NATIONAL HIGHWAYS AUTHORITY OF INDIA

Grand Trunk Road Project

Consolidated Environmental Impact Assessment Report

E432
Volume 2

EXECUTIVE SUMMARY
DRAFT
CALCUTT
January 2001

Lea Associates South Asia Pvt. Ltd.
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FILE COPY
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1. EXECUTIVE SUMMARY

1.1 OVERVIEW

The National Highway-2 (NH-2) connecting Delhi with Calcutta is one of the most important high-density corridors in the country. The 1400km long NH-2, located in the Upper Gangetic Plain in northern India, traverses through the states of Delhi, Uttar Pradesh, Bihar and West Bengal. The NH2 carries (1998) between 12,000 and 33,000 passenger car units (PCUs) daily. A substantial part (48% to 86%) of the traffic is goods traffic. The traffic volume on most of the sections is expected to grow up to 40,000 PCUs between 2005-2010AD and in some sections would be as high as 1,25,000 PCUs by 2015 AD. The existing highway is a two-lane carriageway, with traffic bottlenecks, various highway deficiencies as well as lack of proper facilities. To cater to the high volume of traffic, there is an urgent need for capacity augmentation of the highway.

Capacity augmentation of the NH-2 is proposed under the Golden Quadrilateral (6900km highway joining Delhi, Mumbai, Chennai and Calcutta) of the National Highway Development Programme (NHDP) of the Gov. As part of the Delhi-Calcutta section of the Golden Quadrilateral, the Delhi-Agra section (210km) at the west end, and Barwa Adda - Calcutta section (278km) at the east end of the NH-2 have already been 4-laned with assistance from the ADB. For the remaining sections, the following project are proposed:

- The Third National Highway Project (TNHP) involving 4-laning of 8 contract packages between Agra and Barwa Adda, with WB financing (477km, under implementation);
- The Grand Trunk Road Project (GTRP) involving 4/6-laning of 7 contract packages between Agra and Barwa Adda (432km), with proposed WB funding;
- Etawah Bypass 4-laning project (14km) to be implemented with NHAI funding; and,
- Allahabad Bypass 4-laning project (85km) to be taken up in 2001AD with proposed WB funding.

In addition, Panagarh-Palsit (60km) and Durgapur Expressway (65km) capacity augmentation and further strengthening projects are planned on the earlier completed section between Barwa Adda and Calcutta. The Durgapur Expressway project will be implemented in a commercial (build-operate-transfer) basis.

All the above projects are scheduled to be completed by the last quarter of 2003AD.

1.2 THE GRAND TRUNK ROAD PROJECT

TNHP and GTRP are both located on the Agra-Barwa Adda section of the NH-2. For project preparation, the Agra-Barwa Adda section was divided into 16 contract packages. The project preparation (including the environmental and social assessment studies), for the entire length of the NH-2 between Agra and Dhanbad, has commenced in 1998. Eight of the 16 contract packages were selected for TNHP, depending on the project preparedness, progress on land acquisition and utility relocation. Of the remaining eight packages, seven are proposed to be taken up under the GTRP.
Table 1.1: Contract Packages of TNHP and GTRP

<table>
<thead>
<tr>
<th>Contract Package</th>
<th>Description</th>
<th>From (chainage)</th>
<th>To (Chainage)</th>
<th>Length (km)</th>
<th>Part of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>I - A</td>
<td>Agra- Shikohabad</td>
<td>198.660</td>
<td>250.500</td>
<td>50.840</td>
<td>GTRP</td>
</tr>
<tr>
<td>I - B</td>
<td>Shikohabad – Etawah Bypass (start)</td>
<td>250.500</td>
<td>307.500</td>
<td>59.020</td>
<td>GTRP</td>
</tr>
<tr>
<td></td>
<td>Etawah bypass</td>
<td>307.500</td>
<td>321.100</td>
<td>13.600</td>
<td>Etawah bypass</td>
</tr>
<tr>
<td>I - C</td>
<td>Etawah bypass (end)- Bhognipur</td>
<td>321.100</td>
<td>393.000</td>
<td>72.825</td>
<td>GTRP</td>
</tr>
<tr>
<td>II - A</td>
<td>Sikandra/Bhognipur – Bhaunti</td>
<td>393.000</td>
<td>470.000</td>
<td>61.600</td>
<td>TNHP</td>
</tr>
<tr>
<td>II - B</td>
<td>Bhaunti – Fatehpur Border</td>
<td>470.000</td>
<td>38.000</td>
<td>51.330</td>
<td>GTRP</td>
</tr>
<tr>
<td>II - C</td>
<td>Fatehpur Border- Khaga</td>
<td>38.000</td>
<td>115.000</td>
<td>77.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>III - A</td>
<td>Khaga- Kokhraj</td>
<td>115.000</td>
<td>158.000</td>
<td>43.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>III - B</td>
<td>Kokhraj – Paharpur Village</td>
<td>158.000</td>
<td>245.000</td>
<td>87.000</td>
<td>Allahabad Bypass</td>
</tr>
<tr>
<td>III - C</td>
<td>Paharpur village –Raja Talab</td>
<td>245.000</td>
<td>317.000</td>
<td>72.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>IV - A</td>
<td>Raja Talab – Mohania</td>
<td>317.000</td>
<td>65.000</td>
<td>76.100</td>
<td>GTRP</td>
</tr>
<tr>
<td>IV - B</td>
<td>Mohania-Sasaram bypass</td>
<td>65.000</td>
<td>110.000</td>
<td>45.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>IV - C</td>
<td>Sasaram bypass</td>
<td>110.000</td>
<td>140.000</td>
<td>31.100</td>
<td>GTRP</td>
</tr>
<tr>
<td>IV - D</td>
<td>Sone River – Aurangabad</td>
<td>140.000</td>
<td>180.000</td>
<td>40.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>V - A</td>
<td>Aurangabad – Ranigan</td>
<td>180.000</td>
<td>240.000</td>
<td>60.000</td>
<td>TNHP</td>
</tr>
<tr>
<td>V - B</td>
<td>Raniganj – Barakatha</td>
<td>240.000</td>
<td>320.000</td>
<td>81.570</td>
<td>GTRP</td>
</tr>
<tr>
<td>V - C</td>
<td>Barakatha– Barwa-Adda (Dhanbad)</td>
<td>320.000</td>
<td>396.750</td>
<td>76.750</td>
<td>TNHP</td>
</tr>
<tr>
<td>Total GTRP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>422.780</td>
</tr>
</tbody>
</table>

Source: NHAI, 2000

This report summarises the EA carried out for the contract packages A, B & C of Package I, B of Package II, A & C of Package IV and B of Package V.

1.2.1 PROPOSED IMPROVEMENTS

The existing project highway (between Agra and Dhanbad) has a two-lane (2 x 3.5m) bituminous carriageway, with paved/unpaved shoulders. It is now proposed to widen this highway by addition of a new 2-lane carriageway with paved shoulders and strengthening the existing carriageway by overlays/rehabilitation/reconstruction (including, in places replacing the existing bituminous pavement by cement concrete rigid pavement). Existing cross-drainage structures on the highway are proposed to be repaired/rehabilitated. New cross-drainage structures would be provided on the new 2-lane carriageway.

In addition to strengthening the existing carriageway, the project would improve the geometric deficiencies including the improvement of the various intersections. The proposed improvement aims at improving the riding quality, improving journey speed and reducing congestion of traffic on the highway. It is proposed to provide service roads, proper drainage, grade-separation, road furniture, utilities and amenities wherever required.

The project highway passes through 4 cities, 19 towns and 253 village settlements. To minimize the adverse impacts on the various settlements and to minimize the land and structure acquisition, short bypasses and realignments have been proposed. In all, a total of 12 short bypasses have been proposed apart from the 20km long bypass at Sasaram have been proposed for a total length of 73.16km (i.e., 17% of the total length of the project highway).
1.3 ENVIRONMENTAL IMPACT ASSESSMENT PROCESS IN THE PROJECT

The environmental impact assessment for each of the project packages employed a reiterative approach in which environmental issues have been identified in successive levels of detail and specificity at each step in the process. Incorporation of feedback from the various stakeholders as well as "public hearings" and analyzing were essential features of this methodology.

The following were the stages of environmental impact assessment of the project:

- Preliminary Environmental and Social Screening (PESS): A PESS study of each of the Consultancy packages had been carried out as part of the feasibility study, to categorise the corridor into sections based on environmental and social sensitivity, and to screen significant environmental and social issues that needed to be addressed.

- Documentation of Baseline Conditions: The potentially affected area (PIA) was defined and the baseline conditions were documented.

- Assessment of Potential Impacts: Potential significant impacts were identified on the basis of an analytical review of baseline data.

- Integration of Environmental Assessments in the Design Process: The design and decision-making process integrated environmental and resettlement and rehabilitation issues and prompted the early identification of appropriate actions, as shifts in alignments based on awareness of the locations of cultural resources.

- Assessment of Alternatives: Alternatives were continuously assessed throughout the process. A more formal assessment was also undertaken as a part of the environmental assessment process, including the assessment of the "No Action" Alternative.

- Mitigation & Enhancement Measures: Positive actions to not only avoid adverse impacts, but to capitalize on opportunities to correct environmental degradation or improve environmental conditions were determined. The mitigation measures would be directed towards the restoration of the dynamic balance of nature.

- Community Consultation: Consultations with concerned officials, agencies and potentially affected persons continued through the process and will continue as the project proceeds. The issues raised by the communities and the various stakeholders were incorporated, as far as possible, in the design and construction/operation plan of the project highway.

- Environmental Management Plans (EMP): An EMP for each of the contract packages detailing the measures to be taken for the implementation of the various measures proposed. This includes the monitoring plan and gives details of the resources budgeted and the implementation arrangements.

Being taken up in continuation of the TNHP, the same EA methodology has been adopted for the GTRP as well. However, As a learning from the experiences from, in addition to the EA process as adopted for TNHP, a further in-depth study of the following issues has been carried out as part of the GTRP:

- Addressal of direct and induced impacts on the various environmental components;
- Specific designs for the mitigation measures provided;
- Site specific enhancement designs for elements along the corridor, including cultural properties, water bodies, bus stops etc;
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- Redevelopment of borrow areas;
- Prediction of impacts due to the project on air / noise, and provision of mitigation measures;
- Traffic management plans during construction; and
- Monitoring mechanisms and indicators during construction and operation periods.

1.3.1 WORLD BANK EA REQUIREMENTS
This project is a Category A project, because of its cumulative magnitude of environmental and social impacts, and therefore requires full environmental analysis and assessment. The emphasis of the World Bank is an integration of the mitigation measures into the project design and mainstreaming environment in all stages of planning, implementation and operation.

It may also be pertinent to note that while the World Bank requirements now have been modified and new projects must conform to the OP 4.01, this project was identified and the individual environmental assessments were prepared within the framework of OD 4.01 only.

1.4 IMPLEMENTATION ARRANGEMENTS
The Grand Trunk Road Project has been initiated and is being carried out by the NHAI, established as an authority, as a part of the Ministry of Road Transport and Highways (MRTH), Government of India. The NHAI, through the Chief General Manager (WB) will be responsible for the effective implementation of the project activities. A General Manager (WB) will assist the CGM and the Project Directors of the various project packages. Separate NHAI units, Project Implementation Unit (PIU) with a Project Director as its head have been established for each of these packages. The PIUs would play a key role in implementation including the overall control of construction activities and implementation of contracts. International consultants have been appointed for carrying out the feasibility study and preparation of the Detailed Project Reports and designs for the project packages. To ensure the effective implementation of the project, Construction Supervision Consultants procured under ICBs will support the NHAI.

To assess, advise and monitor the environmental performance of the various projects being planned, designed and implemented by the NHAI, an Environmental Unit has been established at the Corporate Office of the NHAI. The Environmental Unit is headed by the General Manager (Environment), and is assisted by two managers - one each for the Environmental and Resettlement aspects. The Environmental Unit is responsible for the co-ordination of the environmental and social issues of the various project packages and PIUs, and work in close interaction with the environmental managers at the various PIUs.

1.5 ENVIRONMENTAL IMPACT ASSESSMENT

1.5.1 METEOROLOGICAL PARAMETERS

CLIMATE

Baseline Scenario
The stretches of the Project Highway (NH-2) taken up as part of the Grand Trunk Road Project are located in the humid sub-tropical region with marked monsoon effects. The weather generally remains dry and hot, while in winters cold weather prevails. The summer season is...
usually dry with high temperatures ranging between 30° to 47°C. During rainy seasons the temperatures vary between 24° to 36°C. Temperature during winter varies between 10° to 26°C. January is coldest month with temperatures dipping to less than 5°C.

