major water bodies	Water shortage in down stream water users.	The construction of bridges across major water bodies has to be done by serving prior notice to the users. Care should be taken to avoid mixing of construction materials with water channel such that it may affect the down stream users or water supply schemes.	Contractor and CSC
Construction of embankments	Blocking of cross drainage and resultant flooding.	Earth, stone or any other construction material should be properly disposed off so that the flow of water in cross drainage channels is not blocked.	Contractor and CSC
Absence of proper sanitation and waste disposal in construction camps	Contamination of water bodies and spreading of water-borne	Construction laborers` camps shall be located away from the habitation and from major water bodies. Adequate sanitary facilities, drainage, washing and toilet facilities with septic tanks and refuse collection and disposal should be provided to the workers. The provision of water supply and toilet facilities should	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
	diseases. Health risk to workers & public	be made as per the stipulated guidelines in the Indian Labour Act. Water quality monitoring should be conducted as per Environmental Monitoring Plan.	
Use of water for construction from community water sources	Scarcity of water to the community	Arrangement for supply and storage of water will be made by the contractor in such a way that the water availability and supply to nearby communities remain unaffected. If a new tube-well is to be bored, proper sanction and approval by Ground Water Department is needed. The wastage of water during the construction should be minimized. In case of tapping water from community sources, consent to be obtained from local Administration for the same.	Contractor and CSC
Construction of impervious bituminous pavement and drains	Reduction in area for ground water recharge	Rain water harvesting pits will be constructed at average distance of 500 m. The pits should be atleast 3 - 5 m above the highest ground water table.	Contractor and PIU
3. Impact on Air Quality			
Gaseous emission from construction vehicles and machinery	Deterioration of ambient air quality and adverse health impacts.	All vehicles, equipment and machinery used for construction should be fitted with latest air pollution control equipments and should be regularly maintained to ensure that the emission levels are as per norms of PCB. Idling of delivery trucks or other equipment should not be permitted during periods of unloading or when they are not in active use. The human settlements should be at least 500 m down windward direction of Hot (asphalt) mix plant. The construction operations during nights, especially in the winter season should be carried out under restricted conditions. Air quality monitoring should be conducted as per Environmental Monitoring Plan to detect any deterioration in air quality due to the construction activities.	Contractor and CSC
Dust generation due to material handling, operation of crushers and hot mix plants, movement of construction vehicles and construction	Dust emissions will have adverse effect on the health of construction workers as well as the public in the	All precautions to reduce the level of dust emissions from the hot mix plants shall be taken. The hot-mix plants should be sited at least 500 m from the nearest habitation and from major water bodies. They should be fitted with dust extraction units. Water should be sprayed on the earth mixing sites, asphalt mixing site and service roads. During sub grade construction, sprinkling of water should be carried out at least	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
activities	surrounding communities. Dust settled on leaves may reduce growth rate of the plants.	twice a day on a regular basis during the entire construction period especially in the winter and summer seasons. Special attention should be given in the sections where the alignment passes through sensitive areas such as schools, hospitals and urban areas. As soon as construction is over the surplus earth should be utilised to fill up low-lying areas. In no case, loose earth should be allowed to pile up along the alignment. Vehicles delivering material should be covered. Air quality monitoring should be conducted as per Environmental Monitoring Plan.	
4. Impact on Noise Levels			
Noise generated from construction vehicles, asphalt plants and equipments	Since the noise generating activities are localised and intermittent, no serious impact on human health is anticipated. Residential areas nearby the construction site may experience increase in night time ambient noise levels.	Construction contract should clearly specify the use of equipment emitting noise of not greater than 90 dB(A) for the eight hour operation shift. The citing of construction yards should be done leaving at least 100 m distance from any residential areas which will allow noise to attenuate. The main noise producing sources such as the concrete mixers, generators, grader etc. should be provided with noise shields around them. The noise shields can be any physical barriers, which is effective in adequate attenuation of noise levels. A 3 m high enclosure made up of brick and mud with internal plastering of a non-reflecting surface will be very effective in this regard. For protection of construction workers, earplugs should be provided to those working very close to the noise generating machinery. At construction sites within 150 m of human settlements, noisy construction should be stopped between 10:00 pm and 8:00 am Noise level monitoring should be conducted as per Environmental Monitoring Plan.	Contractor and CSC
5. Impact on Flora and Fauna			
Removal of trees for widening of existing road and construction of realignments.	The impact on biodiversity will be negligible since most of the trees are of common occurrence.	Small trees shall be transplanted wherever possible to minimise the impacts of loss of trees. Trees should be removed in phases. Areas of tree plantation cleared will be replaced according to Compensatory Afforestation Policy under Forest Conservation Act-1980. The compensatory plantation should be carried out in consultation with the State	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
	Loss of trees will lead to Increase in soil erosion, loss of shade and other benefits of trees, and decline in air quality.	Forest Department. Adequate care of the compensatory plantation should be taken up so as to achieve optimum survival rate. Landscaping should be done with a lag of 3 to 4 months from the start of the work on any section. The section should be deemed to be complete when the landscaping is over. Survival rate of plants must be included in the contract specifications so as to ensure that the compensatory plantation achieves the objective of compensating lost trees. Indigenous and endemic tree species suitable for the area should be planted at the onset of monsoon season. The plants should be provided with adequate protection from animals and proper monitoring should be carried out to ensure their growth.	
Removal of mangroves	Since the area of impact is limited the loss of mangroves would be negligible. Mangroves loss will lead to ecological imbalance around the section	Mangrove restoration plan with afforestation in thrice the area lost will be taken up with State Forest Department with establishment of nursery and re-plantation of mangroves in pre identified areas. Similar species as prevalent should be planted with adequate protection and proper monitoring for their growth.	Contractor and CSC
6. Impact on Protected Areas (Mollem National Park, Bhagwan Mahavir Wildlife Sanctuary and Forest areas)			
Construction of highway / Raw Material handling within protected areas	Impact on soil	Borrow areas should not be located in protected areas. Debris dumping should be completely avoided. No labour camps / material stocking yard should be located within protected area. Construction material, especially hazardous material handling should be done with due care to avoid spillage within protected area limits.	Contractor and CSC

