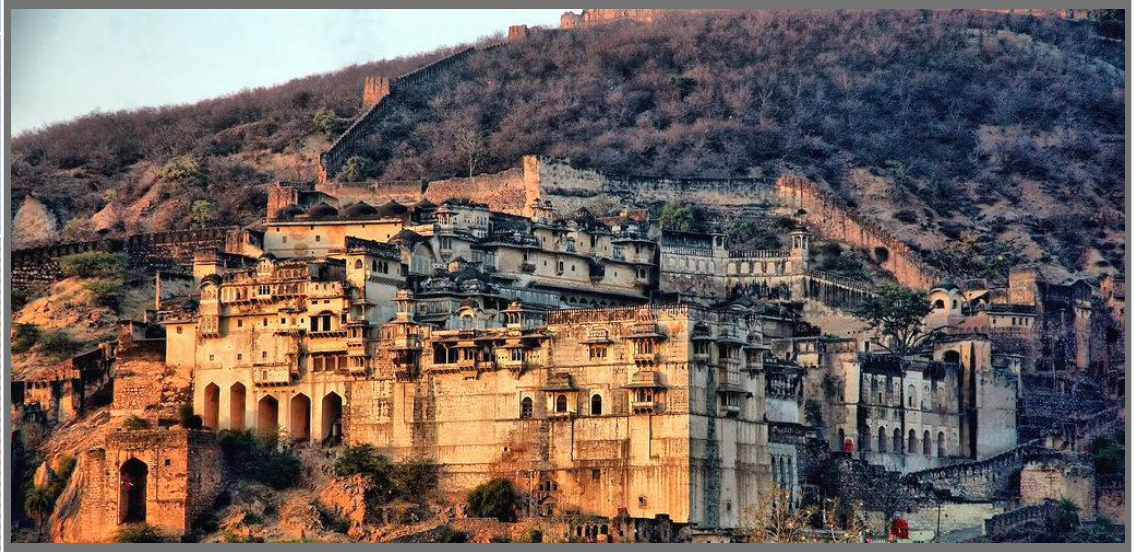
Draft Environmental Impact Assessment (EIA) Report

(Baseline period-March to May 2018)

Consultancy Services for Development of 8 lane (Greenfield highway) from Banda Hera village (Ch. Km 392.800) to Moondiya village (Ch. Km 452.625) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan



Project Proponent : National Highway Authority of India
Ministry of Road, Transport & Highways, Govt. of India

Environmental Consultant : Feedback Infra Private Limited, Gurugram
QCI Certificate:- **NABET/EIA/1821/RA0116 dated 11th Jan 2019**

July-2019

For National Highway Authority of India
Feedback Infra Private Limited

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ABBREVIATIONS

AAQ	Ambient Air Quality
AAQMS	Ambient Air Quality Monitoring Station
AIDS	Acquired Immuno Deficiency Syndrome
BGL	Below Ground Level
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantities
BPL	Below Poverty Line
CALINE	California Line Source Dispersion Model
CCTV	Closed-circuit television
CF	Conservator of Forest
CGWB	Central Ground Water Board
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CoI	Corridor of Impact
CPCB	Central Pollution Control Board
CPR	Community Property Resource
DFO	Divisional Forest Officer
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FGD	Focus Group Discussions
GO	Government Order
GoI	Government of India
GoRJ	Government of Rajasthan
GW	Ground Water
HC	Hydrocarbon
IMD	India Meteorological Department
IRC	Indian Roads Congress
IS	Indian Standard
Leq	Equivalent Continuous Noise Level
LHS	Left Hand Side
LCV	Light Commercial Vehicles
MAV	Multi Axle Vehicles
MC	Monitoring Consultant
MPN	Most Probable Number
MoEF	Ministry of Environment and Forests
NAAQS	National Ambient Air Quality Standards
NBWL	National Board of Wildlife
NGO	Non-Governmental Organisations
NH	National Highway
NPV	Net Present Value
NOC	No-objection Certificate
NO_X	Oxides of Nitrogen
ODR	Other District Roads
PAF	Project Affected Family
PAH	Project Affected Household
PAP	Project Affected Person
PD	Project Director
PF	Protected Forest
PIU	Project Implementation Unit
PM	Particulate Matter
PPP	Public Private Partnership
PUC	Pollution Under Control
R&R	Resettlement and Rehabilitation
RAP	Resettlement Action Plan
RF	Reserved Forest
RHS	Right Hand Side
ROW	Right of Way
SH	State Highways
SO_2	Sulphur Dioxide
SPCB	State Pollution Control Board
SW	Surface Water
TDS	Total Dissolved Solids
UV	Ultra Violet
USEPA	US Environment Protection Agency

1 INTRODUCTION

1.1 Project Proponent

National Highways Authority of India (NHAI), an autonomous agency of the Government of India, is responsible for management of the network of national highways across the country. It is a nodal agency of the Ministry of Road Transport and Highways (MoRTH), Government of India. The vision is to meet the nation's need for the provision and maintenance of national highways network to global standards and to meet user expectations at time-bound and cost-effective manner, within the strategic policy framework set by the Government of India and thus promoting economic well-being and quality of life of the people.

NHAI is the nodal authority / project proponent for the development of the Proposed highway project.

1.2 The Project

Government of India has decided to develop ~42,000 km of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under the Bharatmala Pariyojana. Delhi-Mumbai Greenfield Highway via Vadodara is one of the projects under Bharatmala Pariyojana. The project being discussed under this report concerns a section of the proposed green-field highway under Bharatmala Pariyojana Lot 4 / Package 4: Rajasthan – Haryana Border to Kota. The Project is planned as 8-lane green-field highway.

Salient features of the Project are as follows.

Table 1-1: Project Salient Features

S. No.	Particular	Details
1	Project Name	Development of 8 lane (Greenfield highway) from Banda Hera village (Ch. Km 392.800) to Moondiya village (Ch. Km 452.625) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan
2	Nature of Project	8-lane, access-controlled Greenfield Highway
3	Location of project stretch	The proposed green field section starts from close vicinity of Banda Hera village (Ch. Km 392.800) and ends near Moondiya village (Ch. Km 452.625) Section of NH-148 N (Total length 59.625 Km) in Kota district of state Rajasthan)
4	Geographical Coordinates	25° 6'29.90"N, 76° 3'28.39"E to 24°36'58.25"N, 75°51'25.65"E
5	Land details	Proposed highway follows plain, rolling and hilly terrain.
6	Water demand	About 2801120 KL water will be required during construction phase.
7	Sources of water	Tanker Supply through vendor having necessary permission
8	Nearest railway station	Ravtha Road Railway Station-at a distance of 1.5 km from the proposed road
9	Nearest State highway / National highway	Proposed alignment is crossing SH-9A, SH-51 and NH-12
10	Nearest airport	Kota Airport- Approx. 22.0 km

S. No.	Particular	Details
11	Seismic Zone	Proposed alignment falls under Seismic Zone II, which is considered to be low damage risk zone. According to the rating, Zone II is considered to be most stable zone, whereas Zone - V least stable zone. Proposed alignment is located in High Damage Risk Zone (Vb = 47 m/s) as per Wind and Cyclone Hazard Classification of India.

1.3 Project Location

The proposed Project alignment start from close vicinity of Banda Hera village (Ch. Km 392.800) (25°06'29.90"N, 76°03'28.39"E) and traverses entirely greenfield through plain, rolling and hilly terrain at places and ends near Moondiya village (Ch. Km 452.625) (24°36'58.25"N, 75°51'25.65"E) of Kota district of Rajasthan state. This project is an 8-lane highway for a length of 59.625 km. The location of the Project stretch is shown in **Figure 1.1** below.

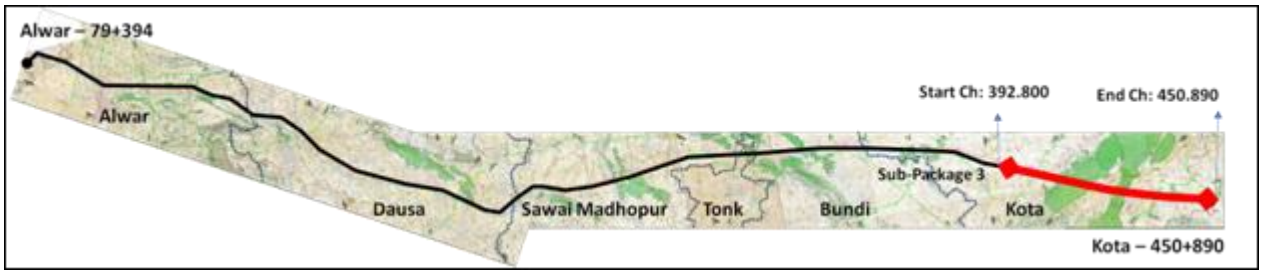


Figure 1-1: Location Map of Proposed Highway

Project Alignment duly imposed on SoI top sheet is shown as **Annexure 1.1.**

1.4 Environment Impact Assessment Process

Applicability of various environmental regulations and guidelines were reviewed for the project and its allied activities. As per the EIA notification, 2006, the project is covered under serial no. 7(f) as category 'A'.

The proposed project has been scoped for Terms of Reference (ToR) *vide* File No.10-76/2018-IA.III dated 18th April, 2019. ToR compliance is presented as **Appendix-1** of this report.

1.5 EIA Methodology

The EIA study has been undertaken simultaneously along with the design of the project road. The methodology followed for the study have been shown in the form of flow chart below in **Figure 1.2.** The important findings of the environmental assessment provided important feedback to the design team, especially in terms of the sensitive receptor, Forest and wildlife area, archaeological sites and religious properties. It helped in modification of the designs report and incorporated mitigation measures, wherever the impacts are avoidable.

1.6 Approach and Methodology

Present EIA study has been undertaken based on EIA Notification 2006 (amended thereof), ToR accorded for the project from MoEF&CC and Environmental Impact Assessment Guidance Manual for Highways prepared by Administrative Staff College of India, 2010.

The sections below detail out the methodology adopted for the assessment of environment for the project.

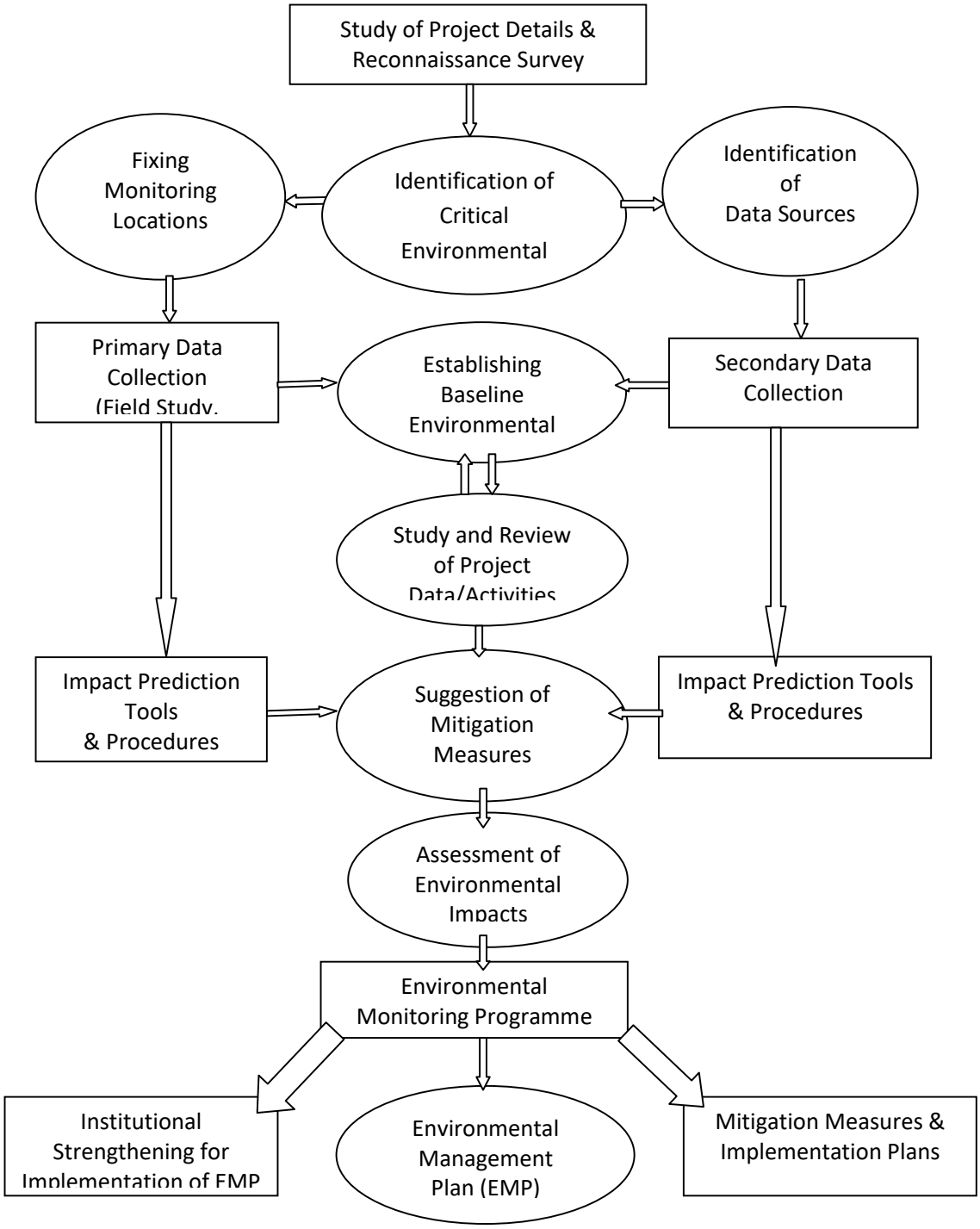


Figure 1-2 : Methodology of EIA

1.6.1 Reconnaissance Survey

A reconnaissance survey was undertaken for identification of Valued Environment Components (VECs) falling within the RoW of the proposed highway. Locations of environmentally protected

areas (National Parks, Wildlife Sanctuaries, Biosphere Reserves, Reserved / Protected Forest, Important Bird Areas, World heritage Sites, Archaeological Monuments *etc*.); surface water bodies; environmentally sensitive receptors (educational institutions, religious structures, medical facilities *etc*.) along the green field alignment were identified during the survey. The Consultant conducted preliminary analysis of the nature, scale and magnitude of the impacts that the project is likely to cause on the environment, especially on the identified VECs.

1.6.2 Review of the Project Information

Project information from Technical Design Report and other secondary information were reviewed to assess the project status and various Technical aspects. Accordingly, major impact areas were identified for detailed assessment during EIA Stage.

1.6.3 Review of Applicable Environmental Regulations

Applicability of various environmental regulations and guidelines were reviewed for the project and its allied activities. Review analysis in respect to Govt. of India guidelines and regulatory environment framework is presented in the **Table 1-2** below.