The project area receives most of its rainfall from the south-western Monsoon and enjoys a moderate annual rainfall of about 980mm of which over 90% occur during the four rainy months. The region, on an average records a relative humidity of 64%.

Potential Impacts

By and large, though no change in the macro-climatic setting is envisaged, the microclimate is likely to be temporarily modified by vegetation removal, decrease in surface water bodies and the addition of increased pavement surface. Negative impacts on microclimate may be long term, but can be reversible if appropriate mitigation measures are adopted. The negative impacts would be mainly restricted to the areas adjacent to the road.

Mitigation Measures

The project has proposed replacement of trees felled in the ratio of 1:2, i.e., 2 new trees to be planted for every tree cut. In addition, as part of the engineering design, additional measures such as turfing of embankments and landscaping of the entire project road have been proposed which shall minimise the adverse impacts on microclimate. Also, transplantation of trees (shifting trees from existing location to new locations outside the CoI) is another measure to minimize cutting of healthy grown trees, which provide shade and other benefits and help control the microclimate along the roadside.

Enhancement Measures

A detailed landscape plan has been prepared for the project road, which proposed plantation of suitable trees based on location in the available space in the RoW. This shall more than restore the microclimate along the road to its baseline situation.

1.5.2 NATURAL AND BIOPHYSICAL ENVIRONMENT

1.5.3 AIR QUALITY

Baseline Scenario

The monitoring of the ambient air quality (AAQ) for the various land uses along the project corridor was carried out along the first row of potential receptors (approximately at 15m from the edge of existing pavement), so as to establish the baseline concentrations.

A comparison of the baseline levels with the respective standards for the various locations, reveal that the gaseous pollutants (CO, NOx and SOx) are all within the permissible limits. The SPM levels exceed the permissible limits of 200 mg/m³, at major urban locations, and significant higher levels have been observed in urban areas such as Agra in Package I and Rama devi Crossing, Kanpur in Package II. The Carbon monoxide (a significant pollutant from the exhaust of petrol driven vehicles) levels, is observed to be below 114.5 mg/m³ (or 0.1 ppm), at a distance of 15 m from the edge of the pavement. Air borne - Pb, a major pollutant from petrol driven vehicles is also well below the detectable limits of 1.0 mg/m³ limit for highest concentration in rural and residential areas, as most of the vehicles on the corridor are diesel
driven, but for the urban locations. Even at these locations, air borne lead is of not great significance and the concentrations are well within the permissible limits.

**Air Quality in the Taj Trapezium**: Part of the Package IA and IB from km 199.6 to km 255 passes through the Taj Trapezium\(^1\). A total area of 10,400 square kilometers covering parts of Rajasthan and Uttar Pradesh in the shape of a Trapezium (Refer Plate 5-3) has been identified as the zone of influence for the protection of Taj Mahal from pollution sources especially Air Pollution.

The maximum-recorded SPM value (241.8 \(\mu g/m^3\)) in the Taj Trapezium was at Firozabad, which is far above the permissible SPM value of 100 \(\mu g/m^3\) for sensitive areas. All the locations monitored in the Taj Trapezium exceeded the permissible limit for SPM. The SPM value in the reserved forest area was found to be 148 \(\mu g/m^3\). This indicated the loss of quality in the forest environs and introduction of anthropogenic activities in the forest. The CO, NOx and Pb levels were within the permissible standard limits at all locations. The RPM values exceed at all but one location and were in the range of 75-141 \(\mu g/m^3\). The \(SO_2\) levels were found to be in the range of 6 \(\mu g/m^3\) - 13.7\(\mu g/m^3\) well within the permissible standard for \(SO_2\) in sensitive areas.

**Potential Impacts**

During the construction stage, increase in the concentration of air pollutants is likely during the construction stage, especially from the hot-mix plants and the batching plants. As the project involves limited bituminous construction, this impact has been minimized. During the construction period, temporary impacts include generation of odour from construction activities as well as from the construction camps.  
- Dust is likely to be generated due to the various construction activities including:
- Site clearance and use of heavy vehicles and machinery etc.
- Procurement and transport of raw materials and quarries to construction sites
- Stone crushing operations in the crushers
- Handling and storage of aggregates in the asphalt plants
- Concrete batching plants
- In the asphalt plants due to mixing of aggregates with bitumen.

To assess the likely impacts on the Ambient Air Quality in the operation stage due to the project, the prediction of pollutant concentrations along the corridor has been carried out using CALINE-4. Highway, predicted traffic volumes likely and the surrounding land uses. The predicted pollution levels have been plotted to a distance of 100m on either side of the corridor and the pollution concentration contours for each of the pollutants worked out.

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\(^1\) The region is home for over forty Protected monuments, three of which are listed as World Heritage Site (WHS) namely the Taj Mahal, Agra fort and Fatepur Sikri. The major centers covered under the Trapezium are:
- Mathura and Vrindavan towards its northwest corner;
- Firozabad at its south east corner;
- Kaldeo National Park, Bharatpur in the west direction; and
- Agra as the epicentre of the area.
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From the predicted concentrations, it is observed that maximum concentration of pollutants occur with in a distance of 25 to 45m from the centerline of the proposed alignment. The results indicate that the SPM concentrations exceed the permissible limits. Package IA is located within the Taj Trapezium, within which the standards for sensitive areas apply. The concentrations of the gaseous pollutants and SPM in the Taj Trapezium shall exceed the permissible limits by 2014.

Along the other project packages, the concentrations are exceeded in the major urban areas and intersections. The predicted AAQ concentrations also exceed the permissible limits within the Gautam Buddha Wildlife Sanctuary in Package VB.

Mitigation Measures

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. Bypassing settlements and consequent elimination of the slow moving local traffic, like Sasaram in IV C, will ensure smooth flow of traffic and reduce emission of pollutants. The following table shows the mitigation measures adopted during the design stage to minimize air pollution and improve air quality.

<table>
<thead>
<tr>
<th>Package</th>
<th>Chainage (Km.)</th>
<th>Location</th>
<th>Suggested Avoidance/ Mitigation measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>200.635</td>
<td>Agra Intersection</td>
<td>Flyover is proposed</td>
</tr>
<tr>
<td></td>
<td>206.000</td>
<td>Forest area</td>
<td>The stretch realigned to the south</td>
</tr>
<tr>
<td></td>
<td>216.300</td>
<td>Elamapur</td>
<td>Area is bypassed</td>
</tr>
<tr>
<td></td>
<td>223.000</td>
<td>Raja Ka Tal</td>
<td>Bypass on North</td>
</tr>
<tr>
<td></td>
<td>236.000-243.000</td>
<td>Firozabad</td>
<td>Camageway is elevated</td>
</tr>
<tr>
<td>IB</td>
<td>217.000-223.000</td>
<td>Siraiganj</td>
<td>Area being bypassed</td>
</tr>
<tr>
<td></td>
<td>272.000</td>
<td>Intersection in Siraiganj</td>
<td>Bypass proposed</td>
</tr>
<tr>
<td></td>
<td>260.000-282.000</td>
<td>Ukhrend Village</td>
<td>Bypass proposed</td>
</tr>
<tr>
<td></td>
<td>301.800</td>
<td>Jaswant Nagar</td>
<td>Segregation of local from through traffic</td>
</tr>
<tr>
<td>IC</td>
<td>325.000-326.500</td>
<td>Sarai Ekdil</td>
<td>The congested stretch realigned</td>
</tr>
<tr>
<td></td>
<td>337.000-340.000</td>
<td>Bakewar</td>
<td>The area is to be bypassed</td>
</tr>
<tr>
<td></td>
<td>353.000-357.500</td>
<td>Sarai Ajitmal</td>
<td>The village is bypassed on the southern side of the existing highway</td>
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<tr>
<td>IIIB</td>
<td>474.000-476.000</td>
<td>Industrial area near LPG bottling plant</td>
<td>Segregation of the through traffic through provision of truck layby</td>
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<tr>
<td></td>
<td>493.000</td>
<td>Ramadevi crossing</td>
<td>Realignment from Km 92.050 on the existing bypass to Km 92.800</td>
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<tr>
<td></td>
<td>15.000-17.500</td>
<td>Rooma Village</td>
<td>Being bypassed</td>
</tr>
<tr>
<td>IVA</td>
<td>39.000-41.500</td>
<td>Saidraza</td>
<td>This stretch is bypassed</td>
</tr>
<tr>
<td></td>
<td>45.200-46.900</td>
<td>Naubatpur</td>
<td>This stretch is bypassed</td>
</tr>
<tr>
<td>IV C</td>
<td></td>
<td>Intersection of Gaya Road with GT Road</td>
<td>The area is bypassed</td>
</tr>
<tr>
<td></td>
<td>110.000-131.000</td>
<td>Sasaram Urban area – A congested Urban area</td>
<td>The urban area is bypassed</td>
</tr>
<tr>
<td></td>
<td>119.000-127.000</td>
<td>Crushers outside Sasaram</td>
<td>Area is being bypassed</td>
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<td>VB</td>
<td>251.300</td>
<td>Hot mix plant within the sanctuary</td>
<td>Control of emissions from the hot mix plant</td>
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<td></td>
<td>281.800</td>
<td>Intersection of NH-2 with NH-33 &amp; Barhi Urban area</td>
<td>The area is bypassed</td>
</tr>
<tr>
<td></td>
<td>305.000-307.000</td>
<td>Barkaiha</td>
<td>Segregation of local traffic</td>
</tr>
</tbody>
</table>

The asphalt plants, crushers and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants will be taken up. The hot mix plant will be fitted with dust extraction units. To control emissions from the stack, an adequate cyclone/scrubber will need to be provided in the event of the emissions exceeding the SPCB norms.

A vehicle management schedule prepared by the contractor and approved by the Supervision consultant shall be adhered to. Water will be sprayed in the lime/cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork,
water will be sprayed on regularly to prevent dust. To avoid dust emissions likely to result from transporting crushed rock and earth, the vehicles delivering construction material will be covered.

The concentrations of ambient air quality parameters obtained using Caline 4 indicate that along most packages, the concentrations of the pollutants of concern will exceed the limits for residential areas, at least within 25 m of the centerline of the road. However, pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, can be planted in the first row. Broad-leaf species can 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.

**Air Quality in the Taj Trapezium:** The following pollution resistant species are recommended for plantation along the project road traversing through the Taj Trapezium: Terminalia arjuna (Arjun), Cassio fistula (Amaltas), Ficus religiosa (Peepal), Ficus bengalensis (Banyan), Syzygium cumini (Jamun), Tamarindus indica (Imli), Polyalthia longifolia (Asok), Terminalia tomentosa (Saja), Azadirachta indica (Neem), Bombax ceiba (Seemul), Alsetonea scholaris (Chatim), Spathodea campanulata (Spathodea), Terminalia catappa (Kathbadam), Pterocarpus acerifolius (Redwood) and Putranjiba roxburghii (Putranjiba).

**1.5.4 WATER – HYDROLOGY AND DRAINAGE**

**Water Resources**

**Baseline scenario**

**Drainage Channels:** The project corridor falls and traverses across the Ganga drainage system which comprises of the Ganga as the main stream and its tributaries viz. Yamuna, Ramganga, Gomati, Sarda, Rapti, Gandak, Kosi and Sone. The Ganga, Yamuna and Sone, are all part of the Himalayan Drainage system, having their source in glaciers and hence perennial.

**Ground Water:** With in the Ganga Yamuna Duab, ground water is found in the confined and unconfined zones and the water table varies between 2 - 9m. Ground water level in Package II varies from 4m to 20m in June. Ground water level at Raja Talab (km315) was observed to be 4m in winter and 5.5m in summer. The ground water levels in Package IV (km. 317-65-km 110-140) are mostly at depths of 6m to 8m except around Sasaram, where it is at a depth of 20 m.

**Water Bodies:** There are 53 stagnant water resources including ponds located along the NH-2. Most of them are located in or alongside the RoW and are being used by the local community for washing /bathing purposes. These surface water bodies can be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project. A few of these waterbodies are historically and culturally important. Significant among these are Budiya Ka Tal (km216), Raja Ka Tal (km234), ponds at km246, km343, km350, km362 (Package I), Baghai Pokhara at km 42.000 (Package IV) and the Tilaiya reservoir in Package V B.

**Water Quality:** The baseline water quality monitoring carried out at the 17 locations, as part of the consolidation/verification exercise indicates that concentrations of major physico-chemical parameters along the entire NH-2 covered under the Grand Trunk Road Project is within limits set by the Bureau of Indian Standards for drinking water and surface water quality for bathing.
Microbiological characteristics of water are, however, of concern. All surface water bodies show bacterial presence and most of the samples also show faecal coliform presence thereby indicating contamination by human discharges. This makes water from these sources unsuitable for use without treatment. The groundwater quality is satisfactory and all parameters of interest are within the specified limits.