Activity	Environmental Impact	Mitigation Measures	Responsibility
	<p>Impact on air quality</p> <p>Impact on noise levels</p> <p>Impact on tranquility of protected areas due to human influence within protected area.</p>	<p>Minimum construction machineries should be deployed within protected area limits.</p> <p>Mixing of raw materials should be completely avoided within protected areas.</p> <p>Simultaneous working of construction machineries should be avoided in protected areas to have least noise level due to the activities.</p> <p>Least minimum number of machineries should be deployed along the construction site falling within protected areas.</p> <p>Noisy construction should be completely avoided during night time (10.00 pm – 6.00 am)</p> <p>Human activities should be completely restricted to the proposed RoW such that there should not be any ingress in to forest areas for poaching of animals / any other items.</p>	
7. Impact on Health and Safety of Workers			
<p>Poor maintenance of machines and vehicles, poor light conditions at the work place, carelessness and poor management of work</p>	<p>Accident risk to workers from construction activities.</p>	<p>To ensure safe construction environment, lighting devices and safety signal devices shall be installed. Traffic rules and regulations to be strictly followed. Safety of workers undertaking various operations during construction should be ensured by providing them helmets, masks, safety goggles etc.</p> <p>Regular tool talks, mock drills, training programmes to be organized towards educating workers towards adopting safe working methods.</p> <p>The electrical equipment should be checked regularly to avoid risks to workers. At every work place, a readily available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), nursing staff and an attending doctor to be provided.</p>	<p>Contractor and CSC</p>
<p>Unhygienic conditions at work place and camp sites, Non-availability of good drinking water.</p>	<p>Health problems to workers</p>	<p>Adequate drainage, sanitation and waste disposal to be provided at workplaces. First Aid facility to be made available at each work locations. Periodical medical checkup facility to be provided to all the workers.</p> <p>At every workplace, good and sufficient water supply shall be maintained to meet the daily chore of the residing population.</p>	<p>Contractor and CSC</p>