Table 1-2: Applicability review of the Regulatory Environment Framework

S. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
1	The Environmental (Protection) Act. 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act for protection and improvement of the environment.	Yes	All environmental Notifications, Rules and Schedules are issued under the EPA Act	MoEF&CC, State Dept. of Environment & Forest, CPCB and RPCB
2	The EIA Notification, 14th September 2006 & subsequent amendments	Identifies all new national highways, expansion of national highways projects greater than 100 km involving additional ROW or land acquisition greater than 40m on existing alignments and 60m on re-alignments or by-passes (item 7 (f) of schedule) as one of the projects requiring prior clearance.	Yes	Project Highway is a new national highway (NH 148N) project. Hence, Environment Clearance is required from MoEF&CC	MoEF&CC & SEIAA
		Opening of New Borrow Area	Yes	Prior Environmental Clearance to be taken by Contractor if there is any need for opening of new borrow area	
		Opening of new Quarry Area (including excavation of River bed)	Yes	Prior Environmental Clearance to be taken by Contractor if there is any need of mining activity	
3	Notification for use of Fly ash, 3rd November 2009 and its amendment on 25th January 2016	"No agency, person or organization shall, within a radius of 300 Kilometres of a thermal power plant undertake construction or approve design for construction of roads or flyover embankments with top soils; the guidelines or specifications issued by the Indian Road Congress (IRC) as contained in IRC specification No. SP: 58 of 2001 as	Yes	Kota Super Thermal Power Station, Kalisindh Thermal Power Station, Chhabra TPP and Adani Power Kawai Thermal Power Plant, are located within 300km from the proposed highway alignment	MoEF&CC, RPCB

S. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
		amended from time to time regarding use of fly ash shall be followed and any deviation from this direction can only be agreed to on technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-Chief of the concerned agency or organization or on production of a certificate of "fly ash not available" from the Thermal Power Plant(s)			
4	The Water (Prevention and Control of Pollution) Act, 1974	Central and State Pollution Control Board to establish / enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction / operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	Rajasthan Pollution Control Board
5	The Air (Prevention and Control of Pollution) Act. 1981	Empowers RSPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of crushers, hot mix and batching plants *etc*.	Rajasthan Pollution Control Board
6	Noise Pollution (Regulation And Control) Act, 1990, 2010 and its subsequent amendments.	Standards for noise emission for various land uses	Yes	Construction machineries and vehicles to conform to the standards for construction	Rajasthan Pollution Control Board
7	Forest (Conservation) Act, 1980 its subsequent amendments.	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the Forest conservation Act.	Yes	Proposed alignment is passing through Mawasa Arandkheda Binyani A protected forest and Barkalaji Reserve forest in Kota District	State Forest Department, MoEF&CC
9	Wildlife Protection Act, 1972 and amended thereof,	Protection of Wildlife Sanctuaries and National Park	Yes	Proposed alignment is passing through Darrah Wildlife	NBWL, SBWL & Chief Wildlife

S. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
				Sanctuary.	Warden
10	Ancient Monuments and Archaeological sites & Remains Act 1958 and amended thereof,	To protect and conserve cultural and historical remains found.	No	No ASI Notified monument is located within proximity of proposed alignment. Applicable for any “chance find” would be Notified / surrendered to the competent authority.	Archaeological Survey of India, State Dept. of Archaeology
11	The Motor Vehicle Act. 1988 its subsequent amendments.	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate” is issued to reduce vehicular emissions	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
12	The Explosives Act (& Rules) 1884 (1983) its subsequent amendments.	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying	Yes	Use of blasting materials if required for new quarrying operation and storing of Diesel / Petrol in the camp site, to be obtained by the Contractor / Concessionaire	Chief Controller of Explosives
13	Public Liability And Insurance Act, 1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials like Bitumen shall be used for road construction	Labour Commissioner / District Magistrate
14	Hazardous and Other Wastes (Management, & Trans-boundary Movement) Rules, 2016 and amended thereof	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	Rajasthan Pollution Control Board
15	Construction and Demolition Waste Management Rules, 2016 and Solid Waste Management	Safe disposal of construction waste and municipal solid waste	Yes	Construction waste shall be generated due to the demolition of existing structures &	Rajasthan Pollution Control Board

S. No.	Regulation / Guidelines	Relevance	Applicability (Yes / No)	Reason for Application	Implementing / Responsible Agency
	Rules 2016			construction activities and municipal waste likely from the construction worker camp	
16	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during road construction	District & Local Crisis Group headed by the DM and SDM
17	Mines & Minerals (Regulation & Development) Act, 1957 & amended thereof,	Permission of Mining of aggregates and sand from river bed & aggregates	Yes	Mining of sand, soil or aggregates shall require permission from mining dept.	State Department of Mining
18	The Building & Other Construction Workers (Regulation of Employment & Conditions of Service) BOCW Act, 1996	Employing Labour / workers	Yes	Employment of labours	District labour Commissioner

1.6.4 Assessment of Alternatives

With and without project scenarios have been assessed. The assessment of alternatives included that of Process Technology (Pavement, cross-sections, *etc*.), sources of materials from an environmental management perspective, selection of alignment, *etc*.

1.6.5 Assessment of Baseline Environmental Profile

Secondary data such as Survey of India Topo-sheets, District Planning Maps, Forest Working Plans, booklet of Central Ground Water Board, details of Archaeological Monuments *etc*. have been collected from various secondary sources. Further, secondary data, which are relevant to understand the baseline as pertaining to physical and biological environments has been collected and reviewed.

Data pertaining to all facets of environment which include physical, ecological and socioeconomic environment, both through primary and secondary sources were collected. Key relevant information sources have been summarised in **Table 1-3** below.

Ambient air & noise, ground and surface water samples were monitored at various locations identified along the corridor. The monitoring and analysis for each component were carried out as per MoEF&CC and CPCB guidelines during the study period from March to May, 2018. The results of the monitoring were compared with the relevant national standards.

In order to quantify the impacts of the project road on various receptors, a receptor identification survey was carried out. The receptors included the information for educational institutes, hospitals, cultural & religious properties, community properties, water bodies, major pollution generating sources, ecological components *etc*.

Table 1-3: Primary and Secondary Information Sources

Parameters	Information Source
Technical information	Design Report
Inventory of features like water Bodies, Community structures, environmentally sensitive locations areas, congested locations *etc*.	Total station surveys, Google Earth, Bhuvan, Survey of India Maps, Primary Transect Walk, Drone Survey
Climatic Condition & Meteorological data	India Meteorological Department, Districts Groundwater Brochure of CGWB, Primary data collection
Geology, Seismicity, Soil and Topography	Districts Groundwater Brochure of CGWB, Seismicity data available of National Disaster Management Authority Website and Primary survey & Investigation
Land Use / Land Cover	Survey of India Toposheet, Google Earth, Bhuvan and Ground Truthing
Drainage Pattern	Survey of India Toposheet, Total Station Survey at Site, Districts Groundwater Brochure of CGWB, field observation and consultation with stakeholders
Ecology & Biodiversity and identification of Forest Area	Onsite survey, DFO/wildlife office, Research generals and I-bat
Air quality Noise, Soil and Water	Onsite monitoring and Analysis of Field samples, SPCB & CPCB published data

Parameters	Information Source
Borrow Areas, Quarries and other construction material source	Material Surveys
River geo-morphology, hydrology, drainage, flood patterns	Water resource Dept., Districts Groundwater Brochure of CGWB, outcome of the consultation and field observations
Socioeconomic Environment	Census of India 2001 & 2011 and Public Consultation during the Field survey

1.6.6 Assessment of Impacts

Assessment of potential impacts has been carried out based on the project design and baseline environment data as collected from primary and secondary sources. Assessment of the environmental impacts were carried out to ascertain the direct and indirect impacts likely to be induced due to proposed development. The general impacts are land acquisition & allied impacts on society, dust & air pollution due to removal of structures, trees & vegetation and other construction activities; noise pollution due to construction activities, loss of flora and its impacts on the ecology and impacts on water resources, effect on existing biodiversity, effect on hilly area ecosystem.

For each impact predicted, feasible and cost-effective mitigation measures has been suggested to reduce potentially significant adverse environmental impacts to acceptable levels.

1.6.7 Consultations

Consultations on environmental issues with community members, institutional stakeholder and PAPs in the form of Focused Group Discussions, Stakeholder meetings, *etc.* were carried out. Consultation process were involved both formal and non-formal discussion. The feedback generated through these meetings has been incorporated as far as possible in the design and construction of the highway. The consultation process shall continue even during the implementation stage to gauge the general opinion. The outcome of consultation activities is elaborated in Chapter 7- **Additional Studies.**

1.6.8 Environment Management and Monitoring Plan

All affirmative action's not only to avoid and deter but also to capitalise on the opportunities provided by the project in order to improve the environmental conditions have been deliberated. The various mitigation and enhancement measures proposed have been included in the report. Based on their applicability, both general and case specific measures were incorporated as follows:

Generic measures: To avoid or mitigate impacts on environmental components, general mitigation measures were identified based on the characteristic features.

Site Specific: At representative sensitive locations, site-specific mitigation measures and enhancement designs have been formulated.

The EMP action plan has been prepared in sufficient of the proposed mitigation and enhancement measures. Monitoring indicators have been identified to have a continuous check on impacts associated with project activities.

1.7 Structure of the Report

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

Chapter- 2: Project Description describes the project design features related to environment, health and safety aspects.

Chapter-3: Analysis of Alternatives details out the various alternatives for the project str*etc*h, construction technology alternative, *etc*.

Chapter- 4: Baseline Environmental Profile describes the existing environmental set up of the study area;

Chapter-5: Anticipated Environmental Impact & Mitigation Measures details out about impacts associated with the proposed developmental activities. Mitigation measures for identified impacts are also covered in this chapter.

Chapter-6: Environmental Monitoring programme discuss about the monitoring indicators, reporting mechanism and responsibility distribution for successful implementation of Environment Management Plan

Chapter-7: Additional Studies covers details about the Public Consultation and Hearing. Chapter also contains the brief of additional studies suggested by MoEF&CC during ToR appraisal meeting.

Chapter-8: Project benefits to the local community and environment are discussed in this chapter;

Chapter-9: Environmental Management Plan details both the generic and specific EMPs for the project Highway. Implementation arrangements give a brief about the implementation methodology. This chapter also discusses about the Environmental Budget.

Chapter-10: Summary and Conclusion briefs the EIA study outcome along with recommendation for the project.

Chapter- 11: Disclosure of the Consultant provides the details of the consultants engaged along with their capabilities and experiences.

2 PROJECT DESCRIPTION

2.1 Project Profile

The Project entails 8 lane access-controlled green-field highway section of NH-148N. The proposed alignment of the project starts from Ch. km 392.800 near Banda Hera village and ends near Moondiya Village at Ch. km 452.625 in Kota district of Rajasthan state. This section covers 59.625 km length in Kota district of state of Rajasthan.

The Geo-graphical Coordinates of start and end points are given in Table 2-1 below.

Table 2-1: Project Coordinates

Description	Coordinates
Starting point	25°06'29.90"N, 76°03'28.39"E
Terminating point	24°36'58.25"N, 75°51'25.65"E

Total length of the Project is about 59.625km with 100m Right of Way has been considered for proposed alignment. Location of the Project stretch is shown in **Figure 2.1**.

2.2 Project Features

The Project highway is 8 lane green-field highway shall be based on expressway standards as per IRC SP 99-2013. The various aspects of design that have been considered in the development of design for the proposed highway are brought out in this section. It mainly consists of geometrics of expressway, interchange design, junction design, cross sections, drainage design, pavement design, structure design for culverts, bridges, flyover, VUP's, LVUP's, SVUP's, and interchanges.

2.2.1 Design Speed

The project corridor passes through plain, rolling and hilly terrain. The adopted design speed is 120kmph throughout the stretch. Design speed for various terrains given Table 2-2 below.

Table 2-2: Design Speed

Nature of Terrain	Cross Slope of Ground	Design Speed (Kmph)
		Ruling
Plain, Rolling & Hilly	Upto 25%	120

2.2.2 Right of Way

The recommended minimum Right of Way is given in Table 2-3 below.

Table 2-3: Recommended Minimum Right of Way

Section	Right of Way (ROW) in m
Rural Section	100
Rural sections passing through semi urban areas	100

At interchanges, toll booth, highway amenities and truck lay byes etc. additional land shall be acquired.

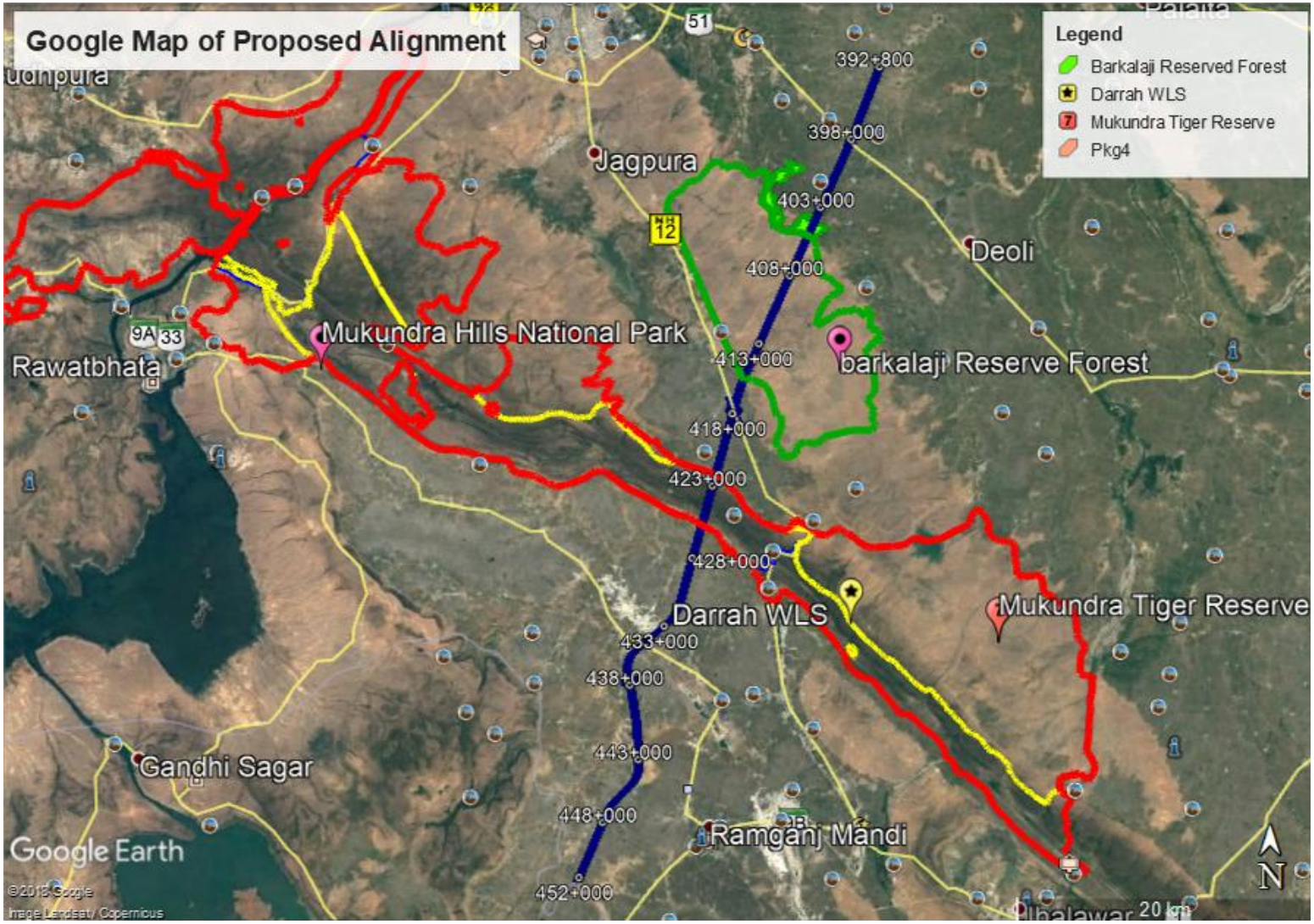


Figure 2-1: Proposed alignment marked on Satellite Imagery (Google Earth)

2.2.3 Cross-fall and Super Elevation

The cross-fall on straight sections of project road carriageway shall be as given in the **Table 2-4** below. Each carriageway shall have unidirectional cross-fall.

Table 2-4: Cross-fall on different Surfaces

Cross-sectional Element	Annual Rainfall	
	1000 mm or more	Less than 1000 mm
Carriageway, Paved Shoulders, Edge Strip	2.5%	2.0%

The cross-fall for earthen/granular shoulders on straight portions is at least 1.0 percent steeper than the values given in above table. On super elevated sections, the earthen portion of the shoulder on the outer side of the curve is provided with reverse cross-fall so that the earth does not drain on the carriageway and the storm water drains out with minimum travel path.

2.2.4 Super Elevation

The super elevation in the proposed highway is limited to 5% Super elevation shall not be less than the minimum specified cross-fall.

2.2.5 Typical Cross Sections

For 8 lanes highway different Cross-section has been developed on the basis of IRC-99-2013. 2x15m carriageway having each lane width of 3.75m. The paved shoulder width of 3m on both sides and 22m wide central median has been provided.

Keeping these basic requirements, various typical cross sections were developed to meet the need of land use along the project road. Details of Cross Sectional Elements for particular typical cross sections and location-wise application of TCS are given in **Table 2-5**.

Table 2-5: List of Typical Cross Sections

TCS	Applicability	Cross Sectional Elements
1	Rural Areas (8 Lane with Paved Shoulder)	Carriageway: 2X15m EDGE strip: 2 X (0.750m Paved + 1m Earthen) Paved Shoulders: 2X3.0m Granular Shoulders: 2X2.0m Central Median: 22.0m Side Drain: Unlined both side Utility Corridor: 2X3.0m ROW: 100 m
2	Over Bridge and Grade Separator (8 Lane with Paved Shoulder)	Carriageway: 2X15m EDGE strip: 2X0.750 m Paved Shoulders: 2X5.0m Central Opening: 19.5m ROW: 100 m

Source: Design Report

2.2.6 Grade Separators

At grade; junctions are safety hazard in view of high speed and thus no at-grade junctions are provided in the project corridor.

2.2.7 Major & Minor Bridge

Bridges shall be provided on all the rivers/streams crossing and water bodies falling within the proposed alignment.