Potential Impacts

The following impacts are likely to occur along these flowing water resources where new cross-drainage structures are to be constructed

Modifications to flow: Due to the massive engineering works the river's waterway will have to be diverted. The waterway will be constricted, increasing velocity downstream of the bridge. This will mean increased sediment load with the flow. The additional two lanes, which is essentially a paved impervious surface, will cause increased surface runoff along the roadsides to the tune of 3444453 cu.m

Impairment to Water Quality: Increased load of light, difficult to settle, sediment will make the water more turbid. Large, heavy sediment, particularly with slow moving water (like in the Sone), may smother algae and eventually alter the nature of the sub-stratum. The contamination of the ground water resources due to the project are 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 as hand pumps etc., and along the entire length of the corridor especially around urban areas and productive lands.

Water Quality: The short-term increase in runoff during the construction stage may also occur due to the removal of trees, vegetative cover and compaction of the surrounding soil. 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. The spoil heaps around the construction sites are also prone to erosion and contribute to the increased sediment load in the near-by water bodies. The major parameter of concern would be the sediment load from the spoils.

The major pollutants of concern are suspended solids, oil and grease, lead and other heavy metals. 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 lead 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.

Water Logging: The primary cause of water logging at certain stretches along the road is due to previous borrowing operations. During rains, these borrow areas get filled up and remains water logged due to inadequate local drainage. Places like Firozabad and Shikohabad (in Package I), Jagdishsarai (km 28), Chandauli (km 31) in Package IV A are level with or below the surrounding terrain and are prone to get inundated.
Depletion of Water Source: The quantum of water to be used for road construction will be around 1300 m$^3$/d (of which 75-80% will be used for road marking, 20% for drinking and domestic purposes, 1% for dust suppression, and the remainder for other uses) for the entire project, peaking to about 1500 m$^3$/d. The huge demand shall be met through availability of ample supply both from surface sources (3 major rivers: Yamuna, Ganga and Sone) and ground water (with water table varying from 4-8 m).

The project requirement of 1500 m$^3$/d works out to only 0.07% of the total flow in the major rivers. Thus, even by this comparison, it is apparent that the water requirement for the project will not be a major impact on the environment.

Loss of Water bodies/Ground Water sources: Many water bodies shall be partially filled up due to the proposed widening. A total of 190 wells and 548 hand pumps shall be relocated due to the project. Relocation of these water resources have been worked out in consultation with the community, and all community resources impacted due to the project will be relocated at suitable locations. The typical designs and details of the relocation of the hand pumps and the protection measures for the various categories of wells need to be worked out to minimise the impacts during both the construction and operation stages of the project.

Flood Hazard: All the rivers of the Himalayan Drainage system are north south flowing perennial rivers, causing frequent flooding and shift in course as they reach the lower reaches of the catchment area. Man-made inundation problems occur mostly at the built-up stretches due to rising of shoulders/kerbs by the local residents. Some parts of Agra, Kanpur, and Varanasi in UP are prone to flooding whereas in Bihar the stretch where the road intercepts the Tilaiya Tank is prone to flooding.

Mitigation Measures

Protection of Banks and edges: Road run-off is let off into natural drains of adequate capacity from ditches at the end of formation to prevent destabilization of the embankment. Release of road run-off directly from the ditches can erode edges of the water body into which the run-off is let off. To ensure that run-off does not damage the water body it enters, cascading for scour protection has been proposed.

Cascade for Scour Protection: Letting off run-off directly could cause the scouring of the bed of the drain. Cascade arrangement allows dissipation of the energy of the run-off and traps some sediment within the spaces between adjacent bricks. Brick trays, each 1 brick thick, are used to break the momentum of the flowing water and the brick weirs allow uniform flow into the natural drain. The last of the weirs (made out of 1:4:8 P.C.C.) is so constructed that the final tray lies 500 mm below the water surface.

Silt Fencing: Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geotextile (MIRAFI 140N or equal) with extremely small size supported by a wire-mesh mounted on a panel made up of angle frame. The frame will be installed at the edge of the water body along which construction is in progress. The wire-mesh will provide structural stability and the 25x25x3 mm angle section will act as posts for the silt fencing.
Sedimentation Chamber: Excessive sediment loads are expected from road run off as it is discharged into the environment. To remove the sediment, a small sedimentation chamber at the end of ditches before discharging into the watercourse has been proposed. The entry into the chamber will be through a bar screen which can take care of large floating debris, if it finds its way into the run-off.

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 vehicle parking areas of the contractors' camps. On the other hand, during the operation stage, the discharge can be from anywhere along the entire road stretch. Thus, the source is diffused and virtually unrestricted. In either case, the technique for the separation of oil and water is the same: gravity separation. Enough detention time is provided to run-off to allow oil to float on to the surface.

Siting of Activities: The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body. In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided. The slopes of embankments leading to water bodies will be modified and rechannelised to prevent entry of contaminants into the water body.

Cross Drainage Structures: 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.

Raising the road level has been proposed to avoid future inundation in the inundated stretches along the corridor. Along the settlements, as part of the engineering design, provision has been made for drainage along the sides of road. These drains will be properly maintained by the NHAI as part of its corridor management plan. To ensure efficient cross-drainage and to prevent water logging along the sides, adequate size and number of cross-drainage structures have been provided.

Recharging pit for roadside drain in urban areas: In urban areas too, the run-off in roadside ditches needs to be disposed of. Provision has been made for urban recharging pits along stretches where the road passes through large urban areas. These vertical drains serve two purposes: they dispose of unwanted run-off and encourage recharging of underground water resources. The drains have gravel columns and geosynthetic filter fabric at about 2 m depth from the top of the bores and to prevent the transportation of contaminants into the aquifer. The drains will be provided at the beginning and the end of each settlement and near the outfall to a natural drain if the highway crosses one inside a settlement.

It should be pointed out that all the devices being suggested require periodic maintenance and cleaning to operate at their design capacity.

Relocation of Water Supply Sources: As part of the design, all sources of community water supply will be replaced as near to the existing source as practicable, after consultation with the local community. A major benefit of the arrangements worked out for the GTRP is the prevention of stagnant pools of water around wells and hand pumps which not only are a likely breeding ground for vectors but also cause of dirt, especially in the silty soils through which the NH-2 passes. The various arrangements worked out to prevent the adverse impact on the existing well structures or to enhance the existing ones are described below.
**Enhancement Measures**

**Hand pumps to be relocated:** All replaced hand pumps will be provided with a proper apron and drainage arrangement for the safe disposal of water. For hand pumps located within the RoW or very close to it, it will include a flat apron and drain into the roadside ditch. The length of the drain has been limited to 3 m and the width of the P.C.C. bed inside the drain will depend on the width of the discharging area.

**Defining space for Improved usage:** Based on the existing use of the well or tube well, the use level and activities supported by the water source have been evaluated. For example, if washing clothes is one of the activities being conducted at a particular well, the enhancement shall provide a washing platform as part of the enhancement. Similarly, small seating space has been proposed at specific locations to enhance the social use of the spot. Additional paved space provided shall facilitate better use of the space by the community.

**Plantation:** The community wells, tube wells etc are not only significant community gathering spots but also provide water to weary travellers. At locations where it is feasible to plant trees, the project has proposed the plantation of shade and fruit trees. Tree bases (chabutaras) built around these trees shall not only provide seating space but also enrich the quality of the spaces for the local and the road user.

Road construction activities can lead to increased run-off both during the construction and operation stages. During the construction stage, the removal of vegetation and compaction of soil can lead to increased run-off. Similarly, the area of open ground lost to the pavement increases the run-off from the open ground.

**Enhancement Measure**

**Water Bodies to be Enhanced:** Enhancements to water bodies include strengthening of embankments of the water bodies, improving water quality and catchment characteristics, creating informal spaces around the water body, parking facilities and other site specific enhancements. Based on the significance and use values of the water bodies along the project road, water bodies have been identified for enhancement along the project road. Following Table 1-3 lists the package wise water bodies identified for enhancement.

<table>
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<th>S.No</th>
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1.5.5
1.5.6 LAND

Physiography

Baseline Scenario
The project road traverses through the great Indo-Gangetic Plains (altitude below 300m) confined by the northern mountains on the east, north, and west and peninsular plateaux on the south. The Ganga plain is divided into the Ganga-Yamuna Doab, the Rohilkhand Plain to the north of the Ganga-Yamuna doab, Avadh plain covering eastern half of Uttar Pradesh and Bihar plain further to the east.

Packages I and II of the highway between passes between the plains of the River Ganga and Yamuna. Package III falls in the lower Ganga-Yamuna Doab, while Package IV is located in the Trans-Ganga Region, both of which are also flat plains. Package IV is part of the flat flood plain of the Ganga and Sone rivers. The highway in Package V-A falls in the Hazaribagh plateau, which is a gentle rolling terrain. The last stretch of the project highway (Package V-C) falls in the Chhota Nagpur Plateau.

Potential Impact
The proposed project would have no measurable impact on the topography of the project region. No significant cutting has been designed in this project, and impact on topography has been absolutely minimized. Moreover the waste material from the existing pavement is proposed to be used in the filling to raise the proposed road level.

Geology and Seismicity

Baseline Scenario
The region through which the project highway passes is structurally a part of the Ganga plain, which has been formed by the in filling of the Indo-Ganga trough during the Pleistocene period. It has an alluvial cover of 400-1500mm deep.

Potential Impact
The entire stretch of the project highway traverses through seismic zone III as defined by the Indian Standard (IS) 1893-1994 seismic zoning classification system, i.e., a zone of relative stability. The project does not have any impact on the geological or seismic stability of the area.

Soils

Baseline Scenario
The soils of the great ganga plains are alluvial soils formed through the process of deposition of sand, silt, clay etc in layers and are formed along river courses and low lying tracts. The soils along the project packages are capable of producing high yields, largely due to the rich soil nutrients deposited by the Ganga and Yamuna Rivers and their tributaries.

Majority of the soils sampled along the NH-2 for the Grand Trunk Road project are neutral to slightly alkaline. Texturally, they are classified as silty or silty loams and hence soil expansion is not a concern.
Executive Summary: Environmental Impact Assessment
Grand Trunk Road Project

Soil Quality:

Baseline Scenario

Soil quality assessment was conducted especially for evaluating heavy metal contamination with respect to Lead (Pb), Chromium (Cr) and Cadmium (Cd). Lead (Pb), usually the heavy metal of concern from automobile exhaust was recorded below 0.001% (or 1 ppm) - the limit set by the U.S. EPA for concentration in soil.

Potential Impact

Loss of Productive Soil: The entire corridor lies in a fertile agricultural belt, the adjoining land use is predominantly agricultural. This loss of topsoil, especially in the irrigated areas, can be a long-term residual impact. Though this is a genuine concern, the benefits of realignment in terms of increased flows, safety and improvement in ambient air quality in settlements avoided will compensate at least in part for the loss to the economy as a whole.

Soil erosion: As the profile of the road is being raised (about 1m above the mean maximum flood levels), erosion of the pavement embankment, if the side slopes are not properly designed, will be an issue on most part of the project road. Erosion potential exists mostly at high embankment areas of the road, especially at bridge-approaches and at certain isolated patches on Package V (km233-243). Once the trees are removed during pre construction stage and the ground cover is cleared on the expanding side (mostly limited to one side of the existing carriageway) for the widening, the problem due to erosion could increase.

Soil Quality: Contamination of soil can take place in sites wherein construction vehicles are parked and serviced due to leakage or spillage of fuel and lubricants. Pollution of soil can also occur due to leakage or spillage of asphalt and bitumen and around hot-mix plants, refuse and solid waste generated from labour camps or due to accidental vehicles spills. As the proposed project enables smooth traffic-flow and removes traffic bottlenecks, it is expected that the impact on soil quality, overall, will be beneficial.

Mitigation Measures

Minimising Land Acquisition: Land acquisition has been minimised in the proposed project, especially along the stretches with predominant agricultural land utilisation. Though the impact on the productive soil is unavoidable, adequate measures have been worked out for minimising the loss of soil, as by the storing of topsoil to be laid back after the construction period etc.

Reinforced Earth Walls: The project would improve the erosion situation by developing all the road embankments at a slope of 1:2. All high embankments along the bridges and ROBs are provided with reinforced earth walls. Gravity return walls will be provided on all bridges to encase the whole embankment, replacing the existing cantilever return walls, and therefore reducing the probability of erosion.