Activity	Environmental Impact	Mitigation Measures	Responsibility
		Measures to be implemented so that waste water is collected in septic tanks/soak pits. No surface stagnation of water will be allowed to avoid vector outburst.	
8. Impact on Cultural Properties and Amenities			
Construction at culturally or archaeologically important locations.	Damage or loss of cultural properties	All necessary and adequate care should be taken to minimise the impact on cultural properties If articles such as fabrics, coins, artifacts, structures or other geographically or archaeologically important materials are discovered, the excavation should be stopped and the Archaeological Department should be intimated.	Contractor and CSC
Roadside landscaping	Improved aesthetics	Avenue plantation to be carried out with foliage, shady trees mixed with flowering trees, shrubs and scented plants as per detailed designs. Rest areas for travelers at specified chainages to be developed with landscaping so as to avail shade.	Contractor and CSC
Improvement of roadside amenities	Improved comfort level of travellers	Restoration and improvement of bus shelters, bus bays and truck stoppage sites to be carried out as per detailed design. Road furniture like footpaths, railings, traffic signs etc. shall be erected as per design.	Contractor and CSC
Enhancement of cultural properties	Harmony, goodwill and coherence amongst communities	Enhancement of all cultural properties and access road shall be completed as per the design	Contractor and CSC
OPERATIONAL PHASE			
Improvement of road geometry and pavement condition	Less chances of accidents.	Proper implementation of traffic rules by the traffic Police. Proper maintenance of traffic signs and implementation of accident care facilities along the road by the project implementation agency.	Contractor, PIU and Police
Improvement of road surface and its maintenance	Reduced dust generation from road. Increased vehicular emissions due to increased traffic.	Proper implementation of vehicular emission control rules by the Motor Vehicles Department. Roadside tree plantation to be restored and maintained as per the compensatory plantation plan. SPM, RSPM, CO, SO ₂ , and NO _x to be monitored as per Environmental Monitoring Plan.	Contractor, PIU and Motor Vehicles Department
Increase in traffic	Increase in the	Development of greenbelt comprising selected species of trees with high canopy	Contractor,

Activity	Environmental Impact	Mitigation Measures	Responsibility
	ambient noise levels, especially during night time along the project road.	along the project road for attenuation of noise. Use of horns should be restricted at sensitive locations like schools and hospitals through the use of appropriate signboards along the road. Use of air horns should be minimised during night. Noise barriers should be provided along the road at sensitive locations such as hospitals, schools, residential areas, courts etc. Noise monitoring should be conducted as per Environmental Monitoring Plan.	PIU and Police
Increase in embankment height and Improvement of flood water drains	Water logging during monsoon will not take place.	The cross drainage system and the flood water drains should be periodically cleared.	Contractor and PIU
Construction of Rain water harvesting pits at an average distance of 500m.	Enhanced ground water recharge.	The rain water harvesting pit opening should be periodically cleaned during operation phase such as to ensure enhanced ground water recharge.	Contractor / NHAI.
Compensatory plantation	Improved biodiversity and aesthetics	The re-plantation scheme, containing Indigenous and endemic tree species suitable for the area, should be strictly implemented.	Contractor and PIU
Mangrove plantation and maintenance	Restoration of mangrove areas	The re-plantation and maintenance scheme at mangrove locations should be strictly followed.	Contractor and PIU
Movement of vehicles with higher speed along protected forest areas	Impact of traffic on wild animals.	Drivers should be warned with proper sign boards for speed restriction within the forest areas especially along the possible animal crossing locations and about the major wildlife habitats near by the highway. Usage of air horns should be completely avoided within protected forest areas both during day and night time. Forest officials should carry out frequent patrolling along the road in the protected areas to avoid exploitation of forest resources / teasing of animals by road commuters.	NHAI / State Forest Department

Activity	Environmental Impact	Mitigation Measures	Responsibility
Spillage of hazardous chemicals due to accidents	Soil and water bodies nearby the accident site may get contaminated. Safety risk to the public nearby the accident area.	The rules as defined in Environmental (Protection) Act, 1986 should be complied For delivery of hazardous substances, three certificates namely permit license, driving license and guarding license issued by Transport Department should be maintained. Vehicles carrying hazardous substances should display mandatory safety signs In case of spillage, it should be reported to relevant department and their instructions should be followed Cleaning of the spills at the accidental site should be carried out as per regulations.	Motor Vehicles Department, Police
Improved safety measures and improved traffic management	The chances of accidents would be reduced	Traffic management plan to be developed, especially in congested locations. Traffic control measures including speed limits to be enforced strictly. RoW should be properly marked and further encroachment of RoW should be strictly prevented. Road side vendors should be restricted to designated areas only.	PIU, Motor Vehicles Department and Police

E4. EMP and Monitoring Plan Cost

Project specific Environmental Management Plan (EMP), stating the various impacts, mitigation measures, is formulated to avoid / minimise anticipated impacts. The responsibility of implementing suggested mitigation measures lies mainly with Contractor and, Project/ Design Consultant. A Monitoring Plan is also proposed to evaluate the efficiency of mitigation measures recommended in the EMP and facilitate management decisions for the project. The cost of implementing mitigation measures works out to Rs. 2892.23 lakhs during construction phase. The operational cost of the same is estimated at Rs. 2.70 lakh per annum for the first three years and Rs. 16.24 lakhs from fourth year onwards. The break up for the cost is presented in **Table E.2**.