Table 2-6: Major bridge

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total width (m)	Remarks
1	416.750	3x25	2X21.25	Pond/water body
2	427.816	4X30	2X21.25	Takli River
3	430.540	4X25	2X21.25	Pond/water body
4	442.050	4X25	2X21.25	Pond/water body
5	451.690	4X25	2X21.25	Pond/water body

Source: Design Report

Table 2-7: Minor bridge

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total Width (m)	Remarks
1	401.313	1X30	2x21.25	Local stream
2	408.701	1X20	2x21.25	Local stream
3	410.306	1X20	2x21.25	Local stream
4	412.011	1X15	2x21.25	Local stream
5	413.721	1X10	2x21.25	Local stream
6	413.941	1X10	2x21.25	Local stream
7	420.811	1X30	2x21.25	Local stream
8	427.101	1x15	2x21.25	Local stream
9	432.160	1X15	2x21.25	Local stream
10	437.560	1X15	2x21.25	Local stream
11	441.350	1X20	2x21.25	Local stream
12	442.800	1X20	2x21.25	Local stream
13	443.350	1x10	2x21.25	Local stream
14	447.200	1x20	2x21.25	Local stream
15	450.169	1X15	2x21.25	Local stream

Source: Design Report

2.2.8 Access Control

The proposed highway is completely access controlled and access shall be provided through interchanges only.

2.2.9 Tunnel

The Project alignment passing through the Mukundra Hills Tiger Reserve is from Chainage km 422+200 to km 425+750 (Length about 3.550 km). The proposed highway alignment is crossing two hillocks and a valley portion in between. In order to obviate the needless bisection of the MHTR, an underground tunnel is suggested in the above section. Moreover, in order to avoid disturbance in the vicinity of the tiger reserve, both end faces of the tunnel may be placed about 500m away from the boundary of protected area of Critical Tiger Habitat (Core of Mukundra Hills Tiger Reserve) by implying “Cut & Cover Technique. The length of the tunnel, the slope of the highway in this stretch and its depth will depend on the technical feasibility study of the valley area.

2.2.10 Vehicular Under Pass (VUP)

VUP's are provided between the Project highway and MDRs. The lane width of the cross road varies from 7.0m to 10.0m. The provision of future widening from 2 lane to 4 lanes is already taken into consideration for these roads. These are provided perpendicular to the Project road.

Table 2-8: Details of VUP

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total width (m)
1	448.773	1x20x5.5	2X21.25
2	450.812	1x20 x5.5	2X21.25

Source: Design Report

2.2.11 Light Vehicular Under pass (LVUP)

LVUP has been provided for metal roads / ODR. These are low configuration road compared to VUP's. These are provided perpendicular to the Project road.

Table 2-9: Details of LVUP

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total width (m)
1	400.984	1X12X4	2X21.25
2	412.251	1X12X4	2X21.25
3	419.901	1X12X4	2X21.25
4	426.734	1X12X4	2X21.25
5	433.300	1X12X4	2X21.25
6	434.120	1X12X4	2X21.25
7	439.010	1X12X4	2X21.25

Source: Design Report

2.2.12 Small Vehicular Underpass (SVUP)

To ensure complete access control and make cost effective grade separation, a smaller dimension VUP (SVUP) has been provided for VR/mud roads with width less than 5.50m. All cross roads are not provided with SVUP's. In some of the cross road 4mx3m Box is provided.

For few, mud roads/ tracks which are at close interval and for which direct underpasses are not provided shall be connected by connecting roads.

Table 2-10: Details of SVUP

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total width (m)
1	394.345	1x7x4	2X21.25
2	396.701	1x7x4	2X21.25
3	397.251	1x7x4	2X21.25
4	401.465	1x7x4	2X21.25
5	401.741	1x7x4	2X21.25
6	405.141	1x7x4	2X21.25
7	406.501	1x7x4	2X21.25
8	410.961	1x7x4	2X21.25
9	416.686	1x7x4	2X21.25

S. No.	Design Chainage (Km)	Span Arrangement (m)	Total width (m)
10	418.291	1x7x4	2X21.25
11	422.005	1x7x4	2X21.25
12	428.616	1x7x4	2X21.25
13	429.438	1x7x4	2X21.25
14	436.110	1x7x4	2X21.25
15	438.365	1x7x4	2X21.25
16	440.200	1x7x4	2X21.25
17	441.240	1X7X4	2X21.25
18	441.760	1X7X4	2X21.25
19	442.160	1x7x4	2X21.25
20	443.520	1x7x4	2X21.25
21	445.320	1x7x4	2X21.25
22	446.600	1x7x4	2X21.25
23	447.310	1x7x4	2X21.25
24	448.200	1X7X4	2X21.25
25	449.510	1X7X4	2X21.25

Source: Design Report

2.2.13 Interchange Design

The interchanges are proposed on National highway/ State Highways. The interchanges are designed with proper ramps and loops as per IRC: 92 latest versions.

Project road will cross the following major roads NH 76 in the state of Rajasthan. Being fully access controlled, there will be no at grade junctions. Entry/Exit will only be provided from interchanges. Grade intersections adversely influence the quality of highways in terms of speed, capacity and safety because of interruptions to the flow of traffic. Thus the basic requirement for the design of intersections is not only to cater to the safe movements for the drivers, but also to provide them full traffic information by way of signs, pavement markings and traffic signals. Only one interchange has been provided and rest all crossing will be grade separated. Location of interchanges is given in **Table 2-12** below:

Table 2-11: Interchange Detail

S. No.	Design Chainage (Km)	Clear Span (m)	Skew	Total width (m)	Remarks
1	398.241	4x30		2X21.25	SH-51
2	417.810	2x30	55^{o}	2X21.25	-
3	434.825	4x30		2X21.25	NH-9A

Source: Design Report

2.2.14 Connecting / Service / Slip Roads

Connecting roads are provided to maintain proper circulation of local traffic, continuity of travel and to facilitate crossing over to the other side of the project highway through an under/overpass. Connecting roads shall be provided outside the RoW and width of connecting road shall be same as

standard of crossing road. The construction and maintenance of connecting roads shall be part of the Project Corridor.

Connecting roads also provide connectivity to highway amenities across the project highway. These roads shall be comply with standard of service road. The detail of location where connecting / service / slip road are provided is given in the below **Tables 2-13:**

Table 2-12: List of Proposed Connecting / Service / Slip Roads

Chainage		Total Length (m)	Existing	Type of Road	LHS Length(m)	RHS Length(m)
From	To		Width of Road(m)			
395.400	395500	100	3.78	B.T ROAD	100	0
401.400	401550	145	3.79	C.T ROAD	70	75
401.740	401980	240	2.4	B.T ROAD	0	240
419.700	420600	900	5.6	B.T ROAD	0	900
420.940	421240	300	5.6	B.T ROAD	0	300
429.240	429437	197	2.7	C.T ROAD	0	197
429.437	429800	363	4.06	C.T ROAD	363	0

Source: Design Report

2.2.15 Median Openings

Median openings with detachable barrier will be provided at about 12-15 km (between two interchanges) for traffic management for maintenance works and vehicles involved in accidents.

2.2.16 Boundary Wall at ROW

Road Boundary wall to be constructed as specified in Ministry Circular No.RW/NH-24036/27/2010-PPP dated 25.04.2018.

2.2.17 Embankment and Cut Sections

The design and construction of the road in embankment and cutting shall be carried out in accordance with Section 300 of MORT&H Specifications and standards & specifications given in IRC: SP-99 latest version.

2.2.18 Pavement Design

As per life cycle cost analysis and considering safeguarding the depleting natural resources, project location and the strategic importance of the Project highway (which is a major connecting link from Delhi to Vadodara and further, Vadodara-Mumbai Expressway), the perpetual pavement with a design of 50 years is recommended for the Project highway. Accordingly, summary of proposed pavement design is given in the below **Table 2-14.**

Table 2-13: Proposed Pavement Design for Main Carriageway

Pavement Composition	Pavement Type	Recommended Crust Thickness (mm)
Stone Matrix Asphalt (SMA) with PMB 40 and minimum 2% Hydrated Lime	Perpetual	50
Dense Bituminous Concrete (DBM) with minimum 2% Hydrated Lime		250

Pavement Composition	Pavement Type	Recommended Crust Thickness (mm)
Wet Mix Macadam (WMM)		150
Cement Treated Sub-base (CTSB) with minimum 2% Cement content		200
Total		650

Source: Design Report

Note: The cement and lime content shall be provided as per actual mix design during the construction, however in any case it shall not be less than as mentioned in Table 2-15 above

Table 2-14: Proposed Pavement Design for Connecting/Service & Slip Road Sections

Pavement Crust Composition	Recommended Thickness (mm)	Grade of Bitumen
Bituminous Concrete (BC)	40	VG-30
Dense Bituminous Macadam (DBM)	50	
Granular Base (WMM)	250	
Granular Sub Base (GSB)	200	
Total	540	

Source: Design Report

2.2.19 Drainage

The IRC: SP 42 will be followed for design of highway drainage. The planning of highway and drainage is intricately linked with the terrain, alignment of the highway and the proposed cross drainage works. The planning and designing of adequate drainage system is a primary requirement for maintaining a structural soundness and functional efficiency of a road. Pavement structure including sub-grade must be protected from any ingress of water; otherwise over a period of time it may weaken the sub-grade by saturating it and cause distress in the pavement structure. Hence disposal of water from the pavement and sub-grade is a basic consideration in road design. Over and above quick drainage takes away the water from pavement surface and reduces chances of skidding of vehicles. In order to guard the pavement from the poorly drained conditions, planning, designing, construction and maintenance of longitudinal drains on either side of the roads is very much essential. The surface water from the pavement and shoulders will be made to flow in to the drains by providing suitable cross Slopes / Camber.

Earthen drains are provided through-out the project corridor to ensure efficient drainage from carriageway to drain. All drains are connected to cross drainage structure. Median drains are provided with rain water harvesting structure. Proper drainage arrangements are provided for grade separated structures. If requires, CD work is also provided for loops and ramps.

2.2.20 Capacity of Project Highway

Based on the guidelines decided by the Ministry of Road Transport and Highways (MoRTH) office memorandum No. NHAI/Planning/EC/DPR/2016 dated 3rd May 2018, the end-lane configuration and the stage development to be considered based on present day traffic should be as given below **Table 2-16.**

Table 2-15: Design service volume standards for LOS-B

Sl. No.	Present traffic including induced traffic (PCU)	Present Lane Status	End Lane Status	Stage Development	ROW (m)
(i)	Upto 20,000 PCUs	Upto 2LPS	8 Lane	4 Lane highway with 4 lane structures	70
(ii)	20,000 - 30,000 PCUs	Upto 2LPS	8 Lane	6 Lane highway with 8 lane structures	70
(iii)	30,000 - 40,000 PCUs onwards	Upto 2LPS	8 Lane	8 Lane highway with 8 lane structures	70
(iv)	40,000 PCUs onwards	Upto 2LPS	12 Lane	8 Lane highway with 8 lane structures Service Roads in urban areas	100
(v)	40,000 PCUs onwards	4-Lane	6/8-Lane	* Option of a Green-filed alignment or 8 lane with 8 lane structures (where lifecycle cost is lower) * 6 Lane with 6 lane structures, in cases, where portion of the corridor has been 6 laned or 6 lane structures have already been developed on 4 lane highway or Cost of land acquisition for brown-field expansion is prohibitive.	7

2.2.21 Highway Amenities

Wayside amenities have to be provided at every 25.0 Km on both the sides. The service areas of sizes (300m X 600m and 100m X 80m) are to be provided at alternate locations. All amenities are connected with subway which enable passengers to use amenity also.

1. In the bigger wayside amenity having size of 300m x 600m, all facilities such as drinking water kiosk, toilet facilities, truck parking, bus parking, car parking, separate restaurants for truck driver, restaurants for other road users, children park, petrol station, garage, generator set/ solar system area, ATM's, Ambulance area, medical room *etc*. to be provided.

2. In the smaller wayside amenity having size of 100m x 80m, facilities such as drinking water kiosk, toilet facilities, truck parking, bus parking, car parking, restaurants, petrol station, garage, generator set/ solar system area, ATM's *etc.,* to be provided.

2.2.22 Toll booth

Toll booths are proposed along the project stretch for collection of toll fee. Toll booth shall comprise of minimum of 4 lanes for toll collection, toll islands, toll canopy, service area and administrative block. Weigh in Motion (WIM) systems shall be installed to check the overloading of vehicles.

2.2.23 Lighting

Lighting shall be provided at all interchanges, toll plazas/booths, bridges, overpasses/ underpasses and tunnels *etc*. as specified in IRC:SP:99-2013.

2.2.24 Traffic Management Systems

Advance Traffic Management Systems (ATMS) shall be provided as per Clause-816 of MORT&H Specifications for road and bridge works.

2.2.25 Way side Amenities / Service Areas

Toilet facilities and kiosks with smaller parking shall be constructed. Apart from development of access controlled 8 lane expressway, the project has also proposed several other enhancements such as, toll plazas and rest areas with restaurant, toilet facilities, ATM facility, emergency first aid, repair / maintenance facility, parking provisions for trucks and cars, PCO and Police outposts.

2.2.26 Crash Barriers

Metal Beam Crash Barriers is proposed at high embankment locations and at major bridge approaches. The barrier would be of "Thrie" beam type consisting of steel posts and a 3mm thick "Thrie" beam rail. There would be a steel spacer block between the post and the beam to prevent the vehicle from snagging on the post. The steel posts and the blocking out spacer would be channel section of 75mm x 150mm size and 5mm thick. The posts are spaced 2m centre to centre. All members of the system would be hot dipped galvanized. Crash barrier system absorbs impact of vehicle and laterally restrains a vehicle from veering off. This would ensure minimum damage to the vehicle and passengers.

2.2.27 Traffic Control Devices, Road Safety Devices and Road Side Furniture

Traffic Control Devices, Road Safety Devices and Road Side Furniture shall comprise of road signs, road markings, object markers, hazard markers, studs, delineators, attenuators, safety barriers, boundary fences, boundary stones, kilometer stones, *etc*. as per Relevant IRC Guidelines (IRC 2, IRC:8, IRC:35, IRC:67, IRC SP 99,*etc*), MORTH Guidelines for Expressways manual and Section 800 of MORT&H Specifications shall be followed.

2.2.28 Landscaping and Tree Plantation

The trees and shrubs shall be planted at appropriate locations within Right of Way as per "Green Highway Policy 2015" at the following areas.

Table 2-16: Areas Identified for landscaping & tree plantation

Sl. No.	Types of Plantation	Location (Km)	Remarks
1	Shrubs	In median except Structures	Ornamental type plantation shall be provided
2	Land Scaping	All interchanges/ Service Areas / Toll Booths / O & M Centres	Ornamental type plantation shall be provided
3	Plantations	Available open land within ROW	Two rows @5 m c/c near edge of ROW on both side

2.3 Components & Activities of the Proposed Project

The development of the road would necessarily entail the following three stages. Each of the stages would have several activities and sub-activities. The three stages are

- Detailed design and Pre-Construction Stage
- Construction Stage
- Post-Construction, Operations & Maintenance Stage

The sub-activities and activities which would be undertaken in each of the three stages are detailed in below sections.

2.3.1 Infrastructure Requirement for Highway Development

During the construction and operations of the highway the following infrastructure shall be developed and maintained by the Contractor

2.3.1.1 Construction Camp

Even though local labour shall be employed to the extent possible, the number of activities would require specialized skilled labour e.g. operator of the vehicle and machinery, skilled crews for specialised operations e.g. bar-bending and casting. These labours in most cases would be migrant from other parts of Rajasthan or other states. The Contractor will setup a construction camp for accommodation of the workers.

2.3.1.2 Hot Mix Plant

For the manufacturing of the bituminous material the contractor shall setup a Hot mix Plant. The plant shall be setup considering the sitting guidelines specified by regulatory authorities.

2.3.1.3 Batching Plant

The Concrete batching plant shall installed for concrete casting of structures i.e. Minor bridges, box and Hume pipe culverts. The Batching plant in addition to cylos for cement, aggregates and sand would also have an area for storage of cement and additives.

2.3.1.4 Lay down Areas

The contractor will identify an area for storage of the raw-material required for construction including soil, sand GSB and aggregates. These material will be stored as open heaps within the lay down area. Covering of materials, whenever required will be done in the stack-yard. The lay down area might also be used as a maintenance yard for the vehicles and machinery.