Turfing of Slopes: 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 recommendations for the treatment of embankment slopes for erosion control, IRC: 56-1974.
**Executive Summary: Environmental Impact Assessment**

**Grand Trunk Road Project**

**Brick Pitching on Slopes:** If slope protection is to be provided for slopes gentler than 1:2, brick pitching will be adopted. The advantage of this arrangement is that it allows the growth of vegetation in the empty spaces created on the face of the slope, while providing better retention. A kerbstone and gabion box arrangement will be provided at the bottom, in case the slope is abutting a water body.

**Stone Pitching:** If the slope is steeper than 1:2, stone pitching will be carried out. Stones will be fixed on slopes by gentle hammering. A P.C.C. anchor will be provided which will prevent sliding of stones on slope. The gaps between adjacent stones allow grass to grow which will hold the soil firmly together.

**Gabion Protection:** Gabion structures will be provided in case the slope ends into a water body. These structures are made up of wire mesh baskets and boulders. The utility of this structure lies in void ratio of its boulders and strength of the mesh to keep them in place. This structure also provides the opportunity for natural soil to get infiltrated and fill up the voids. The voids in the structure retain water for longer time thus assisting vegetation to grow. This structure will be used on edges of ponds, lakes or water bodies where slope protection is required.

**Quarries and Crushers**

**Baseline Scenario**

Existing quarries that are already in operation with the required environmental clearances have been recommended for this project, and no new quarries have been proposed. In the absence of suitable quarries and quarry materials in the vicinity of the project highway stretch between Agra and Kanpur (package I and II), it has been proposed that the required quantity of aggregate can be obtained from Jhansi and Kabrai. Both these locations have numerous quarries, already operational and are major sources of construction material. Quarry sites for Package II and I have been identified at seven locations. Along Package IV, stone quarries have been identified at four locations with lead varying from 1.3km to 17 km. Two moorum quarries have also been identified for the package IV. For Package V, 4 quarry sites have been identified with haul distances varying between 27km to 49km.

**Potential Impact**

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. 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.

As no new Quarry needs to be opened for this project (majority of the material being generated from cut operations within the site itself), therefore, no new impacts are likely to arise due to quarrying operations.

**Impact due to Crushers within the Gautam Buddha Wild Life Sanctuary:** The baseline survey reported hot mix plants and crushers in full operation within the buffer area of the Wild Life Sanctuary. No impact during the operation stage is likely, as all illegal quarrying operations shall be stopped within the forest area.
Mitigation Measures

To ensure that quarrying operations do not have an indiscriminate impact on the environment, the material shall be procured only from licensed quarries and which have proper quarry redevelopment plans in place, to be adapted once the quarrying operations are over.

Borrow Areas

Baseline Scenario

As the profile of the road is being raised (about 1m above the mean maximum flood levels), significant borrowing of earth is required for the embankment fill material, and for the construction of the pavement. A total of 195,93,500 cu.m of earth is required for the project. The soils to be used, as sub-grade, select sub-grade and shoulder materials need to be hauled from designated borrow areas.

A total of 118 borrow pits have been located along the vicinity of NH2. The above identified borrow areas can be categorized into the 3 following:

- Barren Areas (or areas which are not cultivable)
- Areas where the owners are willing to create ponds, or fishponds, and
- Agricultural areas where the existing level of ground is higher than the surrounding and the owners want these parcels of land to be lowered to facilitate irrigation.

Borrowing in the Wild Life Sanctuary: As the baseline reports, some private borrow pits have been identified in the Gautam Buddha Wild Life sanctuary. These activities are contributing to habitat fragmentation and discontinuity of the wildlife corridors within the sanctuary. The project needs to ensure that quarrying and borrowing operations are not carried out in the sanctuary, nor should the project encourage or facilitate road construction through use of the crushing units and borrow areas located in the buffer area of the sanctuary. In fact, the project needs to initiate the task of rehabilitating these activities outside the buffer area of the sanctuary.

Potential Impacts

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. 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.

However, 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 protection measures need to be worked out for the minimizing of such impacts during the haulage of borrow materials.

Mitigation Measures

The borrow areas selection and recommendations for borrow areas for use in the GTRP have been based on environmental as well as civil engineering considerations. In packages IV A&C and package VB, the local people themselves have suggested to borrow off their land either to level off their high agricultural land or develop or deepen their ponds for pisciculture.
Non-Cultivable lands: Borrowing of earth will be carried out to a depth of 1.0 m. The borrowing of earth shall not be done continuously; the slope of the edges shall be maintained at not more than 1:4. Ridges of not less than 8m shall be left at intervals not exceeding 300 m, small drains shall be cut through the ridges, if necessary, to facilitate drainage.

Productive lands: Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands or at the contractor has to obtain the prior permission of the SC. At such locations, the depth of borrow pits shall not exceed 45 cm and if may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

Elevated lands: At locations where private owners desire their fields to be levelled, the borrowing shall be done to a depth of 1 m or up to the level of surrounding fields.

Fish Ponds: At locations where the private owners (or in some cases, the community) desire to develop lands (mostly low-lying areas) for pisciculture purposes and for use as fishponds.

Borrow Areas near Settlements: Borrow pits 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.

Enhancement Measures

Redevelopment of Borrow Areas: 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 Supervision Consultant. The borrow pits will be redeveloped by filling and providing 150 mm thick layer of preserved top-soil; by creating a pond for fisheries, etc; or by leveling an elevated, raised earth mound and covering it with 150mm thick preserved top-soil. Replantation of trees along the edges of borrow areas will be carried out.

Use of Fly Ash as Fill Material

Baseline Scenario

There are seven thermal power plants in the states of UP and Bihar, within a distance of 100 km from the corridor (Obra, Harduaganj, Panki, Auraiya, Rihand in Uttar Pradesh and Patratu, Barauni, Muzaffarpur in Bihar). Disposal of fly ash at these various plant locations is a significant issue. One of the large-scale uses identified for fly ash is its utilisation as fill material in road embankments. Different forms of fly ash, such as pond ash, bottom ash, etc have found application as construction material in roads, either as compacted material or as stabilised material, the most common stabilising additives being lime and cement.

It is noteworthy that the performance of all these embankments has been excellent, with no settlements or other signs of distress. Pavements on these embankments have also shown better performance than those on compacted soil fills. This can be attributed to the higher shear strength and deformation modulus of compacted fly ash, compared to that of compacted soil.

Potential Impact

Although fly ash is an excellent fill material, it has adverse health impacts as well. Therefore, extreme care should be taken during handling and transportation of this material. Fly ash being a very fine material gets air borne easily and causes dust nuisance.
Although fly ash is likely to create adverse impacts during pre construction and construction. No adverse impact from Fly ash is envisaged during the operation phase, as it will remain within the embankment in a compacted form and topped by layer of soil. Further, adequate turfing shall prevent any release of fly ash in the environment.

**Mitigation Measures**

Fly ash shall be transported to site in gunny bags and the vehicles should be covered with tarpaulin etc to minimize fly ash dust being generated. The surface of the fly ash stockpile shall be covered with tarpaulins or a thin layer of soil or other granular material not subject to dusting. Traffic movements shall be restricted to those areas which are kept moist, to prevent tyres of passing vehicles dispersing ash into the air. Traffic movements should be restricted to those areas which are kept moist, to prevent tyres of passing vehicles dispersing ash into the air.

1.5.7 **NOISE LEVELS**

**Baseline Scenario**

Barring a few exceptions, the nighttime noise levels were lower than the corresponding daytime measures. A variation of as much as 15 dB (A) to as little as none was observed at the monitoring locations between the day and nighttime noise levels. The monitoring shows package IA and IIB has the highest noise levels. The junction near the road connecting Kanpur at km485 (Naubasta crossing) recorded the highest noise levels at one location. But, the rest of the corridor had much lower noise levels. The contribution of other activities due to proximity to the urban area of Kanpur is also evident from a difference of as much as 15 dBA between the day time and night noise levels. It is worth noting that even the L90 (night) levels recorded at Naubasta crossing are higher than the noise levels allowed in residential areas during day time. At all locations, the L90 (night) levels are close to the allowable noise levels during daytime for residential areas. Overall the noise levels ranged between 50 dBA and 88 dBA.

**Noise in the Gautam Buddha WildLife Sanctuary:** Noise levels along the package V B have a special significance since it passes through Gautam Buddha Wildlife Sanctuary between km 242 and 260. Very high noise levels (up to 83 dB(A)) are predicted for Chainage 252 to 260 km.

**Potential Impacts**

Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include the excavation for foundations and grading of the site and the construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during construction stage. However, these increased noise levels will prevail only for a short duration during the pre construction and construction stage.

Noise is a major area of concern, especially since a number of sensitive receptors (schools and colleges, hospitals) have been identified to be quite close to the road all along the GTRP.

**Mitigation Measures**

- ** Enforcement Measures:** Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less that 90dB(A). If required, machinery
producing high noise as concrete mixers, generators etc, shall be provided with noise shields.

- Workers to wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8 hour shift.
- Construction sites shall not be located 300 m from settlement areas. No hot mix, batching and aggregate crushing plants shall be located within 200m of sensitive land uses as schools, hospitals etc.

**Noise Barriers:** The shielding of the noise from the highway has resulted in design of barriers for the attenuation for the entire length of the settlements. Either the sound waves can be controlled near the source or the receptor can be shielded. Since safety of road using vehicles is of paramount importance, a specific clear distance needs to be maintained from the pavement. Hence, the only viable option is to provide a shield around the receptor.

The noise attenuation has been worked out by the adoption of the following types of noise barriers

- Physical barriers in the form of walls, screens etc.
- Structural modifications at the receptor locations, in the form of provision of double-glazing etc.
- Rearrangement of the sensitive locations, through changes in the internal planning where possible
- Earthen berms between the highway and the receptor and,
- Vegetative barriers in the form of thick screen of vegetation etc.

Noise barriers have been designed and proposed at sensitive locations schools, and hospitals.

The following table lists the package wise locations the no of noise barriers proposed

**Table 1.4 Noise Barriers proposed along the Project road**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>No of noise Barriers Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>IC</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>IIB</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>IVA</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>IVC</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>VB</td>
<td>-</td>
</tr>
</tbody>
</table>

**1.5.8 FLORA**

**Roadside plantations**

**Baseline Scenario**

The total number of trees existing on the RoW (or within 30m on either side of the existing road centre line) is 48416 (21,977 in Package I, 6972 in Package II, 16384 in Package IV and 3083 in Package V).
Potential Impacts

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 trees will reduce comfort levels for slow moving traffic and pedestrians.

The felling of these roadside trees may lead to temporary increase in erosion (erosion will be controlled once construction occur at the area of trees cut). Marginal impact would also arise with respect to air quality and ambient noise, as trees attenuate air pollutants and noise at varying degrees. The following table lists the trees, which shall be felled in the project.

<table>
<thead>
<tr>
<th>Package</th>
<th>Number of trees to be felled</th>
</tr>
</thead>
<tbody>
<tr>
<td>I A</td>
<td>7,900</td>
</tr>
<tr>
<td>I B</td>
<td>6,455</td>
</tr>
<tr>
<td>I C</td>
<td>7,622</td>
</tr>
<tr>
<td>II B</td>
<td>6,972</td>
</tr>
<tr>
<td>IV A</td>
<td>15,200</td>
</tr>
<tr>
<td>IV C</td>
<td>887</td>
</tr>
<tr>
<td>V B</td>
<td>3,083</td>
</tr>
<tr>
<td>Total</td>
<td>46,119</td>
</tr>
</tbody>
</table>

Mitigation Measures

Tree felling has been minimised and a large number of the trees (46 to 61% among different packages) were saved by design modification.

Tree Transplantation: Tree transplantation is a keynote of this project to save healthy and significant trees, which would otherwise be felled due to the proposed four laning. Following Table gives the no of trees, which shall be transplanted in the project. The following table lists the no of trees to be transplanted package wise.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>No of Trees to be Transplanted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>592</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>475</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>1,726</td>
</tr>
<tr>
<td>4</td>
<td>II B</td>
<td>nil</td>
</tr>
<tr>
<td>5</td>
<td>IV A</td>
<td>458</td>
</tr>
<tr>
<td>6</td>
<td>IV C</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>V B</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>818</td>
</tr>
</tbody>
</table>

Enhancement Measures

Road Landscape Plan: The road landscape has been developed envisaging a holistic approach to the entire stretch. A concept has been evolved so as to maintain visual characteristics and uniformity in terms of landscape along the stretch. To achieve this, the entire stretch of the project corridor has been divided into homogenous landscape sections based on similarity in terms of soil conditions, climate (temperature and rainfall) and topography.

On the basis of these geo-climatic and local conditions, the GTRP stretch has been divided into 3 major homogenous zones with 13 sub-divisions presented in the following table. These
sections were further divided into 48 sub-sections based on the adjacent land-use of rural or urban stretches. The landscape plan includes preparation of a detailed section wise and land use wise plan.