Table E.2. Cost Estimates for Environmental Management Plan

Item	Assumptions	Cost in Rs.
A. Total Cost During Construction Phase		
1. Provision of Sewage and sanitation facilities for the construction camps, including maintenance for 3 years	Lump Sum	2,000,000.00
2. Provision of Water Supply Facilities for the construction camps	Lump Sum	160,000.00
3. Compensatory avenue plantation of thrice the number of trees to be cut and their fencing and maintenance for three years	Rs.900/Tree x 10311 Trees x 3	27,839,700.00
4. Shrub plantation in the median for the entire corridor @500 saplings/km and their fencing and maintenance for 3 years	Rs. 500/Shrub x 500 Shrubs x 64.95 km	16,237,500.00
5. Environmental Monitoring		
5.1. Air Quality Monitoring at sensitive locations at an average distance of 10 km	Rs. 2000/location x 6 locations x 3 seasons x 3 years	108,000.00
5.2. Water Quality Monitoring at major water bodies at an average distance of 25 km	Rs. 2500/location x 3 locations x 2 seasons x 3 years	45,000.00
5.3. Noise Monitoring at sensitive locations at an average distance of 10 km	Rs. 500/location x 6 locations x 3 seasons x 3 years	27,000.00
5.4. Soil Quality Monitoring at sensitive locations at an average distance of 10 km	Rs. 2000/location x 6 locations x 2 seasons x 3 years	72,000.00
5.5. Mobilisation Charges	Rs. 75000/season x 3 seasons x 3 years	675,000.00
6. Dust Suppression at Site	Rs. 800/trip x 10 trips/day x 365 days x 3 years	8,760,000.00
7. Severances & Others (including training, workshops, awareness campaigning etc.)	Lump sum	500,000.00
8. Rainwater Harvesting Structures	Rs 28,500/structure x 2 structure/km x 64.95 km	3,702,150.00
9. Compensatory afforestation		

9.1. Cost for plantation In 4 times the area of Sanctuary and National Park area to be diverted.	Rs 162746.83/Ha* 24.0923 ha*4	15683781.81
9.2. Cost for plantation In equal area of forest area to be diverted.	Rs 162746.83/Ha* 2.6750 ha	435347.7703
10. Net present value of forest land to be diverted for the project		
10.1. NPV Value for Forest Area falling in National Park - 10 times that of NPV of the area	Rs. 1043000 x10x16.1072 ha	167998096
10.2. NPV Value for Forest Area falling in Wild life Sanctuary - 5 times that of NPV of the area	Rs. 1043000 x5x7.9851ha	41642296.5
10.3. NPV Vale for Other Forest Areas	Rs. 1043000 x 2.6750 ha	2790025
11. Construction of Sedimentation Tanks in construction yard near to 1) Concrete mix plant and 2) Hot mix plant	Rs 50000/unit x 2 units in a construction yard x 2 locations	200,000.00
12. Provision for oil interception chambers in construction yard near to 1) vehicle parking, fueling and washing area and 2) hot mix plant	Rs 10000/unit x 2 units in a construction yard x 2 locations	40,000.00
11. Mangrove nursery establishment, maintenance, transplantation to site and maintenance upto maturing for thrice the area of mangrove area lost	Rs. 50000/hectare * 2.0484 ha * 3	307,260.00
Total cost during construction phase		289,223,157.08
B. Annual Cost During Operational Phase during First Three Years		
1. Environmental Monitoring		
1.1. Air Pollution Monitoring at sensitive locations at an average distance of 10 km	Rs. 2000/location x 6 locations x 3 seasons	36,000.00
1.2. Noise Monitoring at sensitive locations at an average distance of 10 km	Rs. 500/location x 6 locations x 3 seasons	9,000.00
1.3. Mobilisation Charges	Rs. 75000/season x 3 seasons	225,000.00
Total annual cost during operational phase during first three years		270,000.00
C. Annual Cost During Operational Phase from 4th Year Onwards		
1. Maintenance of Avenue Plantation	Rs.25000/km x 64.95 km	1,623,750.00
Total annual cost during operational phase from 4th year onwards		1,623,750.00

Source: *Analysis*