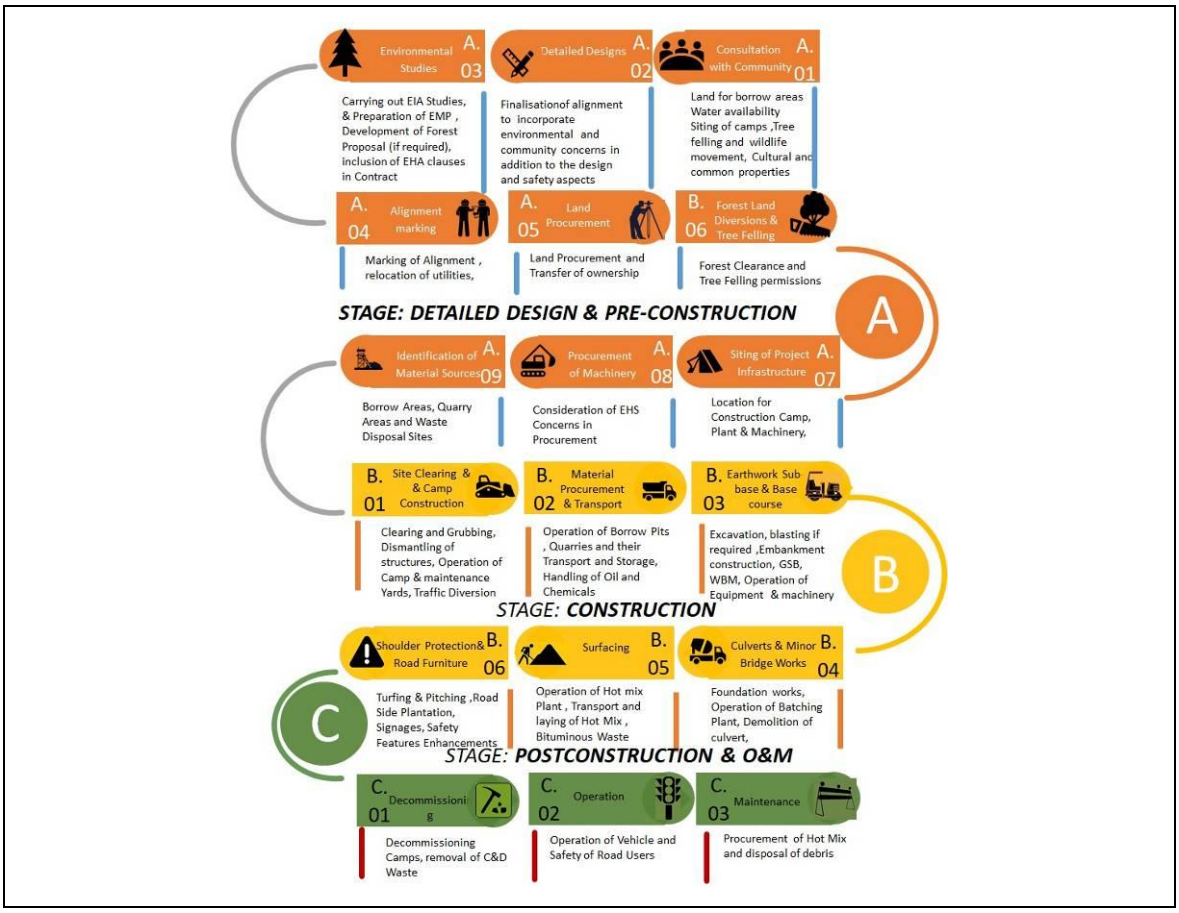


Figure 2-2: Activities in the Typical Highway development project

2.3.1.5 Waste Storage Area

The excavate material from the pavement will be stored at some places before it can be utilised or disposed of at a permanent disposal site provided by the Municipal Corporation/PWD or the local panchayat.

2.3.2 Resource Requirements for the Project

Construction material like aggregates, sand, stone, *etc*. shall be procured from nearby approved quarries. Quantity of the construction material required for the proposed 8 lane Project (Length: about 59.625 km) is given in table below.

Table 2-17: RoW Material Requirement

S. No.	Description	unit	Qty.
1	Earthwork	Cum	10194252
2	GSB	Cum	685603
3	WMM	Cum	350501
4	DBM	MT	1289312
5	BC / SMA	MT	317161
6	Bitumen	MT	70654
7	Emulsion	MT	3642

S. No.	Description	unit	Qty.
8	Cement	MT	154461
9	10 mm	Cum	330352
10	20 mm	Cum	374339
11	40 mm	Cum	215229
12	Dust	Cum	449514
13	Sand	Cum	175135
14	Filler	MT	20804
15	Steel	MT	1092777
16	Water	KL	2801120

Source: Design report

2.3.2.1 Power

Power required at the construction camp shall drawn from the grid where it is available else DG sets shall be used to supply the power to the Construction & Labour Camps.

2.3.2.2 Manpower

The manpower requirement for project shall be varied over the construction period and depending on the quantum of work. About 2200 nos. manpower will be required during the construction phase (Ref. Press Information Bureau Government of India Ministry of Road Transport & Highways dated 26th July 2018). The skilled manpower primarily the machine operators and concrete casting crew would be migrant labours and would be housed in the construction camp.

2.3.2.3 Land Requirement

The approximate land requirement for the proposed alignment is about 710.79 ha. which includes RoW and additional land. The additional land requirement includes components like interchanges and wayside amenities. Detail of the approximate land required for the proposed highway:

Table 2-18: Approximate Land Requirement

Sl. No.	Description	Approx. Land Requirements (in Ha)
1	Row - Carriageway including wayside amenities	708.04
2	Interchange	9.97
Total		**718.01**

Source: Design Report

2.3.2.4 Water

The project will require water for both construction activities and domestic purpose during the construction period. Total water demand for the project will be about 2801120 KL (Including per capita use). The water requirement for construction depends on the climatic conditions, type of equipment, type of material available, mix design; type of construction. Water quantity required for the project road has been calculated considering the following:

- 8-10% of weight of soil for the embankment construction
- 7-8% of weight of soil for sub grade construction

- 5-6% of weight of GSB materials for GSB and WMM
- 150 litre/cum for concrete
- 110 lpcd for person residents of the camp
- 45 lpcd for the no-residents

During the operations phase the water will required primarily for domestic use at the toll plaza and landscaping.

2.3.3 Pollutant Sources & Characterization

2.3.3.1 Construction Phase

During construction phase environmental impacts are likely to result primarily from operation of heavy machinery and equipment's, vehicular movement and from influx of workforce. The potential pollutant sources for construction phase and their strengths are discussed in subsequent sections.

Operations of Heavy Machineries & Vehicular Movement

The operations of construction vehicles, diesel generators and machineries will contribute to Particulate Matter (PM), Sulphur and Nitrogen dioxides (SO_2 and NOx), Carbon monoxide (CO) and other hydrocarbons (HC).

In addition, fugitive emissions are envisaged from plying of vehicles and also from storage, handling and transportation of materials during the construction phase. Mainly dust will be emitted during material transport and during loading-unloading activities which is planned to be controlled by periodic water sprinkling and by adopting good engineering practices.

Also, during construction phase, noise will be generated from operating heavy machineries and from vehicular movement. All the generator sets will be equipped with exhaust mufflers and acoustic enclosures and subjected to periodic preventive maintenance.

Generation of Construction waste

Some amount of waste will be generated from the batching plant, hot mix plant and from the demolition of the building and other structures within the proposed ROW. Some of the material will be recycled and used for back filling. Material which cannot be recycled will considered as Construction and Demolition waste and has to be disposed of as per the existing rules.

Influx of Workforce

Sewage effluent will be generated during this phase from construction camps. Solid waste generated during the construction phase from the camps is expected to comprise of food waste and recyclables viz. packaging material *etc*.

2.3.3.2 Operation Phase

During operations, of the proposed highway both solid (municipal) and liquid waste will be primarily generated from toll plaza and rest area. In case of maintenance the bituminous layer would be excavated during the repair of pavement and needs to be disposed off.

2.4 Traffic Studies & Forecast

Since it is a Greenfield highway, a thorough knowledge of the travel characteristics of the traffic on the existing alternate routes is essential for future diverted traffic estimation on the project road. Hence, detailed traffic surveys were carried out to assess the baseline traffic characteristics on various alternative routes along the proposed alignment.

The Project Highway has been divided into homogeneous sections based on the interchanges provided and for calculating the diverted traffic between 3 points. The homogeneous sections are indicated in below **Table 2-20.**

Table 2-19: Homogeneous Sections

Homogeneous Section	From (Km)	To (Km)	Length (Km)
Section 1	398.240	417.809	19.569
Section 2	417.600	434.825	17.016
Section 3	434.820	452.425	17.600

Source: Design Report

As this is a Greenfield alignment, the various existing alternative routes have been identified. These routes are those which carry the potential divertible traffic.

2.4.1.1 Section Wise Traffic

Project road has been divided into 3 homogeneous sections based on interchange points provided. The section wise traffic has been provided in below **Table 2-21.**

Table 2-20: Section-wise Normal Traffic in Year 2018-19

Homogeneous Sections	Car	Taxi	Mini bus	Govt Bus	Pvt Bus	LMV	LCV	2 Axle	3 Axle	MAV (4 - 6 A)	Total Vehicles
1	912	139	8	50	96	224	812	760	1673	2601	7275
2	740	118	8	15	80	202	699	669	1480	2508	6519
3	715	115	8	14	80	198	696	665	1470	2478	6439

Table 2-21: Section wise Projected Total Traffic

FY	Section 1	Section 2	Section 3
	PCUs	PCUs	PCUs
2018-19	7275	6519	6439
2019-20	7733	6931	6846
2020-21	8223	7371	7280
2021-22	8746	7841	7743
2022-23	10095	9134	8976
2023-24	10692	9672	9505
2024-25	11287	10207	10034
2025-26	12977	11835	11581
2026-27	13650	12441	12179
2027-28	14365	13085	12815

FY	Section 1	Section 2	Section 3
	PCUs	PCUs	PCUs
2028-29	15125	13771	13491
2029-30	16680	15252	14908
2030-31	17487	15980	15626
2031-32	18342	16751	16388
2032-33	19247	17568	17193
2033-34	20205	18434	18047
2034-35	21151	19288	18890
2035-36	22148	20189	19779
2036-37	23199	21139	20717
2037-38	24308	22141	21707
2038-39	25477	23199	22750
2039-40	26596	24210	23748
2040-41	27769	25271	24796
2041-42	29001	26385	25896
2042-43	30293	27554	27050
2043-44	31650	28781	28262
2044-45	32951	29959	29425
2045-46	34312	31190	30641
2046-47	35734	32477	31912
2047-48	37220	33823	33241
2048-49	38774	35229	34630
2049-50	40398	36700	36083
2050-51	42096	38238	37602
2051-52	43871	39845	39189
2052-53	45727	41525	40849
2053-54	47666	43282	42585
2054-55	49694	45119	44399
2055-56	51814	47039	46296
2056-57	54029	49047	48279
2057-58	56346	51146	50353
2058-59	58767	53341	52521
2059-60	**61299**	**55636**	**54788**

Junctions in terms of interchanges are to be decided catering above traffic at least or as per expressway manual guidelines whichever is governing.

2.5 Cost

The total civil cost of the project is about INR 2323.42 Cr.

3 Analysis of Alternatives

The chapter tries to compare feasible alternative to the proposed project with respect to site, technology, design *etc*. The methodology that has been adopted for the evaluation of the alternate alignment route for construction of proposed highway and possible feasible options comparises of the engineering, economic, environmental and social considerations. The chapter discusses how environmental parameters were assigned due importance and were carefully considered in the analysis of alternatives.

3.1 With & Without Project Alternatives

3.1.1 Without Project Scenario

The existing connectivity along the proposed section is mostly two / four lane highway with varying pavement width. The exisiting scenario of the high Traffic volumes along with higher estimated future traffic volumes coupled with the aim of improving the efficiency of freight movement, the capacity of the existing highway is insufficient for handling the high volume of traffic and freight movement. There are dense settlements/habitations along the exisiting highway which causes disruptions to the traffic flow and futher vehicular-pedestrian conflicts creates higher probability for accident occurance. These conflicts lead to reduced efficiency and mobility of the exisiting infrastructure. This is further compounded by the various land use conflicts, in terms of uncontrolled development along the highway. The population growth, increase in traffic volumes and the economic development along the corridor would continue to occur and will worsen the already critical situation. In the absence of proposed development, the existing unsafe conditions and the adverse environmental consequences in terms of the environmental quality along the existing roads would continue to worsen. Moreover, if it is decided not to proceed with the project, then the regional benificiaries (sub-urban and rural population along the proposed alignment) of the proposed Project will be deprived of the socio-economic development of this remote and relatively poorly connected area. herefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development. The inability of the exisiting infrastructure to meet future demands calls for development of an access controlled 8 lane carriageway with hard/granular shoulder.

3.1.2 With Project Scenario

The ‘with project scenario’ is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the development of 8 lanes with paved/granular shoulder. The scenario is economically viable and will improve the existing conditions socio economic status of the project area. It would thereby, contribute to the developmental goals envisaged by NHAI, MoRTH GoI, and enhance the growth potential of the area.

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

effectively offset the environmental damages inflicted due to the project. Comparative assessments of the "with and without" project scenarios are presented in the following table.

Table 3-1: "With and Without" Project Scenarios - A Comparative Assessment

Component	"With" Project Scenario	'Without" Project Scenario
Highway Geometrics	8-lane accces control carriageway with paved/granular shoulder	Existing highway of two/ four lanes carriageway with poor geometrics
Design Speed	120 Kmph	50-60 kmph in rural Sections with traffic jam incidences
Congestion in Settlements	Free flow of traffic due to access control carriageway.	Congestion in urban areas
Felling of road side trees	Felling of both old and young trees. 3 times of the number of new young and healthy trees to be planted as compensatory plantation.	No felling of trees. The old trees may become a safety hazard to the existing highway with passage of time.
Road Safety Measures	Access controlled highway provision of proper road markings and design of geometry to reduce accidents.	Accident incidents shall rise with an increased traffic volume.
Environmental Quality	Provision of drain on both side of the highway to improves environmental quality. An aggressive tree plantation as per IRC SP: 21:2009 and compensatory plantation shall not only provide aesthetics but also improve the quality of air. Lesser distance and free flow traffic condition will reduce carbon emission as expected from similar traffic volumes on existing highway	Poor due to congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to Increase in traffic volumes and further congestion.
Drainage	Drainage along side the proposed highway shall be impropved due to both side drainage facility.	These issues shall remain unaddressed existing highway
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate.
Development	Higher potential for development due to improvement in access and consequent increase in connectivity	Development activities will be greatly hampered by the gross inadequacy of infrastructure.
Improvement in tourism and pilgrimage	Fast and safe connectivity resulting in saving fuel, travel time and cost to reach the different tourist places	Slow movement of traffic on existing highways. Situation will further be worsened as the traffic increase with the time.

3.2 Criteria for Fixing Alignment for Greenfield Highway

Obligatory points through which Greenfield alignment options should not pass are detailed below:

Habitations: Proposed alignment is fixed in such a way that it traverses at a minimum distance of 200-300m from built up areas and avoiding important buildings and structures. However, few isolated buildings falling along the alignment cannot be avoided due to geometric requirements.

Wildlife Sanctuaries, National Parks, Reserve Forest and other Eco Sensitive zones: Utmost care is taken while fixing the alignment near wildlife sanctuaries and National Parks (NP). The MOEF&CC guidelines have been adhered to and the alignment has been fixed keeping it away from NP, Sanctuaries and Tiger Reserves. It was not possible to completely avoid the protected areas. However, every effort has been made to minimise the width and length of affected protected area.

Water Bodies: The Greenfield alignment has been fixed taking due consideration & importance of retaining the existing water bodies, ponds, tanks *etc*. as far as feasible.

Railway Crossings and Important Structures: The components which increases the project cost are the presence of the Major bridges, ROBs and other structures. In order to reduce the project cost, number of structures and their respective lengths were given due consideration while finalising the Greenfield Option.

Moreover, the alternative options have been worked out keeping the following in mind:

- The Greenfield alignment between two terminal stations should be short and straight as far as possible, but due to engineering, social and environmental considerations some deviations may be required.
- The project should be constructible and easy to maintain; the Greenfield project should reduce the vehicle operation cost with respect to the existing option already available *i.e.* using the NH/SHs in combination to reach from point A to point B.
- It should be safe at all stages i.e. during design, construction and operation stages. Safety audits at each stage should confirm the same.
- The initial cost of project (capital expenditure), maintenance cost, and operating cost should be optimum, to enable comparison of economics pertaining to life cycle cost versus other alignment options.
- The Greenfield alignment should be finalised giving due consideration to siting/location of major structures including Major/Minor Bridges, Interchanges and ROBs. The space requirement of interchanges to be kept into consideration to avoid major resettlement.
- Tunnel / Box cutting of Hills should be considered as the last option and should be provided only when it is absolutely necessary.
- The location of spurs for connecting the important towns to be decided while fixing the alignment options.
- The alignment should follow the unused / barren land to the extent possible to reduce the cost of land acquisition and carbon foot print.
- The proposed options in the present case connects the under developed regions of the state of Rajasthan which would lead to the development of new growth canter's along the proposed highway i.e. paving the way for economic development of the region.

3.3 Alignment Options

The National Highways are the highest category of roads in the Indian road network. Most of the major NHs has the following issues:

- As Highways require larger corridor to fit the cross-sectional elements befitting the futuristic traffic flow pattern, desired width cannot be accommodated within the existing road network/corridor.