Enhancement of Junctions: As parts of the road landscape plan all the major and minor road junctions are proposed to be enhanced. Typical enhancement drawings have been prepared for:
- Cross roads
- T Junctions
- Y Junctions
- And Traffic Islands

The following table highlights the no of major and minor junctions identified for enhancement.

**Table 1.7 Junctions to be enhanced n the Project Road**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>Major Junctions</th>
<th>Minor Junctions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>IC</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>IIB</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>IVA</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>IVC</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>VB</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Enhancement of Incidental Spaces: As the new two-lane pavement to be added to the existing road has been proposed either on the north or south side many incidental or irregular spaces have been created along the NH2 especially at curves, at start and end of bypasses etc. The project has identified some of these spaces and prepared landscape and enhancement plans for these spaces to enhance the visual quality of these spaces along the project road.

**Table 1.8: Incidental spaces identified for enhancement**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Package</th>
<th>No of Incidental spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1A</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1B</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>IVC</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>V-B</td>
<td>6</td>
</tr>
</tbody>
</table>

Protected Forest / Reserved forest areas

Due to intense agricultural activities in the region, natural forests have long been removed except in some parts in Bihar. However, plantations of orchards and groves of Mango, Guava, and Banana and Mahua are there in some of the stretches. The following table lists the forest areas through which the proposed alignment passes.

**Table 1.9: Reserved/Protected Forests along the Project Road**

<table>
<thead>
<tr>
<th>Package</th>
<th>Chainage</th>
<th>Forest/Sanctuary</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>204-206</td>
<td>Reserve Forest</td>
<td>The corridor cuts across the Reserved forest</td>
</tr>
<tr>
<td>IC</td>
<td>380</td>
<td>National Chambal Sanctuary</td>
<td>5km from the project corridor near to Aurnya</td>
</tr>
<tr>
<td>IVC</td>
<td>Sasaram Bypass</td>
<td>Kaimur Hills</td>
<td>The proposed alignment cuts across the Reserved forest</td>
</tr>
<tr>
<td>VB</td>
<td>242-260</td>
<td>Gautam Budha Sanctuary</td>
<td>The corridor cuts across the Sanctuary</td>
</tr>
</tbody>
</table>
The Agra Reserved Forest

Baseline Scenario

**Between Km 204 to km206 of Package IA cuts across the Agra Reserved Forest. This is a degraded area and no wildlife has been reported apart from monkeys.**

This problem is exacerbated by the lack of infrastructure for the collection and disposal of domestic solid waste in Agra city. Since there is no policing on the NH-2, there is rampant disposal within this stretch.

This reserve forest is used as garbage dumping site (at km204.1 to km204.5). Moreover, slaughterhouse waste is also dumped along the road in a private plot at km 242.150 on north of the road. Similarly, in Package IIB in Kanpur, garbage was observed dumped on either sides of the road.

**Potential Impact**

The 2 km stretch between km 204 and 206 in Agra is being used as a dumping ground for the wastes from the city. Though the alignment has been routed to minimise forestland acquisition, the acquisition of 0.5 ha of forestland has been unavoidable. The acquisition of forestland is being taken up in accordance to the Forest (Conservation) Act. As the forest is already degraded with city garbage being dumped within the forest and illegal felling of trees, no further adverse impacts to the forest is anticipated. As part of the project, necessary corrective measures have been worked out to stop garbage dumping within the forest area.

**Mitigation Measures**

To prevent any further dumping of the municipal waste within the RoW that has been proposed or along the adjoining forestland, mitigation designs have been worked out of the construction of a barrier to prevent garbage-dumping vehicles to empty their contents from the highway.

Near 251 km Chainage approximately 100m south of the existing NH-2, which acts as the sink for the run-off in the area. It lies on a ridge and increasing its depth will provide the increased capacity needed for tiding over the hot summer months.

The Kaimur Hills Reserved forest

Baseline Scenario

The forests along the proposed alignment of the Sasaram bypass near km 311 are part of the Kaimur hills forest. These have been reduced from dry deciduous to shrub land by the presence of humans and a road leading to the temple of the locally popular goddess Tarachandi. The shops that line the approach to the temple complex have been the source of...
human influence. In addition, the hill on the southern side of Sasaram, the large settlement being bypassed is being cut away by quarrying, very little of which is legal, for rock. The labourers, who do the drilling and cutting are housed in camps near the settlement of Tarachandi in the forest, close to the proposed alignment. The total stretch of 200 or so meters, which is theoretically under forests, appears little different from the settlements that dot highways around the country.

Potential Impact

Improved access through the forest will mean that the illegal quarries will have better roads to bring in new equipment and bring out the material for sale. The proposed road may actually be built with material from these quarries. The project documents will specify that the contractor shall use material only from licensed quarries to avert the use of such environmentally degrading operations. More stringent measures from Bihar State Pollution Control Board would be far more effective in actually improving the situation on the ground than the proposal by the project to avoid use of unauthorized quarries.

Mitigation Measures

The Environment Management Plan has proposed in addition to compensatory afforestation in the area measures such as regular policing and patrolling by the NHAI authorities to prevent unwarranted intrusion in forest areas.

The Gautam Buddha Wild Life Sanctuary

Baseline Scenario

The highway passes through the buffer area of the sanctuary and has been operational for the last 400 years. The sanctuary was originally the property of Maharaja of Tekari till 1948, after which, it was converted to the Protected Forest category vide the Forest Act, 1772. Subsequently, owing to growing anxieties to save the Tiger Population of the country, the sanctuary, which is also habitat for many tigers, was declared as sanctuary in 1976 under the Wildlife Protection act, 1972. As per the State Wild Life Sanctuary map, 400m on either side of the highway has been demarcated as the buffer zone.

Potential Impact

The major threat to the flora in the sanctuary area comes from deforestation for fuel, overgrazing by cattle owned by people living within the sanctuary area, militant-illegal traders nexus and fire rather than from the road construction activity itself. The road construction activity itself will not have a further impact on the already degrades status of the sanctuary. However, the project needs to ensure that allied activities such as location of construction camps, setting up of stockyard, hot mix plants etc are not carried out in the sanctuary.

As the four laning within the sanctuary is proposed to be concentric and no land is to be acquired for the road construction, therefore, it can be safely concluded that no adverse impact to the flora of the sanctuary is envisaged.

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2 The area under the highway is not, and has never been considered a part of the forest area. Due to existence of the road, areas on either side are treated as buffer areas.
Unless appropriate measures are taken to curb access into the sanctuary the issues such as illegal tree felling, man made forest fires, and other anthropogenic activities shall prevail and contribute to the degradation of the natural forest.

Mitigation Measures

**Strip Plantation:** The GTRP envisages the plantation of Sal trees in strips 25 m wide at locations identified by the Forest Department. In addition to these strip plantations, 2000 saplings within the sanctuary area shall be planted as part of the project.

1.5.9 **FAUNA**

**Baseline Scenario**
Domesticated animals constitute the major proportion of faunal density in the area surrounding the project highway. No endangered or rare species has been reported in the area. The baseline study included identification of faunal species native to the study area especially with reference to the RoW and adjoining areas.

**National Chambal Sanctuary:**

**Baseline Scenario:**
A national crocodile (gavial) sanctuary has been declared in January 1979 to include about 500km length of the River Chambal covering portions in states of U.P., Rajasthan, and Madhya Pradesh. Fishing has been totally banned in this sanctuary and forest staff has been posted for enforcement of Protection of Wild Life. The boundary of the sanctuary is about 5 km from Auniya (Package I).

**Potential Impact**
As the sanctuary is located more than 5 kms from the project road no impact

**Gautam Buddha Wild Life Sanctuary:**

**Baseline Scenario**
Domesticated animals dominate fauna species all along the project road except in the Gautam Buddha Wildlife Sanctuary. Aquatic birds are relatively very less in the project area and no endangered species of avian fauna has been recorded in the influence zone of the proposed project.

The presence of endangered fauna, especially the tiger, in the area was a major driving force in the declaration of the sanctuary. The other important species of fauna include the wolf, the leopard, hyena, jackal, spotted deer, sambhar, barking deer, Chinkara and Nilgai. In addition, the langur and Rufous-tailed hare have also been recorded. The elephant herds from Palamau forest migrate to the sanctuary between December and June. Other species recorded in the area are Sloth bear, Bengal fox, Leopard cat, Civets, Mongoose, Giant squirrel, Bats, Shrews etc. A number of bird species have been recorded within the sanctuary. It has 20 species of reptiles including lizards, python and snakes like Russel's viper.
Potential Impact

The envisaged impacts during operation stage are disturbance to local fauna and cattle of the surrounding areas due to noise generated by vehicles. In addition, there is also likelihood of accidental deaths of cattle crossing the road. At no of locations near rural areas cattle were observed crossing the road. Due to improved road geometric design and capacity the speeds shall increase increasing the possibility of accidents with animals grazing nearby the road.

Mitigation Measures

General measures such as prevention of hunting have been recommended and enforcement of regular patrolling during construction and operation stage (as part of corridor management plan during operation stage) has been proposed. The following measures to prevent any impacts on / disruption to fauna within the sanctuary have been provided within the Gautam Buddha Wildlife Sanctuary:

Check Dams: The sanctuary management plan envisages the construction of Check dams along rivers Haraia (km 242.95), Chenari (km 246.8), Mohane (248.2), Chordaha (249.85), Dhanua (251.75). The construction of these check dams shall improve the water situation within the sanctuary. NHAI shall bear 25% of the costs if the construction of these checkdams is completed before 2003 AD (Envisaged target for completion of GTRP).

Wildlife Crossings: Two slab culverts will be improved to create 6m wide underpasses for animals' at km 254.473 and km256.811

Waterholes: In addition, the EMP suggests the creation of two new ponds at sites identified by the District Forest Officer, not necessarily near the alignment of NH-2.

1.5.10 CULTURAL ENVIRONMENT / PROPERTIES

Archaeological/Protected Monuments and other Cultural properties

Baseline Scenario

The project highway traverses through a number of settlements and is often dotted with religious and cultural properties most of which though not of archaeological significance are nevertheless, significant to the community.

Many important cultural and historical settlements lie along the highway. Of significant mention are the cities of Agra, Varanasi Allahabad, Sarnath and Gaya etc. In addition the road is dotted with places of archaeological interest with history as old as the road itself. The following Table lists the archaeological monuments and significant cultural/ historical locations that exist in the study area of the proposed project.

<table>
<thead>
<tr>
<th>Package</th>
<th>Chainage</th>
<th>Place</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td></td>
<td>Budiya Ka Tal</td>
<td>a notified archaeological structure located in a water body(Protected Monument)</td>
</tr>
<tr>
<td>IVC</td>
<td>117</td>
<td>Tomb of Sher Shah Suri</td>
<td>Situated at about 1km from the project highway at Sasaram.(Protected Monument)</td>
</tr>
</tbody>
</table>
Potential Impacts

Of all the protected monuments only Budiya ka taal is located on the edge of RoW of the Project road. There is no adverse physical impact on the protected monument. All other monuments are located outside the direct impact zone of the project road. The Tomb of Sher Shah Suri is about 1 km from the project road. In addition, due to proposal of the Sasaram bypass the monument shall remain unaffected by the increased traffic volume, as all the through traffic shall be diverted from the town.

No negative adverse impact is envisaged on any archaeological and protected monument.

The Taj Trapezium

Baseline Scenario

The Taj Trapezium warrants significant mention in the project. The region houses for over 40 protected monuments, three of which are listed as World Heritage Site (WHS) namely the Taj Mahal, Agra fort and Fatepur Sikri and a fourth World Heritage site, the bird sanctuary at Bharatpur National Park. Akbar's tomb in Sikandra and Itmad-ud-Daula's tomb have been proposed for World Heritage site designation. In addition, there are more than 40 protected monuments within the trapezium.

The major centers covered under the Trapezium are Mathura and Vrindavan towards its northwest corner; Firozabad at its south east corner; Keoladeo National Park, Bharatpur in the west direction; and Agra as the epicentre of the area. Firozabad, which is on the project road, lies in the southeast corner of the Taj Trapezium.

Potential Impacts

The Taj Mahal is more than 15 km from the project road although 55 kms of the project road lies in the Taj Trapezium zone. As the proposed project involves improvement of road geometrics and quality of the pavement the air quality impacts shall be improved during the operation stage as compared to the air quality which would have been in case the road were not fourlaned.

Mitigation Measures

Although no impact is envisaged all along the project road in the Taj Trapezium pollution resistant trees (especially resistant to SO2) shall be planted to absorb sulphur emission from the project road. The project has also included acquisition of 10m strip of land on either sides of the road in Package I for tree plantation to counter the impacts of air pollution.