- The Existing Alignment has either reached their Level of Service or would be reaching in near future.

In order to provide better connectivity between cities and to strengthen overall growth in the backward region of Rajasthan and providing connectivity of the proposed alternative with major cities through link road / spurs it was thought to have an altogether new/virgin alignment (Greenfield) which would reduce the distance and travel time between Delhi and Vadodara significantly. The proposed Greenfield alternative, being a part of that corridor, would thus be designed for a speed of 120kmph taking all design, traffic and safety considerations so as to have a world class highway catering to the future traffic demands. The project section is a section of the proposed green-field highway under Bharatmala Pariyojana Lot 4 / Package 4: Haryana- Rajasthan Border to Kota. Therefore, comparative analysis of complete Lot 4 / Package 4: Rajasthan – Haryana Border to Kota was drawn for possible alignment options. The comparative statement for proposed alignment under Lot 4 / Package 4: Rajasthan – Haryana Border to Kota is given in **Table 3-2**.

Table 3-2: Comparative Analysis for Proposed Alignment

S. No.	Description	Option I	Option II	Option III
1	Length, km	374.142	359.737	373.625
2	Start point	Alignment starts at Haryana/Rajasthan Border (near Firozpur Jhirka) in Alwar district.	Alignment starts at Haryana/Rajasthan Border (near Firozpur Jhirka) in Alwar district.	Alignment starts at Haryana/Rajasthan Border (near Firozpur Jhirka) in Alwar district.
3	End point	Alignment ends at Rajasthan/ M.P. Border in Kota district.	Alignment ends at Rajasthan/ M.P. Border in Kota district.	Alignment ends at Rajasthan/ M.P. Border in Kota district.
4	Districts	Alwar, Bharatpur, Karauli, Dausa, Sawai Madhopur, Tonk, Bundi and Kota	Alwar, Bharatpur, Karauli, Dausa, Sawai Madhopur, Tonk, Bundi and Kota	Alwar, Bharatpur, Dausa, Sawai Madhopur, Tonk, Bundi and Kota
5	Connecting Highways	NH21, NH23, NH27, NH52	NH21, NH23, NH27, NH52, NH552	NH21, NH23, NH27, NH52, NH148, NH552
		SH45, SH14, SH35, SH44, SH30, SH29, SH1, SH37A, SH33, SH51, SH9A	SH45, SH14, SH35, SH44, SH25, SH1, SH33, SH37A, SH70, SH51, SH9A	SH1, SH9A, SH14, SH24, SH25, SH25A, SH33, SH37A, SH44, SH45, SH51, SH70
6	Design Speed, Kmph	120	120	120
7	Lane Configuration	6 lane / 8 Lane Access Controlled		
8	Right of Way, m	100	100	100
9	Approx Travel Time (Hrs/Mins)	3 hrs 45 Mins	3 hrs 36 Mins	3 hrs 43 Mins
10	No of NH crossings	4	5	6
11	No of SH crossings	11	11	12
12	Access Control	Access Control Expressway		
13	Number of structures	MJB 22	MJB 16	MJB 14
		MNB 75	MNB 80	MNB 84
		FLYOVER 11	FLYOVER 10	FLYOVER 10
		INTERCHANGE 10	INTERCHANGE 10	INTERCHANGE 11

S. No.	Description	Option I	Option II	Option III
		VUP 25	VUP 35	VUP 29
		LVUP 84	LVUP 97	LVUP 76
		ROB 9	ROB 7	ROB 7
		Viaduct 1	Viaduct 1	Viaduct 0
		Tunnel 2	Tunnel 3	Tunnel 1
14	Number of settlements shall be affected	28	21	11
15	Affected Forest Area (Ha)	370.49	443.98	207.23
16	Eco-sensitive/Protected Area	Ranthambore Tiger Reserve, National Chambal Sanctuary, Mukundra Hills National Park, Mukundra Tiger Reserve, Darrah WLS	Ranthambore Tiger Reserve, National Chambal Sanctuary, Mukundra Hills National Park, Mukundra Tiger Reserve, Darrah WLS	Ranthambore Tiger Reserve, National Chambal Sanctuary, Mukundra Hills National Park, Mukundra Tiger Reserve, Darrah WLS
17	Merits	1. Passing through the agricultural and barren land		1. Alignment is passing about 12.90 km & 10.58 km away from Ranthamabore National Park and Sawai Madhopur WLS respectively.
				2. Alignment avoids the Amli Tiger Safari.
		2. The forest area is less than Option 2.	2. This Option is having the shortest length and hence would require the shortest travel time.	3. The forest area is least affected in this Option.
				4. Better connectivity to major towns through spurs at Alwar utilizing existing SH-18 & NH-248A.
				5. This option deletes the requirement of

S. No.	Description	Option I	Option II	Option III
				another expressway from Delhi to Jaipur.
				6. Minimum number of settlements affected by this Option.
18	Demerits	1. Alignment traverses through the Amli Tiger Safari which is being built by the state government and hence would not be allowed to be constructed.		1. LA cost is higher than other Options as major development exist near alignment.
		2. Alignment traverses within 550 m & 2.5km from Sawai Madhopur WLS and Ranthambore National Park respectively.	2. Alignment traverses within 5.7 km &8.2 Km from Sawai Madhopur WLS and Ranthambore National Park respectively.	
		3. Alignment is traversing Adjacent to the Ranthambore National Park & Tiger Reserve for significant length.	3. The option traverses at a significant distance from Dausa/Jaipur thus not reducing the travel time to Jaipur from Delhi with respect to NH48.	
		4. The option traverses at a significant distance from Dausa/Jaipur thus not reducing the travel time to Jaipur from Delhi with respect to NH48.		

From the above table it is evident that **Option III** is the preferred option due to following reasons and hence the same was selected by the NHAI:

- Least affected forest area
- Better connectivity to major towns through intersections at crossing state & National Highways.
- Only one tunnel is required in this option; the number of major bridges is minimum in this option.
- Avoids the Amli Tiger Safari, which is being developed by State Government.
- Having significant distance from Ranthambore National Park and Sawai Madhopur WLS as compare to other options.
- Minimum number of settlements affected.

The MORT&H/NHAI suggested the consultant to have reconnaissance / walk through of the proposed alignment so as to suggest minor tweaking as per the site condition and finalize the alignment in close coordination with local PIUs at the earliest. A number of meetings were held at NHAI/MORT&H on the following dates 12.03.2018, 19.03.2018, 26.03.2018, 09.05.2018, 14.05.2018, 28.05.2018, 13.06.2018 to finalize the alignment. Further a joint site visit was also held on 26.06.2018 and 27.06.2018 starting from Alwar up to Kota so as to firm up the alignment. Subsequent to the joint site visit the revised alignment was submitted, discussed and finalized on 16.07.2018 by NHAI/MORT&H officials.

3.4 Cold Mix & Hot Mix Technology Analysis

Cold Mix Technology involves cold asphalt which is a high-quality, polymer-modified cold mix asphalt available in batch orders. Hot Mix Technology involves Hot Mix Asphalt (HMA) which is a combination of approximately 95% stone, sand, or gravel bound together by asphalt cement, a product of crude oil. Asphalt cement is heated aggregate, combined, and mixed with the aggregate at an HMA facility. The comparison between the two is given below:

Table 3-3: Analysis of Cold & Hot Mix Technology

Sl. No.	Parameter	Cold Mix	Hot Mix
1	Description	Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity and material design, of the various components of an asphalt mix - Street Cold Asphalt is soft and sticky out of the bag, but it quickly hardens after application and the end result is a pavement patch with better strength but similar properties to hot asphalt.	Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities. Hot mix asphalt facilities can be broadly classified as either drum mix plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate is dried first, then transferred to a mixer where it is mixed with the liquid asphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement.
2	Requirements	Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shovelled or poured into a pothole or utility cut and tamped down with a hand tool.	Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C) for virgin asphalt and 330 °F (166 °C) for polymer modified asphalt, and the asphalt cement at 302°F (150 °C). Paving and compaction must be performed while the asphalt is sufficiently hot
3	Use	Cold mix asphalt concrete is produced by emulsifying the asphalt	HMAC is the form of asphalt concrete most commonly used on high traffic pavements such

Sl. No.	Parameter	Cold Mix	Hot Mix
		in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact The emulsion will break after enough water evaporates and the cold mix will, ideally, take on the properties of cold HMAC Cold mix is commonly used as a patching material and on lesser trafficked service roads	as those on major highways, racetracks and airfields Asphalt concrete has different performance characteristics in terms of surface durability, tire wear, braking efficiency and roadway noise.
4	Merits	Actually less expensive to use over the life of a road repair Completely seals and patches potholes, utility cuts, edge repairs, and even overlays.	Less expensive for new road construction
5	Demerits	Less resilient and more vulnerable to cracking	Expensive

Benefits of the Cold Mix over Hot-mix Asphalt Concrete

- Durability and strength equivalent to using hot mix
- Permanent repair compared to traditional cold-mix which is only a temporary fix
- No Priming required
- Works even when water is present
- Works at low ambient temperatures (hot-mix cannot be used in cold weather as the asphalt will cool to much prior to compacting)
- Instantly ready for traffic – and in fact product cures and hardens more quickly with compaction forces. Rapid access over the surface reduces down time where there are time-critical schedules
- Limited mess than other brands – product will not stick to or stain hands or shoes even when bucket is freshly opened
- No bleeding
- No drift of bitumen to the surface requiring surface preparation prior to any further overlay
- Reduced labour time and therefore cost
- No requirement for special equipment
- Environmentally beneficial as it reduces carbon emission andnoxious fumes avoid wastage

Cold Mix technology is more suitable for repair of potholes and cracks on roads, bridges, overlays, parking lots, other asphalt and concrete surfaces. Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However, for constructing new roads hot mix technology is better suited. Contractor/Concessionaire shall utilise the same where ever suitable.

3.5 Environmental Considerations

The various mitigation measures for minimising the extent of environmental impacts and avoiding of sensitive environmental features have been worked out. The table below provides the measures that have been adopted for offsetting the impacts. A description of the measures has been presented in the following sections.

Table 3-4: Minimization of Environmental Impacts

Criteria	Means
Maintenance of Design Speed through traffic	Geometrics as per IRC Codes
Improvement of Road Safety	Intersection Improvements; Geometric improvements at curves
Adequate drainage	Provision of drains
Reduction of Air and Noise Pollution	Aggressive tree plantations; good EMP
Displacement of Local Population	Limiting of development within PROW, SIA & RAP
Minimisation of Direct Impact on Sensitive Receptors, cultural and religious properties	Public consultations, Good EMP measures
Minimisation of Property acquisition	Alignment selection, SIA & RAP
Loss of Water body	Wise design
Avoidance of contamination due to Siltation / spillage	Silt Fencing, Oil Interceptor
Displacement of Commercial Properties	Alignment Selection, SIA & RAP
Minimisation of Loss of Utility Lines	Utility shifting in concurrence of regulatory organisation
Minimisation of Tree Loss	Maximum effort shall be given to avoid avoidable tree felling
Stabilisation of Slope	Turfing / Pitching
Accidental Road Kill of Fauna	Proper Signage, Speed Control

3.5.1 Improvement of air and noise quality

- Provision of Noise barrier
- Siting of greenfield highway beyond the settlement reach

3.5.2 Avoidance of Impact of Sensitive, Cultural and Community Properties

- By providing underpass for smooth and safe travel of local populace
- Providing noise attenuation measures mainly along schools and hospitals
- Avoiding direct impact on sensitive receptors

4 DESCRIPTION OF ENVIRONMENT

4.1 General

As a precursor for the prediction of various types of environmental impacts likely to arise due to implementation of the project, it is essential to establish the baseline environmental status in the Direct and Indirect Area of Influence. Details of baseline environment parameters are required for decision making for the project.

4.2 Study area & period

As per the EIA Guidance Manual for Highways (MoEF&CC, 2010), a study area of 15 km radius from the project road was considered for secondary data collection. Primary data has been collected within 500 meters on either side of the proposed alignment. secondary data were collected from publish reports, research papers, working plans, consultation and discussion with Govt. officials. Primary baseline environment monitoring was carried out for the period of March to May, 2018.

4.3 Physical Environment

Physical environmental components along the project road are described below.

4.3.1 Physiography and terrain

Rajasthan has fairly mature topography developed during the long period of denudation and erosion. The present physiography and landforms are greatly determined by geological formations and structures and is the product of the past fluvial cycle of erosion and the recent & continuing desert cycle of erosion. Physio-graphically Rajasthan state can be divided into four units.

- Aravalli hill ranges
- Eastern plains
- Western Sandy Plain and Sand Dunes and
- Vindhyan Scarpland and Deccan Lava Plateau

Kota district is located in the south-east of Rajasthan State. Its shape is something like a cross. The land slopes gently from south to north and is drained by the Chambal and its tributaries. Hills are seen in north, south and eastern portions. Bundi district is in West. The Mukandara range of Vindhyan Hills, which is 145 km long, is located in the district. At many places, it has a curious double formation of two separate ridges, running parallel to each other at a distance of more than two kilometers. The portions lying between these ridges are often covered with dense forests.

Figure 4-1 : Elevation Profile of the Project Area

The proposed road alignment follows mostly plain and rolling terrain. Elevation varies from about 207m above MSL to 283m above MSL.

Proposed alignment mostly passes through the agricultural, barren, forest and hilly area. Some settlement areas also located in close vicinity of proposed alignment.

4.3.2 Climatology

According to the CGWB Report 2017, the year in Rajasthan can be divided into three major conventional seasons as follows:

- The Hot- Weather Season (March to end of June)
- Monsoon Season (End of June to September)
- The Cold- Weather Season (October to February)

The India Meteorological Department has further sub-divided the cold season into two divisions, *i.e.*

- The Season of retreating monsoon (October to December)
- The cold season (January to February)

These seasonal variations have been broadly based on temperature and rainfall conditions in different months.

Kota District

The district has a dry climate. The coldest months last for about three and a half months from November to the mid of February. The period from April to the end of June constitutes the hottest months. The monsoon season starts in the month of July. The hottest wind blows in the months of May and June. Mild wind blows in the months of February, March, September and October. Coldest wind blows in the months of December and January. The district gets maximum rainfall in the months of July & August and minimum in the months of March & April. The weather becomes moisturized and slightly cold during the rainy seasons.

Minimum and maximum temperature was recorded 6.1°C and 48.4°C respectively. The average humidity found as 48% during the period of 2007 to 2011.

Table 4-1: Temperature and Humidity during the Years 2007 - 2011

Year	Temperature (in °C)			Humidity %
	Maximum	Minimum	Mean	
2007	44.9	7.7	27.6	45
2008	44.4	6.2	27.0	46
2009	46.5	9.1	28.2	45
2010	48.4	7.5	28.4	47
2011	47.4	6.1	27.3	48

Source: India Meteorological Department, government of India

Long-Term climatological data has been collected for assessment of prevailing meteorological scenario of the project region, which shows avg. annual of the region is rainfall 586.02mm. The details of long term climatological conditions are given in **Table 4-1** below.

Table 4-2: Long-Term Climatological Conditions at Kota IMD Observatories (1981-2010)

Month	Temp Monthly (°C)		Humidity (%)		Average Wind Speed (kmph)	Dominant Direction	Avg. Rainfall (mm)
	Max	Min	Morning	Evening			
January	28.8	7.9	64	38	4.3	E, NE, N	4.8
February	32.8	10.2	51	29	5.2	NE,E, N	5.9
March	39.2	14.6	36	18	6.1	NE,N,E	4.0
April	43.8	19.8	25	12	7.8	W,NW	3.4
May	45.6	24.0	31	15	10.6	W,NW	11.3
June	44.7	24.1	49	31	12	W,SW	53.32
July	39.3	23.5	72	59	11.5	W,SW	209.6
August	35.8	23.5	79	67	10	W,SW	201.2
September	37.6	23.0	68	51	8.3	W,NW	62.9
October	37.5	18.6	48	29	4.9	NE,E	18.1
November	33.8	13.1	51	31	3.6	NE,E	6.3
December	29.7	9.2	60	37	3.5	NE,E	5.2
Average	**37.38**	**17.62**	**52.83**	**34.75**	**7.3**	**NE,N**	**586.02**

Source: Climatological Normals, Kota IMD Stations, 1981-2010

4.3.3 Geology

The project district is not very much rich in minerals. The building stone is the most important and main mineral found in the Kota district. The deposits of many non-metallic minerals occur in the district out of which the important are sandstone and limestone. The sand stone is quarried in large quantities near Khemaj, Mukundwara and Kanwas. Whereas limestones are exposed between Deoli and suket. These are extensively quarried as slabs for flooring and are well known as Kota Stone. Structurally, vindhyan group of rocks are less disturbed. Over a greater part of the area, the beds are nearly horizontal but at places they show steep dips

4.3.4 Soil

The rocks of Vindhyan system, Satpura range, Narmada Valley, Western Malva plateau and Madhya Bharat plateau cover the major part of the Kota district. However, the small areas lying to the eastern sides of Kota are an exception in as much as their geological antiquity belongs to Deccan Traps of upper cretaceous to lower eoceneage.