Shrines and Sacred Structures

Baseline Scenario

These structures, though are not of any significance at the regional level, do have a significant importance to the local communities. Most of these structures have come up within and adjacent to the existing. The following table summarises cultural properties that have been identified along the project highway.
Table 1.11: Shrines and other sacred structures within Right of Way

<table>
<thead>
<tr>
<th>Package</th>
<th>Temples</th>
<th>Mosque</th>
<th>Gurudwara</th>
<th>Shrine</th>
<th>Church</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>36</td>
<td>5</td>
<td>0</td>
<td>16</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>IB</td>
<td>28</td>
<td>2</td>
<td>0</td>
<td>12</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>IC</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>IIB</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>IVA</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>IVC</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VB</td>
<td>26</td>
<td>7</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td>14</td>
<td>1</td>
<td>41</td>
<td>2</td>
<td>210</td>
</tr>
</tbody>
</table>

Source: EIA Consultants and LASA Field Survey

Potential Impacts

Shrines and Sacred Structures will be subjected to varying degree of impact depending upon their placement in the RoW. Structures, which are close to the proposed CW, are likely to need relocation. One of the adverse impacts of the road rehabilitation project on the cultural property located along the road edge is increased risk of damage to the property due to likely vehicular collision during the operation stage.

Table 1.12 Shrines and Sacred Structures Affected by the Project

<table>
<thead>
<tr>
<th>Resource</th>
<th>Package</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I A</td>
<td>I B</td>
</tr>
<tr>
<td>Temple/Mosque/Church</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Shrines</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>Graves</td>
<td>25</td>
<td>16</td>
</tr>
</tbody>
</table>

Source: Individual EIA Reports, Packages I, II, IV and V, GTRP and LASA Field Survey, October 2000

Mitigation Measures

Various mitigation measures have been adopted to minimize the impacts on cultural properties within the RoW.

**Retaining walls**: have been proposed at locations where the cultural property has been found to be located within the proposed embankment.

**Diversion of Ditch**: has been resorted to where the property in question has been found to be located in the proposed road ditch. In these cases either the ditch shall be taken around the property or a pipe culvert has been proposed to ensure continuity of the ditch below the location of the cultural property.

**Safety**: Measures such as defining the use boundaries of the cultural property, putting up railings or hazard markers towards the road side are some of the measures to increase safety of users of these places.

**Relocation**: Relocation of cultural properties has been resorted to only as a last option. The relocation shall be in full conformity with the wishes of the community and cost of relocation shall be borne by the project. The new place of establishment of the property shall be identified through the community consultation process.
 Enhancement Measures
Along the project road a total of 107 shrines and sacred structures have been identified for enhancement. These properties have been found to be significant to the community during the course of the baseline survey.

Improving, defining, and redefining access and the precincts: 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 has been adopted for ground treatment. Effort has been made to create interesting ground surfaces by using different paving patterns and materials as can be seen in the sketch. The intention is to enrich the roadside places.

Creating seating spaces: Areas have been developed especially around/adjacent to cultural properties where there is easy availability of space and drinking water. The utility of these restspaces increase when created in conjunction with cultural properties.

Plantation: Trees not only enrich the visual quality of a space but also act as functional buffer screens to counter pollution, define areas and provide shade. Plantation of trees has been a prime enhancement as well as mitigation measure in the project. Tree bases have been proposed around existing as well as proposed shade trees to form informal seating spaces, which are evidently preferred to the formal seating spaces.

The following table highlights the package wise nos of cultural properties to be enhanced.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>Temple</th>
<th>Shrines</th>
<th>Mosques/Darga</th>
<th>Gurudwara</th>
<th>Religious Centre/Ashram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IC</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>IIIB</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>IVA</td>
<td>31</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>IVC</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VC</td>
<td>16</td>
<td>3</td>
<td>14</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

1.5.11 OTHER AMENITIES

Baseline Scenario

There are number of amenities and utility services located along the highway like schools, Dhaba, hospitals, etc. Of these, schools and hospitals are important community facilities. A large number of schools are located within close proximity of the highway.

There are number of amenities and utility services located along the highway like schools, Dhaba, hospitals, Petrol Pumps, Bus Stops etc. The location of these amenities along the National Highway is an issue of concern as the haphazard siting of these amenities is contributing to congestion of the highway.
Potential Impacts

Table 1.14: Amenities and Community Resources Affected by the Project

<table>
<thead>
<tr>
<th>Resource</th>
<th>Package</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IA</td>
<td>IB</td>
</tr>
<tr>
<td>School/College</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Hospitals/ PHCs</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Office Building</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: EIA Reports, Package I to V, Grand Trunk Road Project.

Enhancement Measures

Bus Stops: The baseline survey identified location along the project road which are being used formally or informally as bus stops. These locations have been reviewed and locations for construction of new bus stop structures have been finalized. A total of 182 bus stops have been propose along the project road. The following Table 1.15 lists the no of bus stops proposed along the project road.

Table 1.15 Bus Stops Proposed/Enhanced along the project road

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>Bus Stops on North</th>
<th>Bus Stops on South</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>IC</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>IIB</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>IVA</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>6</td>
<td>IVC</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>VB</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Truck Laybys: Following locations along the GT Road have been provided with truck parking laybys to prevent unauthorized parking of trucks on the project road. The locations have been identified on basis detailed primary surveys and site observations.

Table 1.16 Proposed Truck Parking Lay-bys long the Grand trunk road

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Package</th>
<th>Location</th>
<th>Type of Junction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>203.400</td>
<td>IA</td>
<td>North</td>
</tr>
<tr>
<td>2</td>
<td>246.1</td>
<td>IA</td>
<td>South</td>
</tr>
<tr>
<td>3</td>
<td>257.450</td>
<td>IB</td>
<td>North</td>
</tr>
<tr>
<td>4</td>
<td>269.600</td>
<td>IB</td>
<td>South</td>
</tr>
<tr>
<td>5</td>
<td>290.500</td>
<td>IB</td>
<td>North</td>
</tr>
<tr>
<td>6</td>
<td>297.050</td>
<td>IB</td>
<td>North</td>
</tr>
<tr>
<td>7</td>
<td>303.500</td>
<td>IB</td>
<td>North/South</td>
</tr>
</tbody>
</table>

Wells/Hand Pumps: A total of 32 community resources including wells and tube wells shall be enhanced as part of the project. The enhancement comprises of providing apron and proper drainage at these locations. Also plantation of trees for shade and provision of facilities such as
washing platforms and seating at these locations has been proposed. The enhancements have been done on basis of the location of these resources in the ROW

- Category A-Well shaft/Hand Pump within the proposed embankment
- Category B-Well shaft/ Hand pump adjoining/in the proposed ditch
- Category C-Well shaft/Hand Pump away from the Corridor of Impact

Table 1.17 Wells/HandPumps to be enhanced as part of the project.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Package</th>
<th>Wells</th>
<th>Hand Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IA</td>
<td>1</td>
<td>58</td>
</tr>
<tr>
<td>2</td>
<td>IB</td>
<td>16</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>IC</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>IIB</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>IVA</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>IVC</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>VB</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1.5.12 HUMAN USE VALUES

Land Use and Land Speculation

Baseline Scenario

The Great Gangetic plains constitutes the most fertile agricultural belt from Punjab to Calcutta is predominantly under agricultural land use. The state of UP has over more than half of its area under agriculture. Project area falls in the Gangetic plains and constitutes a major chunk of the irrigated arable land of the fertile

Potential Impact

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. Industrialisation 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. In addition, in case of polluting industries, the environment will directly suffer if control measures are not in place.

The total land required for the proposed four-laning and up gradation of the project corridor is 479.971 ha out of which 457.560 ha will be acquired from private holdings and the rest 22.411 ha will be transferred from government and forestlands.
Mitigation Measures

Provision of Retaining Walls: Wherever it is imperative that the land adjacent to the road be used as little as possible for construction, providing retaining walls to the embankment can reduce the width of the formation. Such conditions are frequently encountered in urban areas or where it is decided not to encroach into a water body. Various retaining walls are available to minimize the land-take for highway construction.

Induced/Ribbon Development

Baseline Scenario

The improved access after the completion of the project has the potential to induce land use changes along the corridor and can result in the conversion of the existing agricultural lands to other beneficial uses.

Potential Impacts

The development of a road scheme will lead to extension of urban areas especially at the ends of cities through which the road passes. The improved transportation facility provides the linkages that will allow much better access to previously difficult to reach markets (for buyers and sellers). This would mean not only the people from congested areas in cities will want to move to the fringe, but also, people from near by rural areas would migrate to the city.

Extrapolations of areal growth of urban and rural settlements will ultimate into distinct urban and rural stretches along the corridor. On the basis of above established hierarchies, entire corridor may be divided into following stretches:

- Km 199.660 – km 284.050, where the highest order settlement is Agra, it is envisaged that the sprawl of the dependent settlements will be towards Agra.
- Km 284.050 – km 350.750, where the nearest highest order settlement is Etawah, it is envisaged that the sprawl of the dependent settlements will be towards Etawah.
- Km 350.750 – km 393.000, where the highest order settlement is Aurraiya, it is envisaged that the sprawl of the dependent settlements will be towards Aurraiya.
- Km 470.00 – km 38.000, where the highest order settlement is Kanpur, Kanpur is also the highest order settlement along the project corridor by the virtue of its heavy industrialization. It is envisaged that the sprawl of the dependent settlements will be towards Kanpur.
- Km 317.000 – km 65.000, where the highest order settlement is Varanasi, it is envisaged that the sprawl of the dependent settlements will be towards Varanasi.
- Km 110.000 – km 140.000, where the nearby highest order settlement is Aurangabad, it is envisaged that the sprawl of the dependent settlements will be towards Aurangabad.
- Km 240.000 – km 320.000, where the nearby highest order settlement is Dhanbad, it is envisaged that the sprawl of the dependent settlements will be towards Dhanbad.

Wherever new Bypass is proposed the growth will take place all along the access road towards NH2 and at the start and end of the Bypass.
Mitigation Measures

The entire corridor will acquire a pattern of urban and rural stretches. At certain stretches the concentration, density and level of urbanisation 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. These stretches have been divided into different Policy Zones. These Policy Zones have been evolved according to the following criteria:

- Type and level of interaction with the nearest settlement;
- Density of the area; and
- Amount of overlap of the settlement sprawl.

The Policy Zones are as under:

**Policy Zone I – Metro and Urban:** Where the major settlement is a Metro. These cities continue to grow areally as per their past trends. At the same time they tend to depict a Metro and Urban interaction type of relationship, engulfing any lower order settlement at its periphery. This Policy Zone is likely to depict more and more a metro character with its areal extent increasing rapidly followed by a much larger influence than any other zone. It may experience industrial, institutional, business houses and real estate development.

**Policy Zone II – Metro and Rural:** Where the major settlement is again a metro, here the abutting rural settlement depicts a strong dependence for its livelihood on the Metro and in turn Metro also interacts with for its informal services. With time these rural settlements may become a part of the Metro region only. It may experience the development of daily needs services.

**Policy Zone III – Urban and Urban:** Where interaction occurs between two similar order urban settlements. These settlements depict the Urban Agglomeration type of a scenario, where the two settlements are dependent upon each other. This zone depicts a continuity of urban character with higher attraction factors and growth prospects. It may experience establishment of institutions, medical facilities, entertainment parks and real estate.

**Policy Zone IV – Urban and Rural:** Where any rural settlement is dependent on the nearest higher order (urban) settlement or any higher order settlement (urban) interacts with a lower order settlement. This zone depicts an urban core with rural peripheries tailing towards either the sides. It may experience establishment of schools, religious building, real estate and entrepreneur commercial setups catering the road users.

**Policy Zone V – Rural and Rural:** Where two or more rural settlements are interacting and are dependent on each other. This zone is likely to experience more encroachment in future, because of the socio-economic character of its rural contiguity. It may experience development of small commercial establishments catering to the road users as well as local community.

Distribution of the stretches in different Policy Zones is given in the Table 9.10 below.
Human Health

Baseline Scenario

Inhabitants of urban areas mostly complain about the increase in respiratory and waterborne illness such as asthma, recurrence of cold and cough. Occurrence of Water borne diseases was observed in localities using river water.

Potential Impacts

The proposed project would have both beneficial and adverse impacts on the human health. The pollutants generated during construction period will have adverse impact on the health of workers and nearby habitation area. However, this is temporary in nature. The project through construction worker may induce some new vector borne diseases among the local communities, which is not in the area at the movement. During the operation period, increasing traffic may add more pollutants to air and noise. In spite of these, the project may bring positive impact on the human health if proper mitigation measures are taken.