Table 4-3: Major Soil Category found in Kota district

S. No.	Major Soils	Area ('000 ha)	% of total
1	Deep black clayey soils	216.5	42
2	Deep brown clayey soils	78.4	15
3	Deep brown loamy soils	57.6	11

Source: Agriculture Contingency Plan, Dept of Agriculture Cooperation & Farmers welfare, Govt. of India.

For studying soil quality, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The samples were collected by ramming a core-cutter into the soil up to 90-cm depth. The soil quality was monitored at six locations to assess the soil quality in and around the project alignment. The homogenized samples were analysed for physical and chemical characteristics. The sealed samples were sent to laboratory

for analysis. Soil samples were analysed as per the standard methods prescribed in "Soil Chemical Analysis" (M.L. Jackson, 1967). Soil sampling locations are given in below **Figure 4-2** & **Table 4-3.**

Table 4-4: Soil Sampling Locations

S. No.	Station Code	Ch: (km)	Location	GPS Coordinates	Date of Sampling
1	SQ1	396 + 500	Talha	N 25°5'05.90" E 76°03'01.77"	02-04-2018
2	SQ2	399 + 200	Balapura	N 25°3'50.21" E 76°02'16.90"	04-04-2018
3	SQ3	400 + 200	Arandkhera	N 25°02'23.26" E 76°01'29.58"	06-04-2018
4	SQ4	418 + 450	Phatakhera	N 24°54'32.33" E 75°58'11.05"	08-04-2018
5	SQ5	435 + 650	Chechat	N 24°45'45.08" E 75°53'58.71"	10-04-2018
6	SQ6	447 + 600	Goyanda	N 24°38'46.01" E 75°52'04.13"	12-04-2018

The important physical characteristics of soil are bulk density, porosity and texture. pH of soil was found in the range of 6.88 to 7.65, the soil are, therefore, moderately alkaline. Conductivity of soil in the proposed study area is found to be in the range of 0.20 to 0.37 ms/cm. Available phosphorous of soil samples along the proposed study area ranges from 32.6 to 44.6mg/kg. Potassium content as K in soil samples along the proposed study area is found in the range of 127.6 to156.4 mg/kg. Total organic matter in soil samples along the proposed Study area is found to be fairly high (0.32 – 0.54 %), therefore the soil is having average fertility fertile in terms of productivity.

Table 4-5: Soil Test Result

Sl. No.	Parameter	Unit	SQ-1	SQ-2	SQ-3	SQ-4	SQ-5	SQ-6
1	pH(1:5 suspension)	---	6.88	7.12	7.65	7.32	7.42	7.04
2	Electrical Conductivity at 25^{O}C (1:5 suspension)	mS/cm	0.2	0.37	0.34	0.29	0.26	0.24
3	Infiltration Rate	mm/hr	240	244	248	242	241	238
4	Organic Matter	% by mass	0.48	0.54	0.42	0.36	0.32	0.38
5	Sulphate	mg/kg	55.1	68.2	65.3	62.8	64.2	70.1
6	Potassium (as K)	mg/kg	132.3	127.6	142.3	156.4	140.1	130.5
7	Moisture Retention Capacity	% by mass	36.2	34.1	38.5	39	35.5	32.8
8	Porosity	% by mass	42.1	45.8	40.6	36.2	44.4	38
9	Sand	% by mass	65.1	62.7	66.4	64.8	70.2	69.6
10	Clay	% by mass	16.8	18.2	14	16.6	15.5	12.8
11	Silt	% by mass	18.1	19	19.5	18.6	14.2	17.6
12	Texture	---	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
13	Sodium Sulphate	% by mass	0.034	0.031	0.034	0.036	0.038	0.035
14	Nitrogen	mg/kg	338	334	344	348	341	336
15	Phosphorus	mg/kg	35.6	32.6	38.8	44.6	40.8	44.2
16	Bulk Density	gm /cc	1.296	1.302	1.294	1.308	1.312	1.308

Source: Primary Survey by Noida Testing Laboratories

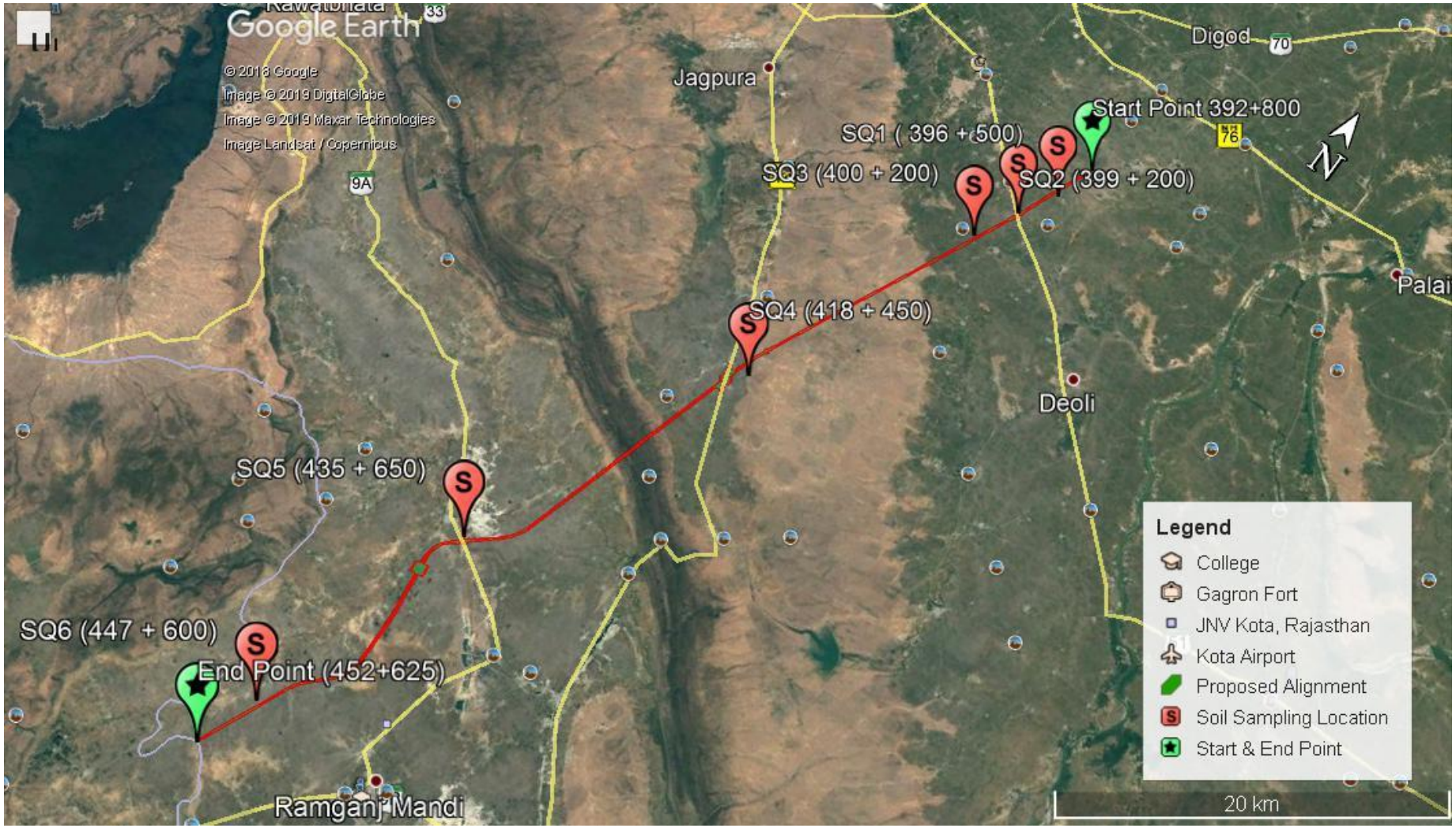


Figure 4-2: Soil Sampling Location on Google Map

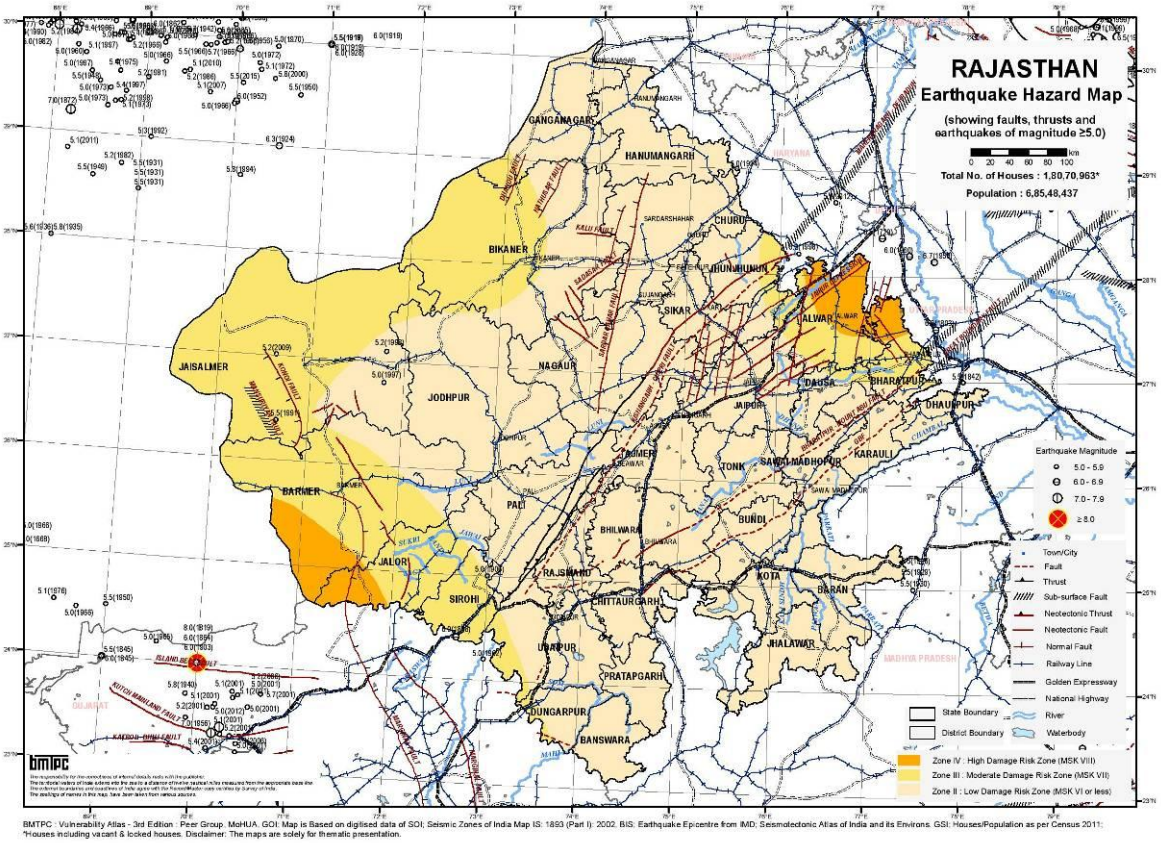
4.3.5 Seismicity

Bureau of Indian Standards [IS-1893 part 1: 2002], based on various scientific inputs from a number of agencies including earthquake data supplied by IMD, has grouped the country into four seismic zones viz., Zone-II, -III, -IV and -V. Of these, zone V is rated as the most seismically prone region, while zone II is the least. Rajasthan state falls in Zones II, III & IV.

The project district falling within the low damage earthquake Risk Zone.

Table 4-6: Earthquake frequency of Project district

S. No.	Seismic Zone	Intensity MSK	Magnitude	District
1	II [Low damage Risk Zone]	II	4.0 - 4.0	Kota



BMTPC : Vulnerability Atlas - 3rd Edition Peer Group: MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS: 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Source: Vulnerability Atlas of India, Third Edition 2019, Earthquake, Wind, Flood, Landslide, Thunderstorm Maps and Damage Risk to Housin, BMTPC

Figure 4-3: Seismic Zones Map of Rajasthan

4.3.6 Land Use and Land Cover

The proposed alignment passes through a large part of agricultural, barren, forest and hilly area across Kota district. The Land Use & Land Cover along the project alignment are presented below.

Table 4-7: Land Use Land Cover of the 500 m buffer of proposed alignment (central line)

S. No.	Category	500 m Buffer Area (sqm)
1	Agriculture Plantation	61.05

S. No.	Category	500 m Buffer Area (sqm)
2	Built Up Area	38.92
3	Canal	2.26
4	Crop Land	1543.41
5	Drain	7.80
6	Fallow Land	15.62
7	Ponds	13.76
8	RAIL	6.41
9	River	12.88
10	Road	34.58
11	Scrub land	310.12
Total		**2046.81**

Source: Google Earth

The graphical representation of the Land use – Land cover distribution in study area is presented in **Figure 4-4.** LULC map is enclosed as ***Annexure 4.1.***

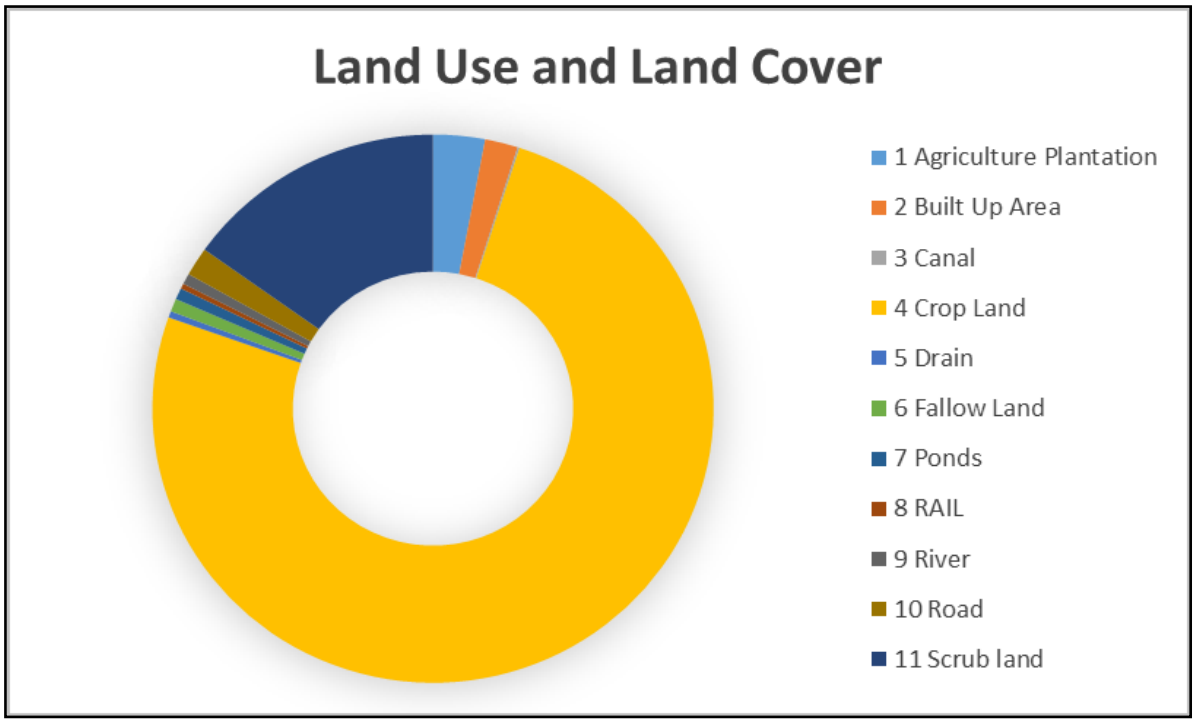


Figure 4-4: Land use – Land Cover Distribution of Study Area

4.4 Ambient Air Environment & Quality

A network of six (6) five ambient air quality sampling locations has been selected for assessment of the existing status of air environment within the study zone. The selection of monitoring locations has been distributed throughout the study area so as to get representative baseline of any variation in land use as well as road geometrics and traffic conditions across the proposed alignment including the baseline at sensitive receptors along the project. The selected locations of ambient air monitoring stations are presented in below **Table 4-7** & **Figure 4.5.**

Table 4-8: Ambient Air Quality (AAQ) Monitoring Stations/Location

S. No.	Station Code	Chainage (km)	Location	Area Category	Distance from Road edge (m)	GPS Coordinates	Height from Ground Level (m)
1	AQ1	395+500	Talha	Residential	100	N 25°05'05.77", E76°03'12.27"	3.5
2	AQ2	398+000	Balapura	Residential	80	N 25°03'48.75", E 76°02'12.72"	4.2
3	AQ3	401+100	Arandkhera	Residential	50	N 25°02'24.69", E 76°01'25.58"	2.8
4	AQ4	417+800	Phatakhera	Residential	150	N 24°04'25.90", E 75°58'11.05"	4
5	AQ5	434+600	Chechat	Residential	100	N 24°45'45.08", E 75°53'58.71"	3.4
6	AQ6	448+850	Goyanda	Residential	100	N 24°38'46.01", E 75°52'04.13"	2.5