Mitigation

At every workplace, good, and sufficient water supply will be maintained to avoid waterborne/water-related and water-based diseases and to secure the health of workers. Adequate drainage, sanitation and waste disposal will be provided at workplaces. Preventive medical care will be provided to workers.

The Environment Management Action Plan includes a reporting system, which shall keep track of the health and hygiene conditions at workers camps including precautions taken to prevent
Road Safety

Baseline Scenario:
Pedestrians, cyclists, animals, herdsmen as well as bullock carts, vehicles carrying hazardous goods and other motorized and/or heavy vehicles use the project highway. These combinations create hazardous conditions for all the road users. Poor pavement structure and lack of warning/informatory signs and incidental parking especially in urban stretches seem to be the reasons for accidents on the road.

Potential Impacts
During the construction stage, dismantling of structure, cutting trees, haulage material obstructing vision, spillage of lubricants on road generally cause road accidents. Similarly, in operation stage, the increase in speed would tend to increase the severity of accidents. However, the number of accidents will be much lesser compared to the "no-project" scenario as the project would provide medians, improve the road geometry, remove congestion, provide facilities for pedestrian and non-motorised traffic. In settlement stretches, service lanes would be provided. The safety benefits from the project are quite significant and it could be even more if mitigation measures are implemented each phase of the project.

Mitigation Measures

Design Measures: Design Improvements at curves, segregating slow moving traffic in the market places by service lanes, provision of wider median in rural stretches and plantation of shrubs/under trees to avoid the glare of vehicles moving in opposite directions during night are some of the design solutions provided. Provision of proper signage, proper lighting arrangements will be made.

Chain link fencing: Two typical arrangements have been worked out to ensure the safety of the pedestrians and for the GTRP. The construction camps will be fenced off using chain-link fencing to prevent unauthorized entry. Chain-link is commercially available in rolls and can be raised on-site as per the perimeter of the construction camps, vehicle-parking areas and any other areas where temporary enclosure is required.

Control of Direct Access: Unhindered access from adjoining properties at high speeds can lead to accidents with fast-moving vehicles on the NH-2. The design developed for the access ensures that the user has to completely change the direction of movement at least twice between leaving the area beyond the RoW and entering NH-2. The semicircular dogleg type arrangement will be provided wherever it is expected that the road-user will visit the adjoining properties. Shrines along the NH-2, schools and educational establishments along the road, public buildings will have this arrangement at the entry/exit. The brick-walled and cement tiled structure will provide the only opening through compound walls of all highway abutting properties.

Traffic Plan: Traffic management plan will be developed, especially in congested locations in the operation stages. Traffic control measures including speed limits will be enforced strictly.

Construction Safety Plan: In addition a construction period safety plan has been prepared to maximize and ensure safety of users and workers during the construction.
1.6 COMMUNITY CONSULTATION IN THE PROJECT

The Public Consultation has been carried out at various stages of project preparation, including at the Environmental Screening stage, Feasibility stage and the Environmental Assessment Preparation stage. Public Consultation was conducted along the various project packages at 46 locations (11, 12, 15 and 8 locations in Packages II through V, respectively). These included 16 Door-to-Door Personal Interviews, 14 Focus Group Discussions, 8 Stakeholders' Consultation Sessions and 6 District Level Public Hearings.

Consultation with the communities resulted in arriving at design solutions, appropriate and conducive to the felt needs of the people. Comprehensive documentation about ecosystem components, hotspots and community networks enabled minimizing the possible impacts.

To redress the environmental issues likely to surface during construction and operational phases, constant communication needs to be continued. This will be ensured by regular progress monitoring of the construction and inviting suggestions/complaints through grievance redressal cells under the PIUs and with cooperation of the NGOs. Meetings will be organized with the project affected people and the various stakeholders at regular intervals at the potential hotspot/sensitive locations before and during project implementation.

1.7 CAPACITY BUILDING & IMPLEMENTATION ARRANGEMENTS

1.7.1 EXISTING INSTITUTIONAL ARRANGEMENTS

NATIONAL HIGHWAYS AUTHORITY OF INDIA

NHAI Corporate: The existing organizational set-up of the NHAI for TNHP & GTRP consists of a corporate office and 5 PIUs-each responsible for the implementation while the corporate office deals with the policy level issues, liaisoning with other government departments, donor agencies, etc. the CGM (WB) is responsible for the effective implementation of project activities. Assisted by two GMs (WB), one responsible for the TNHP while the other looking after GTRP, and a GM (Environment and R & R), the CGM acts as the mode for project implementation at the NHAI headquarters.

The GM (Env. And R&R) is responsible for issues related with physical as well as socio-economic environment. He interacts with the PIUs' Manager (Environment) and Manager (R&R).

Project Implementation Units (PIUs): For each design package, a separate Project Implementation Units headed by a project director, have been constituted. Three managers assist the P.D in the smooth functioning of the PIU. Of the three, one holds the additional charge for environment while another looks after R&R issues. The Manager (Technical i/c Environment) is responsible for the implementation of the various measures proposed in the Environmental Management Plan, while the Manager (Technical i/c R&R) is responsible for the implementation of provisions of the RAP within the package stretches.

OTHER AGENCIES

Non-Governmental Organisations: Non-governmental organisations are involved to assist in the implementation of the RAP to monitor the progress and implementation of the proposed measures. A representative of the NGO will also be a part of the District Level Committee that
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will decide the replacement value of land and properties to be acquired. As part of efforts to address the grievances of the project affected people, Grievance Redressal Committees for each district will also have a representative from local NGOs. This committee will decide (except for courts) on issues related to compensation for acquired land and property and other grievances of PAPs.

Supervision Consultants: In addition to the PIU, the works are to be directly supervised by construction supervision consultants, also selected through International Competitive Bidding (ICB). The contractor and the construction supervision consultants are the agencies responsible during the implementation period. The contractors for this project, who would also be selected through ICB are expected to have substantial environmental capacity with respect to the process, equipment, methods and quality of construction. The construction supervision consultants are expected to supervise implementation of the environmental components of the project by the contractor.

Contractors: As the executioners of the environmental Management Plans for each package, the contractors are expected to follow the letter and spirit of the specifications. Though each contractor will have a set-up for executing works specified in the EMP, it is expected that a certain portion of its staff will have enough environmental awareness necessary for the successful completion of the works entrusted.

1.7.2 PROPOSED INSTITUTIONAL ARRANGEMENTS

NHAI Head Quarters

The corporate headquarters of the NHAI environmental staff will be augmented by addition of one DGM, two Senior Managers and two engineers. This will create a systematic environmental cadre in the NHAI that will act as a channel for inculcating environmentally sensitive assure career-minded professionals that choosing the environmental cell/division/section at NHAI will not bar them from getting potentially responsible positions within the organisation moreover, with the road length being assigned to the NHAI increasing, and the improvement and strengthening of NH2 being accorded very high priority, the work load for the existing skeletal staff will increase. It is for this reason that a new DGM (R&R) is being proposed. The land acquisition for especially bypasses, and the property removal in urban areas necessitates the services of a professional well acquainted with the human dimensions of development projects.

Another position to be created at the Corporate HQ of NHAI is DGM (Env.). Reporting to the GM (Env. + R&R), the DGM will receive and compile quarterly reports from Manager (Env.) in each PIU. He will also oversee the functions of the documentation engineers (detailed out below) who are expected to help ensure that environmental concerns are integrated into the proposed Corridor Maintenance and Management Unit's functioning at the Corporate NHAI level. In addition, the DGM will also be responsible for periodic monitoring, contingency/improved design, providing inputs into the draft budget plans of the Environmental Cell, checking progress and setting targets for line agency works. Previous experience of environmental monitoring would be highly desirable.

In addition, procuring services of two engineers will augment the Environmental Cell at Corporate HQ of NHAI: one for GIS documentation and the other for Contracts. The former fits well with the NHAI's plans for a nationwide Corridor Management and Maintenance Unit as part of the facelift it wishes to give to the organizational structure to make itself more road user-
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Sensitive. Directly overlaying the environmental attributes onto the base map will help create a clearer picture of the conditions on the ground. The Contract Engineer will ensure that the Conditions of Contract are suitably modified to incorporate the various environmental/social provisions. The documentation engineer in charge of GIS should have previous certified training in the area and should preferably have a degree in Civil Engineering. The Contracts engineer should be a Civil Engineer or Planner with a Masters' in Environmental Engineering.

Project Implementation Units (PIU)
At the project level, each PIU will require separate Managers to oversee Environmental and Social aspects individually. The present provision for part-time (in-charge along with Technical aspects) responsibilities is likely to be inadequate since the implementation phase will entail looking after each and every environmentally sensitive location where any project activity is going on. The Manager (Env.) within each PIU must have BE (Civil) or MSc (Environmental Science). The desirable qualifications include ME (Env.). Prior experience on construction site would be a definite advantage. The main responsibilities of the incumbent would be:

- Compile quarterly environmental reports and send the same to the Corporate HQ, NHAI
- Verify compliance monitoring carried out by consultants
- Routine check on the site every 15 days.
- Take on spot decisions rectify minor problems on site
- Oversee supervision consultants
- Ensure co-ordination among government departments/agencies

Construction Supervision Consultants
The Construction Supervision Consultant will need to employ environmental engineers in each construction package along with a specialist already envisaged. These engineers, one each for the 7 contract packages of the GTRP, will actually monitor the site activities, verify that the contractor has executed the management plan provisions as per specifications. They will arrange for the monitoring of environmental conditions as per the monitoring plan and also prepare the reports to be submitted to the PIU. They should ideally be Environmental/Civil engineers with prior experience of environmental monitoring. Otherwise, a post-graduate (MSc/PG diploma) in environmental science could also be considered. However, for this candidate, some prior experience of construction related activity would be highly desirable.

Contractors
The Contractors will have to employ Environmental Engineer/s. Depending upon the number of contracts awarded to each successful bidder, the number will vary. The best situation would be the use of Civil Engineers with electives in environmental engineering during the final year to supervise the environmental aspects. Their duty will include the proper construction and maintenance of the facilities for the labour camps, the measurement and verification of quantities for environmental enhancement, ensuring that proper environmental safeguards are being maintained at borrow sites and quarries from which the contractor procure material for construction. They will also have to prepare the bills of quantities for the work carried out for enhancement. In addition, they will have to ensure that proper facilities are available for the
monitoring of ambient air quality and collection of water and soil samples as provided for in the environmental monitoring plan.

Other agencies

The NGOs involved with the project will need suitably qualified people to deal with the provisions of the RAP. The workers should have had education in sociology/psychology/social work and preferably have some prior experience of R&R works. Though working on such activities for road projects would be definite advantage, previous work for any development project would be acceptable. The NGO selected should have at least one representative in each village affected by the road. The NGO would report to the PIU regarding the progress of implementation of RAP provisions as construction proceeds.

The monitoring pollution of physical environment is being envisaged to be carried out by reputed educational institutions. The table below identifies such institutions for each consultancy package. Though staffing these not a direct concern of the project, it must be ensured that the PIU impresses upon each institute the critical role of their monitoring. The PIU should also ensure that the institutes send competent staff with necessary equipment for monitoring and have the capacity in terms of staff & equipments to simultaneously monitor at least two sites. These institutes will report to the PIU in their own formats.

<table>
<thead>
<tr>
<th>Package</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Aligarh Muslim University, Aligarh</td>
</tr>
<tr>
<td>II</td>
<td>Indian Institute of Technology, Kanpur</td>
</tr>
<tr>
<td>III</td>
<td>Motilal Nehru Regional Engineering College, Allahabad</td>
</tr>
<tr>
<td>IV</td>
<td>Institute of Technology, Benaras Hindu University, Varanasi</td>
</tr>
<tr>
<td>V</td>
<td>Indian School of Mines, Dhanbad</td>
</tr>
</tbody>
</table>

Facilities for the Environmental Cell

The environment cell at the PIU will require a vehicle to inspect works on site. Normally, a four-wheeler with enough seating (room) for two officers and a driver alongwith space for equipment for measurement will be needed at each PIU. A four wheel-drive vehicle will be the preferred choice. The vehicle need not be dedicated for the environmental cell but such an arrangement would be better than sharing PIU's other vehicles. In addition, the PIU is better of having its own monitoring equipment viz noise meter, hand-held gas sensors, etc. in addition the environmental cell at each PIU should be connected to the Documentation Unit at (NHAI by NHAI-wide LAN(WAN).

The (NHAI will need not only the e-mail facilities and connection the NHAI-wide LAN. It will also need a scanner, which can be used with GIS based corridor management system able to handle upto A3 sized sheets for directly transferring top sheet image into the system. Adequate computing facilities to allow the documentation unit to be self-sufficient are suggested. Each official at the (NHAI will have their own PC, a common printer and an access to the Internet. Adequate vehicles (for the DGM(s) & GM) will be needed. In addition, a separate field visit vehicle (preferably a four-wheel drive) should also be kept at the disposal of environmental cell for surprise monitor of construction sites.

1.7.3 ENVIRONMENTAL REPORTING SYSTEM

The Monitoring and Evaluation are critical activities in implementation of the Project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It
provides the necessary feedback for project management to keep the program on schedule. By
contrast evaluation is essentially a summing up, the end of the projects assessment of whether
those activities actually achieved their intended ends. There are two important aspects of
reporting as described in the section dealing with the responsibilities of the Manager
(Environment):

- Reporting on progress,
- Environmental compliance monitoring.

The reporting system will operate linearly with the contractor who is at the lowest rung of the
implementation system reporting to the Supervision Consultant, who in turn shall report to the
PIU. All reporting by the contractor and Supervision Consultant shall be on a quarterly basis.

The compliance monitoring and the progress reports on environmental components may be
clubbed together and submitted to the NHAI (through the PIU) quarterly during the
implementation period. The operation stage monitoring reports may be annual or biennial,

Responsibilities for oversight (overseeing) will rest with the Supervision Consultant’s staff
reporting to the PIU Environmental Unit. Capacity to quantitatively monitor relevant ecological
parameters would be an advantage but monitoring will primarily involve ensuring that actions
taken are in accordance with contract and specification clauses, and specified mitigation
measures as per the EMP. Photographic records will also be established to provide useful
environmental monitoring tools. A full record will be kept as part of normal contract monitoring.

Reporting and Monitoring Systems for various stages of construction and related activities have
been proposed to ensure timely and effective implementation of the EMAP.

1.7.4 INTERNALIZING ENVIRONMENTAL EXPERTISE IN THE NHAI

Moreover, as a long chain of projects is envisaged over the next decade or so in the highways
sector in India, the acquired capacity needs to be fully internalized. Two things become
important in this respect. One, there should be substantial environmental capacity beyond the
staff directly responsible for implementing the EMP in different projects. This may be achieved
through training and dissemination of information. Two, there should be a distinct career path for
the Managers (Environment) once the projects are completed.

The training aspect of the intermediate term capacity building and internalisation is described
below. The career path or incentives to the Environmental and R&R specialists is a long-term
issue and is not within the scope of this assignment. However, it is expected that steps in this
direction will be taken.

1.7.5 OPERATIONALISATION

Operationalisation of the environmental setup for this project would involve three distinct
elements. These are:

- Identification and appointment of Staff
- Procurement of NGOs and other agencies responsible for implementation
- Training

Each of these is described below.

Identification and Appointment of Staff
At the project level, the PIU has already been fully functional. All three managers including the Manager (Technical & i/c Environment) are in place. The Manager (Technical & i/c Environment) has already been involved in the design of the project and preparation of EMP as an associate. The Manager (Technical & i/c Environment) is already familiar with the project site and has developed understanding of the site condition and basic environmental issues. Moreover, the Manager (Technical & i/c Environment) is conversant with the processes, methods and equipment for the proposed construction works.

**Procurement of NGOs and other Agencies**

Services of any other agency, if found necessary during the course of implementation, will be procured by the NHAI.

**Training**

**Training needs**: The DGM (Environment), the Managers (Environment), the personnel of the Construction Supervision Consultant and the Contractor, who would be responsible for the implementation of the EMP, need to be trained on environmental issues of road development project. To ensure the success of the implementation setup proposed, there is a high requirement of training and skill upgradation.

**Training Programme**: The proposed training programme incorporates the project needs as well as the intermediate-term capacity building needs of the NHAI. The programme consists of a number of training modules specific to target groups. The training programme proposed in the TNHP has been retained to build a continuum for the advanced training being proposed as part of the GTRP. However, the numbers have been suitably revised to allow for the training already to be imparted as part of the TNHP.

**Target Groups**: All members of the PIUs/NHAI, staff of the contractors, supervision consultants, the collaborating government agencies represented by the officials identified to be directly responsible for delivery of collaborating services and the NGOs with their field staff will all be imparted training. They are divided into the following target groups.

As the needs of these groups are different from each other, training deliverables would also be distinct. This would be attained by specifying a combination of training modules for each target group. Four such groups have been identified.

- **Group I**: The group that potentially needs training in EMP implementation; environmental design, re-design and environmental conflict resolution. Includes the Managers (Environment) of the PIUs and the representative staff of the Construction Supervision Consultants. (Also NGOs if procured.)
- **Group II**: The group that potentially needs training in environmentally acceptable processes, methods and equipment of road construction. Includes the full PIU, representative staff of the Construction Supervision Consultants and the Contractors.
- **Group III**: The group that would require an understanding of the environmental policies and programmes. Includes the full PIU and the Senior NHAI staff.
- **Group IV**: The group that needs to be included into the environmental awareness programmes. Includes staff of the collaborating government agencies and all staff of the NHAI.
1.7.6 TRAINING PROGRAMME

The training would cover the basic principles and postulates of environmental assessment, mitigation plans and programmes (particularly the World Bank Operational Guidelines and National Policy Perspectives), implementation techniques, monitoring and management methods and tools.

Looking into the potential requirements of each of the target groups, several training modules are suggested below.

Module I: Environmental Overview
Module II: Environmental Regulations and Acts
Module III: Pollution
Module IV: Environmental Impact Assessment
Module V: Environmental management Plan
Module VI: Highway Projects and Environmental Issues
Module VII: Environmental Issues in the Project
Module VIII: The Environmental Management Plan for Highway Projects
Module IX: Environmentally Sound Construction Management
Module X: Planning for Environmentally Sustainable Operation of Highways
Module XI: Long Term Environmental Issues in Highway Management

1.7.7 TRAINING SCHEDULE

The training modules are combined into different training components. There are overlaps in the composition of the target groups and the constitution of the training components. However, each training module would need to be developed keeping in view the composition and responsibilities of the target group members. The training schedule for the various target groups would be as given in Table below.

<table>
<thead>
<tr>
<th>Target Groups</th>
<th>Target Group I</th>
<th>Target Group II</th>
<th>Target Group III</th>
<th>Target Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Managers (Environment), staff of the Construction Supervision Consultant, NGOs</td>
<td>PIU, staff of the Construction Supervision Consultants, the Contractors</td>
<td>PIU and the Senior NHAI staff</td>
<td>Collaborating Government agencies and all staff of the NHAI</td>
</tr>
<tr>
<td>Forums of Training</td>
<td>Lecture Sessions, Workshops, Group Discussions, Short-term Training Courses</td>
<td>Seminars, Workshops, Lecture Sessions</td>
<td>Short-term Training Courses, Visits to Case Studies, Seminars</td>
<td>Audio-Visual Communication, Informal Training</td>
</tr>
<tr>
<td>Training Schedule</td>
<td>Depending on the start of the Project Implementation; Training on Components 1A and 1C must be completed before the start of implementation; Other Components may be held in the initial 2-3 months of project implementation.</td>
<td>Components 2A to be completed before the start of implementation. Training in other Components may be imparted during the initial 6 months of project implementation, preferably on site.</td>
<td>To start before the commencement of project implementation, may continue throughout the implementation period.</td>
<td>Continuing training programme during the project implementation period.</td>
</tr>
<tr>
<td>Contents of Training</td>
<td>Component 1A (Modules I, II and III) Component 1B (Modules IV and V) Component 1C (Module VI) Component 1D (Modules IX and X) and Component 1E (Module XI)</td>
<td>Component 2A (Modules I, II and III) Component 2B (Modules IV and V) Component 2C (Module VI) and Component 2D (Module VII)</td>
<td>Component 3A (Modules I, II and III) Component 3B (Module VI) Component 3C (Module VII)</td>
<td>Component 4A (Modules I, II and III)</td>
</tr>
</tbody>
</table>

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1.7.8 TRAINING BUDGET

The total budget required for implementing the training programme is Rs 7.94 million. The break-up for the entire GTRP is presented below.

Table 1-19: Budget for Implementation of Environmental Training Programme

<table>
<thead>
<tr>
<th>No. of Training Components</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>1</th>
<th>Total Budget (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengthening Training measures already part of TNHP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal Training Sessions</td>
<td>500</td>
<td></td>
<td></td>
<td>5</td>
<td>25,00</td>
</tr>
<tr>
<td>Audio-Visual Communications</td>
<td>25,00</td>
<td></td>
<td></td>
<td>10</td>
<td>210,00</td>
</tr>
<tr>
<td>Case Studies</td>
<td>35,00</td>
<td>2</td>
<td></td>
<td>1</td>
<td>210,00</td>
</tr>
<tr>
<td>Lecture Sessions</td>
<td>45,00</td>
<td>10</td>
<td></td>
<td>1</td>
<td>1,125,00</td>
</tr>
<tr>
<td>Workshops</td>
<td>20,00</td>
<td></td>
<td></td>
<td>5</td>
<td>100,00</td>
</tr>
<tr>
<td>Group Discussions</td>
<td>10,00</td>
<td></td>
<td></td>
<td>1</td>
<td>250,00</td>
</tr>
<tr>
<td>Short-Term Training Courses (in India)</td>
<td>50,00</td>
<td>5</td>
<td></td>
<td>10</td>
<td>2,750,00</td>
</tr>
<tr>
<td>Seminars</td>
<td>100,00</td>
<td>1</td>
<td></td>
<td>2</td>
<td>1,000,00</td>
</tr>
<tr>
<td><strong>Additional Training Modules in GTRP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-Term Training Courses (abroad)</td>
<td>350,00</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1,050,00</td>
</tr>
<tr>
<td>Full-term Training Courses (abroad)</td>
<td>1,200,00</td>
<td>1</td>
<td></td>
<td></td>
<td>1,200,00</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7,940,00</td>
</tr>
</tbody>
</table>

1.7.9 OPERATIONALISATION

Operationalisation of the environmental setup would involve (i) identification and appointment of staff, (ii) procurement of NGOs and other agencies responsible for implementation, and (iii) training.

At the project level, the PIUs have already been fully functional. The Managers (Technical & IEC Environment) have already been involved in the design of the project and preparation of EMP. The Environmental Manager (HQ) will be selected and appointed shortly.

NGOs, as and wherever required, will be procured based on quality-cum-cost basis. Services of those NGOs, if any, already engaged in the project for implementing the RAP will be preferred for implementation of environmental components also. Services of any other agency (including government agencies), if and whenever required during the course of implementation, will be procured by the NHAI.

1.8 ENVIRONMENTAL MANAGEMENT PLANS

Separate Environmental Management Plans (including Environmental Monitoring Plans) have been prepared for each of the Contract Packages. The Environmental Management Plans (EMP) is based on the EIA/EMP reports prepared for the respective Package of the project. The Environmental Management Plan (EMP) consists of the set of mitigation, monitoring and institutional measures to be taken during the design, construction and operation stages of the project to eliminate adverse environmental impacts, to offset them, or to reduce them to acceptable levels. The objectives of the EMPs in different stages of the project are the following:
1.8.1 ENVIRONMENTAL MONITORING PROGRAMME

To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. The broad objectives are

- To evaluate the performance of mitigation measures proposed in the EMP
- To evaluate the adequacy of Environmental Impact Assessment
- To suggest improvements in management plan, if required
- To enhance environmental quality
- To satisfy the legal and community obligations.

Performance Indicators

The physical, biological and social components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators and are Air quality (SPM, RSPM and CO), Water quality (DO, BOD and Coliform count), Noise levels around sensitive locations, Replantation success / survival rate, Erosion indices, Sedimentation rate in the downstream where bridges, culverts, etc., are built, Vital statistics on health, Accident frequency.

Monitoring Plans

The monitoring plans during construction and operation stages have again been described in detail in the respective EMP documents for each of the Contract Packages. For each of the environmental components, the monitoring plan specifies the parameters to be monitored; location of monitoring sites; frequency and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities.

1.8.2 BUDGET FOR ENVIRONMENTAL COMPONENTS OF THE PROJECT

The environmental budget for the various environmental management measures proposed in the environmental management plans, the environmental monitoring plans and the training programme is given below. Further details with respect to the location, units of measurement, and rates applicable are given in the respective EMP documents.

<table>
<thead>
<tr>
<th>Table 1-20 Environmental Budget in the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget Head</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mitigation / Enhancement costs</td>
</tr>
<tr>
<td>Monitoring Costs</td>
</tr>
<tr>
<td>Training &amp; Mobilisation Costs</td>
</tr>
<tr>
<td>Advocacy and Policy Planning</td>
</tr>
<tr>
<td>Total Amount assigned</td>
</tr>
<tr>
<td>Contingency @ 10% of Total</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>GRAND TOTAL FOR ENTIRE GTRP</td>
</tr>
</tbody>
</table>