Source: Primary Survey

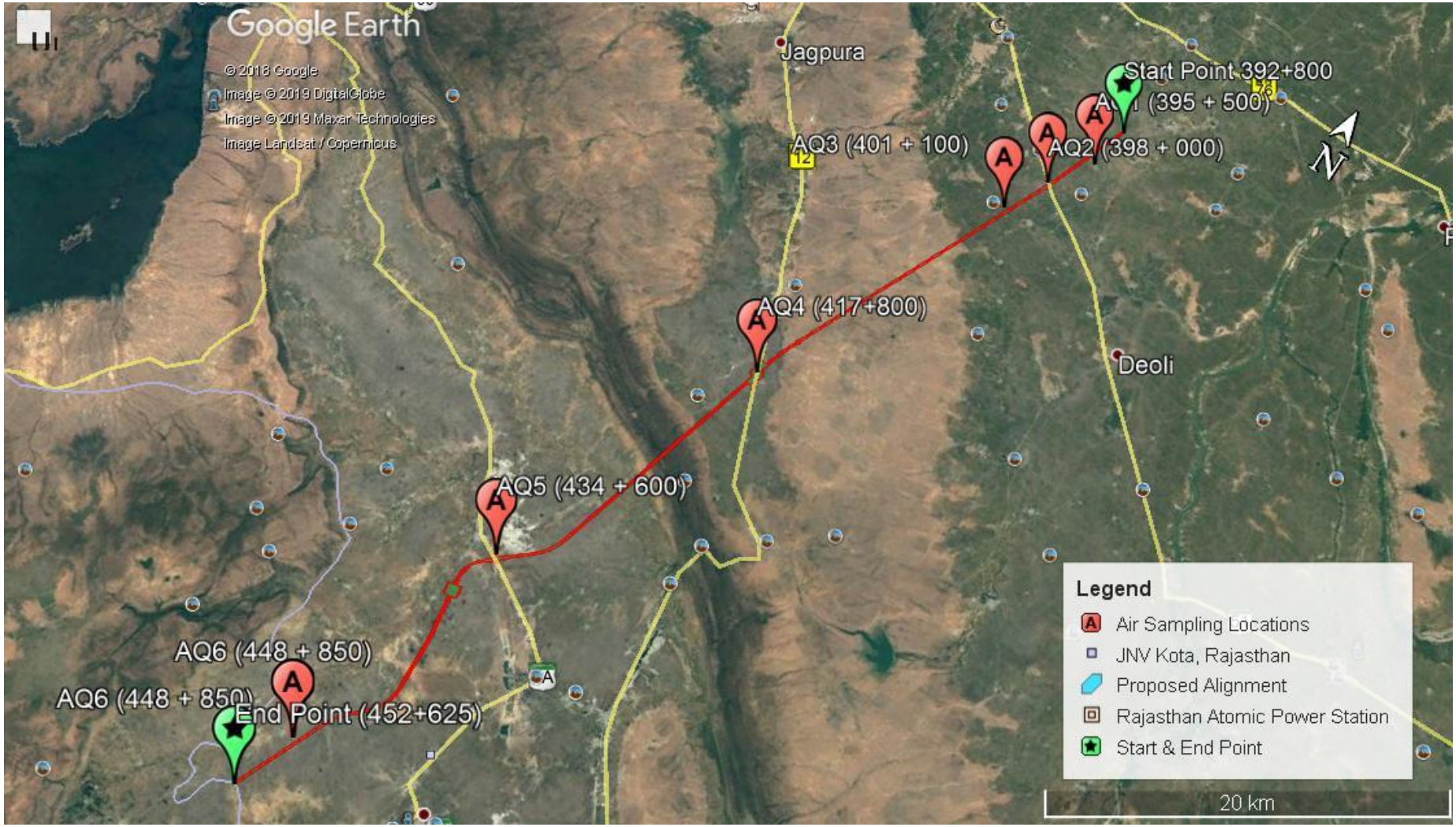


Figure 4-5 : Ambient Air Quality (AQ) Monitoring Location

The summary of ambient air quality results for the project stretch is presented in below **Table 4-8.** The results indicate that all air quality parameters are within the standards specified in the NAAQS except PM 10 AND 2.5. These two parameters found crossing the NAAQS at Chechat due to commercial activities. The 98th percentile value of PM 10 varies between 72.24µg/m3 at Habitation Area (Village – Goyanda) &114.64µg/m3at Habitation Area (Village – Chechat). The below table shows the comparison of PM10 value with the NAAQ standard.The 98th percentile value of PM 2.5 varies between 42.68µg/m3 at Habitation Area (Village –Talha) & 67.38µg/m3at Habitation Area (Village – Chechat).

The 98th percentile value of SO_2 varies between 11.51 µg/m^3 at Habitation Area (Village – Talha) & 20.19 µg/m^3 at Chechat Village. The 98th percentile value of NO_2 varies between 24.08 µg/m^3 Habitation Area (Village –Phatakhera) & 33.24 µg/m^3 at Habitation Area (Village – Chechat). The below table shows the comparison of SO_2 and NO_X value with the NAAQ standards.

The 98th percentile value of CO varies between 0.61 mg/m^3 at Habitation Area (Village – Talha) & 0.82 mg/m^3 at Habitation Area (Village – Chechat).The below table shows the comparison of CO value with the NAAQ standards

Table 4-9: Results of Ambient Air Quality Monitoring

S. No	Sample Code	PM10 (µg/m3)			PM 2.5 (µg/m3)			SOx (µg/m3)			NOx (µg/m3)			CO (µg/m3)		
		Min	Max	98%	Min	Max	98%	Min	Max	98%	Min	Max	98%	Min	Max	98%
1.	AAQ1	60.3	77.1	76.1	31.8	43.7	42.7	6.3	11.7	11.5	16.3	26.2	25.5	0.42	0.65	0.61
2.	AAQ2	60.6	74.2	74.1	33.3	45.8	44.7	7.6	13.5	13.2	19.6	28.4	27.0	0.54	0.67	0.67
3.	AAQ3	60.3	75.6	74.5	34.1	46.4	45.4	8.1	16.4	16.4	17.5	29.1	29.0	0.55	0.74	0.73
4.	AAQ4	56.6	75.0	74.5	26.0	45.9	45.4	6.9	12.2	12.1	14.8	24.7	24.1	0.51	0.72	0.7
5.	AAQ5	90.6	114.7	114.6	56.5	68.3	67.4	10.3	20.2	20.2	22.3	34.2	33.2	0.59	0.82	0.82
6.	AAQ6	59.3	72.3	72.2	30.5	48.2	47.2	7.3	15.4	14.9	17.7	29.5	28.3	0.56	0.73	0.72
NAAQS Limit		**100**			**60**			**80**			**80**			**4**		

Source: Primary Survey by Noida Testing Laboratories

4.4.1 Ambient Noise Quality

Noise is an important environmental attribute in all road projects because vehicular traffic is a major source of noise pollution. Six (6) ambient noise-sampling locations were identified for noise monitoring to characterize the baseline noise levels in the project area. Locations for noise monitoring along the corridor are identified to cover the various land use present along the corridor. Noise monitoring stations are detailed in Table below and **Figure 4.9**.

Table 4-10: Noise monitoring location

S. No.	Station Code	Ch (km)	Location	Date of Sampling	Area Categorization	GPS Coordinates
1	N1	395 + 500	Talha	02-04-2018	Residential	N 25°05'05.77", E 76°03'12.27"
2	N2	398 + 600	Balapura	04-04-2018	Residential	N 25°03'48.75", E 76°02'12.72"
3	N3	401 + 100	Arandkhera	06-04-2018	Residential	N 25°02'24.69", E 76°01'25.58"
4	N4	417 + 100	Phatakhera	08-04-2018	Commercial	N 24°54'25.90", E 75°58'11.05"
5	N5	434 + 600	Chechat	10-04-2018	Residential	N 24°45'45.08", E 75°53'58.71"
6	N6	448 + 850	Goyanda	12-04-2018	Residential	N 24°38'46.01", E 75°52'04.13"

Source: Primary Surveys

The main objective of noise monitoring in the study area is to establish the baseline noise levels, which was used to assess the impact of total noise generated by the proposed project activities. Noise level monitoring was carried out continuously for 24 - hours with one-hour interval at each location using Sound level meter capable of measuring the Sound Pressure Level (SPL) in dB (A). Hourly Leq values were computed by the noise integrating sound level meter and statistical analysis was done for measured noise levels.

The Leq day, and Leq night calculated for various locations in the area are presented below which are compared with the standards prescribed by CPCB for various zones. The Noise quality result presented in below table, show Leq Day time varies from 43.7 to 58.2 dB(A) and Leq Night time varies from 37.0 to 47.8 dB(A).

Table 4-11: Results of Primary Noise Monitoring

S. No.	Sampling Site	L Max	L Min	Leq Day	Leq Night	L10	L50	L90	Noise Quality Standards in dB (A)	
1	NM 1	55.0	37.6	49.8	41.0	48.95	44.87	37.64	**55**	**45**
2	NM 2	55.0	42.4	51.9	37.6	46.795	44.15	39.75	**55**	**45**
3	NM 3	54.8	44.4	50.9	40.7	48.625	45.02	40.52	**55**	**45**
4	NM 4	62.7	51.8	58.2	47.8	56.38	51.35	46.95	**65**	**55**
5	NM 5	48.7	37.8	43.7	41.2	45.21	41.77	36.58	**55**	**45**
6	NM 6	50.0	35.4	45.3	37.0	43.585	40.05	35.65	**55**	**45**

Source: Primary Survey by Noida Testing Laboratories

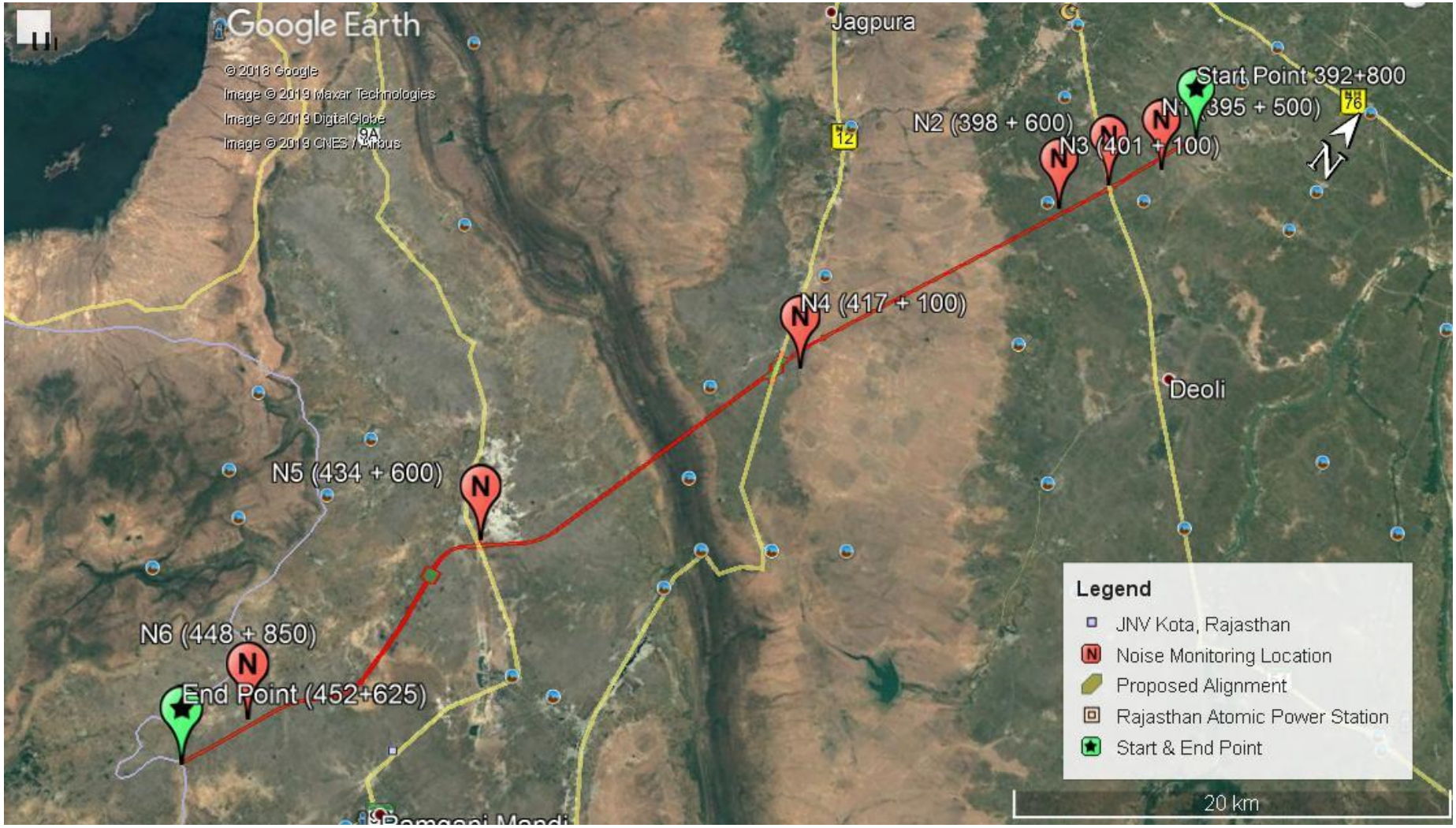


Figure 4-6: Ambient Noise Level (ANL) Sampling Location

4.5 Water Resources

Rainfall is the major source of ground water recharge in the state. However, Rajasthan receives much lower rainfall compared to the other parts of the country. Out of the total rainfall, a sizable portion is in the beginning of the rainy season and this is used for building the soil moisture and lost to evaporation because of its arid conditions.

The Aravalli Hills Ranges from main water divide in Rajasthan. Luni is the only river west of Aravallis. In the remaining area of western Rajasthan comprising about 60% of the geographical area of the state, the drainage is internal, and the streams are lost in the desert sands after flowing for a short distance from the point of origin. Luni itself essentially is an ephemeral stream with flood cycle of 16 years. Drainage in western Rajasthan is towards west and south - west.

The proposed project is falling in the east of Aravalli ranges the main drainage is towards north – east. The rivers of the Rajasthan are mostly seasonal with only two river basins (Chambal and Mahi) being perennial. The Chambal catchment occupies 23% of the total geographical area of the state.

4.5.1 Groundwater Quality

Keeping in view the importance of ground water to the local population, six (6) representative ground water and (3) three surface water sampling locations were identified and analysed for assessment of prevailing water quality. The location for the ground & Surface water sampling is provided in below **Table 4.11 &** F**igure 4.7.**

Table 4-12: Ground & Surface water sampling locations

S. No.	Station Code	Design chainage (Km)	Location	GPS Coordinates
1	GW1	395 + 500	Talha	25°05’05.77”N, 76°03’12.27”E
2	GW2	398 + 000	Balapura	25°03’48.75”N, 76°02’12.72”E
3	GW3	401 + 100	Arandkhera	25°02’24.69”N, 76°01’25.58”E
4	GW4	417 + 800	Phatakhera	24°04’25.90”N, 75°58’11.05”E
5	GW5	434 + 600	Chechat	24°45’45.08”N, 75°53’58.71”E
6	GW6	448 + 850	Goyanda	24°38’46.01”N, 75°52’4.13”E
7	SW1	395 + 500	Talha	25°05'6.62"N, 76°03'10.98"E
8	SW2	397 + 800	Arandkhera	25°04'0.14"N, 76°02'11.16"E
9	SW3	427 + 800	Nayagaon Jag	24°48'49.84"N, 75°56'7.25"E

Source: Primary Survey

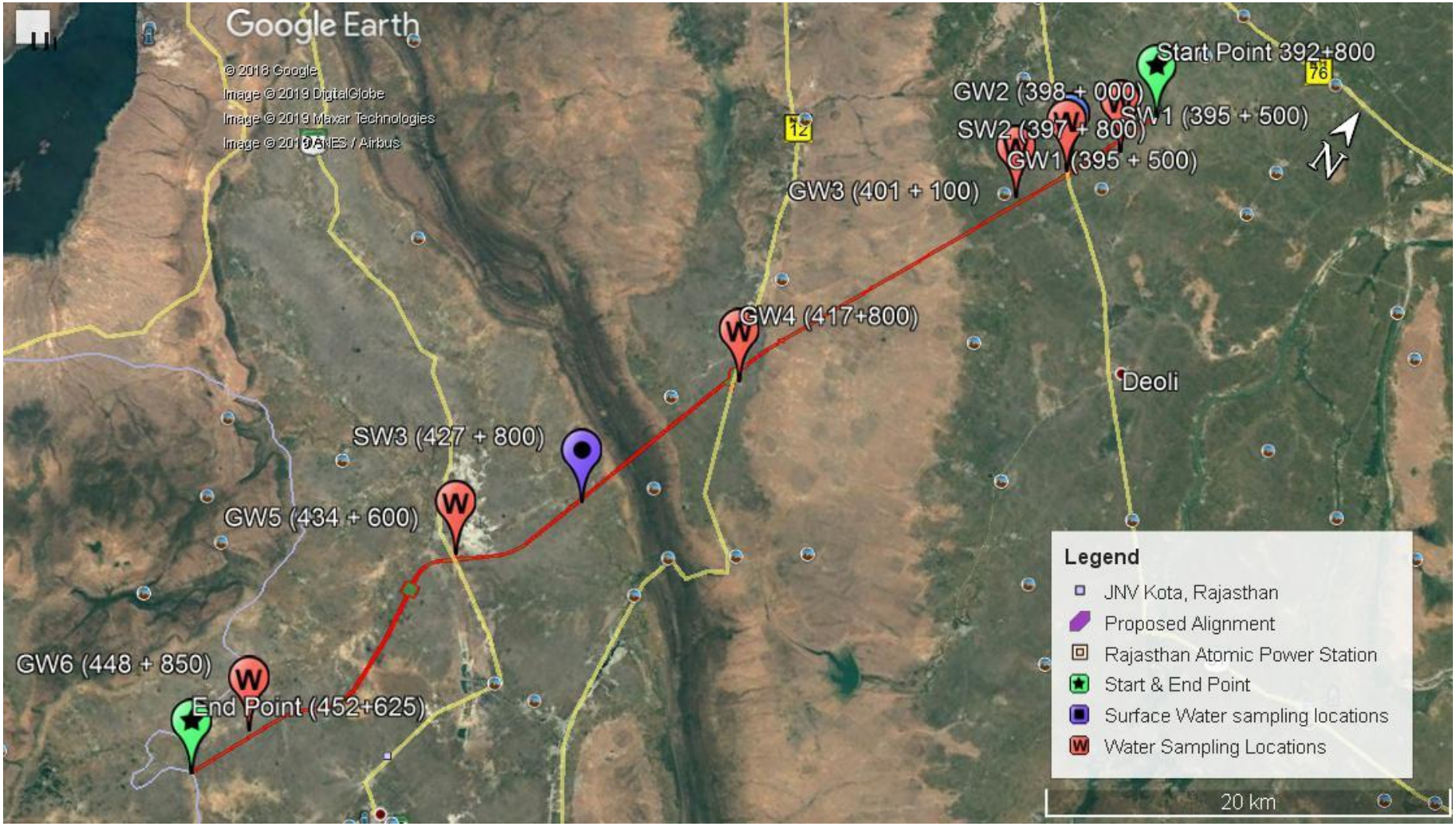


Figure 4-7: Ground & Surface Sampling Location

Table 4-13: Ground Water Monitoring Results

S. No.	Parameter	Unit	IS-10500:2012		GW-01	GW-02	GW-03	GW-04	GW-05	GW-06
			Acceptable Limit	Permissible Limit						
1	Colour	Hazen Unit	5	15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Temperature	^{0}C	-	-	28	28	28	28	28	28
4	Turbidity	NTU	1	5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
5	pH value	-	6.5-8.5	-	6.16	7	6.85	6.8	6.7	6.77
6	Total Dissolve Solid	mg/l	500	2000	732	703	477	554	462	550
7	Calcium (as Ca)	mg/l	75	200	78.57	75.36	75.33	62.54	75.36	80.16
8	Chloride (as Cl)	mg/l	250	1000	59.99	69.98	41.99	75.98	39.99	49.99
9	Copper (as Cu)	mg/l	0.05	1.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
10	Fluoride (as F)	mg/l	1	1.5	0.61	0.52	0.54	0.53	0.43	0.49
11	Iron (as Fe)	mg/l	0.3	No Relaxation	0.284	0.184	0.141	0.187	0.148	0.201
12	Magnesium (as Mg)	mg/l	30	100	44.71	50.67	28.19	37.91	41.8	41.8
13	Manganese (as Mn)	mg/l	0.1	0.3	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
14	Nitrate (as NO_3)	mg/l	45	No Relaxation	6.84	6.12	6.1	5.01	6.03	6.15
15	Nitrite (as NO_2)	mg/l	0.01	No Relaxation	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
16	Sulphate (as SO_4)	mg/l	200	400	61.32	36.36	41.5	35.4	34.19	37.4
17	Alkalinity (as Ca CO_3)	mg/l	200	600	440	424	360	372	428	440
18	Total Hardness	mg/l	200	600	384	396	304	312	360	372
19	Zinc (as Zn)	mg/l	5.0	15	0.284	0.274	0.147	0.088	0.148	0.169
20	Lead (as Pb)	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21	Arsenic (as As)	mg/l	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
22	Total Chromium (as Cr)	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Escherichia coli	Absent/100ml	Absent/100ml	--	Absent	Absent	Absent	Absent	Absent	Absent
24	Coliform Bacteria	Absent/100ml	Absent/100ml	--	Absent	Absent	Absent	Absent	Absent	Absent

Source: Primary Survey by Noida Testing Laboratories

In Kota district, ground water occurs in mainly four hydro-geological formations. These hydro-geological formations are alluvium, sandstone, shale & limestone and among these formations alluvium is the most important formation as it covers the maximum area and also it is the most potential among different hydro-geological formations.

pH ranging from 6.16 to 7.0 in ground water samples taken along the proposed alignment. The chloride content varies from 39.99 to 69.98 mg/l. The Fluoride content in the Kota district is found within 0.43 to 0.61mg/l. The concentration of Nitrate ranges from 5.01 mg/l to 6.84 mg/l. Nitrate values in major part of the district are within 45 mg/l, the maximum permissible limit in drinking water as prescribed by BIS. The concentration of iron in ground water has been found to vary from 0.141 to 0.284 mg/l.

4.5.2 Surface Water Quality

Surface water quality of the entire project stretch has been monitored as per the parameters laid down by Central Pollution Control Board for assessment of surface water quality criteria at 3 locations along the proposed alignment.

Analysis results of surface water quality monitoring revealed that surface water quality meet CPCB water quality criteria Class C. It can be concluded that the surface water is suitable for propagation of Wildlife and fisheries, irrigation and Industrial cooling purpose. Presence of Faecal Coliform indicates, the surface water is contaminated with human excreta, house hold waste, *etc.*

Table 4-14: Surface Water Test Result

S. No.	Parameters	Unit	SW-1	SW-2	SW-3	Tolerance Limit IS:2296 CLASS C
1	pH	-	7.56	6.9	7.76	6.5 -8.5
2	Temperature	ºC	24.1	24.2	22.4	Not Specified
3	Turbidity	NTU	12.6	54.1	6.3	Not Specified
4	Conductivity @ 25^0C	mg/l	466	900	418	Not Specified
5	Sulphate (SO_4)	mg/l	42.01	54.2	20.91	400
6	Nitrate (NO_3)	mg/l	6.5	10.32	3.54	50
7	Total Hardness (as $CaCO_3$)	mg/l	130	292	177	Not Specified
8	Chloride (as Cl)	mg/l	20.14	142.99	15.61	600
9	Fluoride (as F)	mg/l	0.32	0.68	0.26	1.5
10	COD (as O2)	mg/l	11.4	16	10.3	Not Specified
11	Iron (as Fe)	mg/l	0.348	0.502	0.184	50
12	Dissolve Oxygen	mg/l	6	5.6	6.4	4
13	Total Dissolved Solid	mg/l	298	576	268	1500
14	BOD (3 days at 27^0C)	mg/l	4	6.3	3.4	3
15	Calcium (as Ca)	mg/l	28	60.92	39.27	Not Specified
16	Magnesium (as Mg)	mg/l	14.58	34.02	19.2	Not Specified
17	Arsenic (as As)	mg/l	<0.01	<0.01	<0.01	0.2
18	Lead (as Pb)	mg/l	<0.05	<0.05	<0.05	0.1
19	Copper (as Cu)	mg/l	0.093	0.208	<0.05	1.5
20	Zinc (as Zn)	mg/l	0.34	0.398	0.184	15

S. No.	Parameters	Unit	SW-1	SW-2	SW-3	Tolerance Limit IS:2296 CLASS C
21	Manganese (as Mn)	mg/l	0.09	0.11	<0.1	Not Specified
22	Total Chromium (as Cr)	mg/l	<0.05	<0.05	<0.05	0.05
23	Sodium (as Na)	mg/l	12.9	92	92	Not Specified
24	Potassium (as K)	mg/l	2.4	7.8	7.8	Not Specified
25	Total Alkalinity (as $CaCO_3$)	mg/l	143	344	344	Not Specified
26	Total Solid	mg/l	321.8	650.4	273	Not Specified
27	Phosphate (as P)	mg/l	0.164	0.184	0.184	Not Specified
28	Nitrite (as NO_2)	mg/l	<0.01	<0.01	<0.01	Not Specified
29	Total Suspended Solid	mg/l	23.8	74.4	5	Not Specified
30	Total Coliform	MPN/100ML	4.6×10^3	3.4×10^3	1.3×10^3	5000

4.6 Use of Natural Resources

The objective was to locate suitable materials for the construction of embankment, sub-grade and top layers of pavement and bridge structures. The study was carried out to determine the engineering properties of the following materials, which are to be used in construction.

- Borrow areas for locating suitable soils for use in embankment and sub-grade.
- Quarries for locating hard stone / granular materials for use in sub bases, bases, bituminous mixes and concrete works
- Source of fine aggregate for use in DBM/BC layers and cement concrete works.

4.6.1 Borrow Area

The survey of soil from borrows areas for use in embankment and sub-grade layer was conducted along the proposed alignment. The location of borrow areas with their distances from the proposed alignment and the quantities available are given in **Table 4-14** below:

Table 4-15: Identified Borrow Area Locations

S. No.	Location (Ch.)	Direction	Name of village	Lead from Proposed Alignment (Km)	Latitude / Longitude	Quantity / Availability
1	412	LHS	KalyaKheri	6.64	24°51'42.9768''N 75°58'58.6488''E	Abundant

Source: Design Report

4.6.2 Quarry & Crushers

Road construction activities are closely linked with quarry sites around the work sites. The stone materials including sand and granular ones are needed in large quantities for the pavement construction. The other area of requirement is concrete structures, which call for a good quality stone. Extensive survey was conducted to locate the availability of stone metal near the project site. As a result of local enquiries and discussion with the local PWD official's stone metal was identified at various locations. Existing quarries that are already in operation with requisite environmental clearances have been recommended for this project and no new quarries have been proposed.

Table 4-16: Details of Stone Quarry Location

S. No.	Name of the Quarry / Crusher	Latitude	Longitude	Remarks
1	Om Stone Crusher	25°40'24.7332''N	76°12'16.6896''E	Crusher
2	Shree Hari Stone Grits Pvt Ltd	27°34'05.0412''N	76°50'33.1764''E	Quarry cum crusher
3	Mandawar	27°10'00.0007"N	76°50'35.0025"E	Quarry
4	Kotputli	27°40'40.0004"N	76°07'20.0087"E	Quarry
5	Sikundra	26°57'42.0051"N	76°35'06.0020"E	Quarry
6	Savitri Stone Crusher	26°33'34.3980''N	76°17’11.8500''E	Crusher
7	Kamal Stone	26°33'31.2984''N	76°14'56.2128''E	Crusher

Source: Design Report

4.6.3 Sand

Banas River is the main source of coarse sand in the project area.

4.6.4 Fly Ash utilization

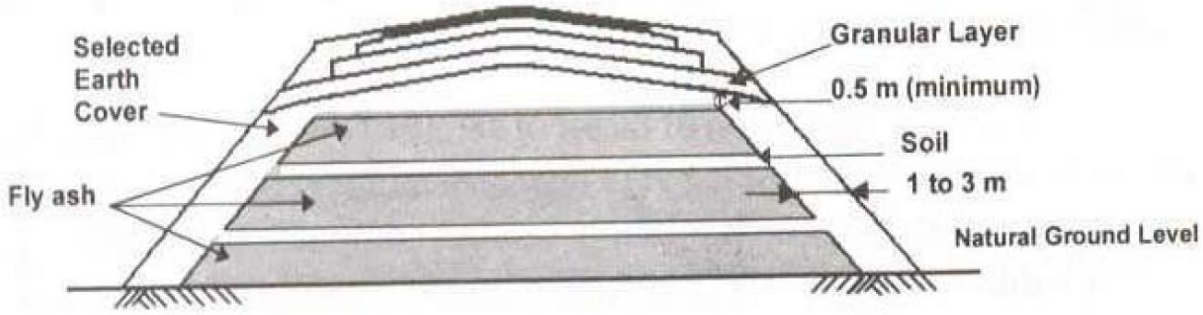
Fly Ash is a lightweight material, which may be used for construction of embankment, sub-grades *etc*. singly or by mixing with suitable admixtures. The fly ash is laid in alternate layers with soil and earth blankets are also provided on the side slopes for the confinement of the materials as per IRC: SP: 58 – Guidelines for use of Fly ash in Road Embankment. The guidelines regarding design / construction of embankments are given in IRC SP: 58-2001.

The thermal power plant at Kota Super Thermal Power Station (KSTPS) is nearest to our project highway & is at a distance of 25 km from the project highway. Generally the Greenfield alignment shall be constructed at approximately 2 to 3m from the ground level which may be more at bridge approaches. Fly ash can provide technically viable, environmentally sound & cost effective alternative to natural borrow soil.

Design Aspect of Fly ash Embankment

The embankment is designed as a composite structure with fly ash in the core and earth cover on the sides and at the top of embankment. However, special emphasis is required to be placed on the provision of earth cover for fly ash embankments since ash is easily erodible. The thickness of earth cover may be in the range of 1-3 m depending on height and slope of the embankment. In regions of moderate to high seismic activity, analysis of embankment stability should consider liquefaction potential of the ash fill.

To prevent the surrounding air from pollution it is needless to mention that proper care should be taken to transport, stack, lay and compact the fly ash materials in wet conditions, until the fly ash embankment with clay blanket on both the side slopes reaches its required height and is covered by a 500mm capping layer of sub-grade soil at the top of the embankment.



Source: (IRC: SP: 58-2001)

Figure 4-8: Typical cross – section of embankment with alternate layers of soil and fly ash

4.7 Biological Environment

4.7.1 Protected Areas

Rajasthan, popularly known for its Forts and Palaces is also a home to a lot of endangered wild animals and birds. State owns 5 National Park and 25 Sanctuaries in the state. Sariska Wildlife Sanctuary, Ranthambore National Park, Chambal Wildlife sanctuary and Mukundra Hills National park are well known worldwide for their tiger population and considered by both wilderness lovers and photographers as the best places in India to spot tigers.

Proposed project is passing through Darrah Wildlife Sanctuary. Darrah Wildlife sanctuary is thickly forested, which lies along the south eastern border of Kota. This hilly sanctuary with thick forests is worth for a visitor to visit. The Darrah sanctuary is spread over an area of 250 sq. km and is strategically located 50 km away from the town of Kota. Officially the Darrah sanctuary was declared as a protected area in 1955. At present, the sanctuary provides habitat to various species of animals including deer, sloth bears, wolves, antelopes, leopards and nilgai. Wolves and antelopes can be spotted here in large numbers.

4.7.2 Forest

The recorded forest area of the state is 32,737 m^2, which is 9.57% of its geographical area. The Reserved, Protected and Unclassified forests are 38.11%, 55.64% and 6.25% respectively of the recorded forest area. However, as the digitized boundary of recorded forest area from the state covers only an area of 23,105 m^2. (Rajasthan State of Forest Report 2017)

The proposed alignment passing through Mawasa Arandkheda Binyani A protected forest and Barkalaji Reserve forest in kota forest division.

Protected Areas / Eco-sensitive Zones/ Animal Corridor

Proposed alignment passing through Darrah Wildlife sanctuary from chainage 422+304 to 425+752 km (Total length 3.448Km.)

4.7.3 Bio-diversity Study

4.7.3.1 Objectives

- To prepare an inventory of plants in the study area

- Determination of Importance Value Index and Shannon Wiener Diversity Index for tree in the study area.

In order to understand the composition of the vegetation, most of the plant species were identified in the field itself whereas the species that could not be identified a herbarium specimen was collected along with their photographs for identification later with the help of available published literature and floras of the region.

The study area was divided into three study sites on the basis of disturbance gradient i.e. highly disturbed (HD) area , mildly disturbed (MD) area, and undisturbed (UD) area for studying the status of plant diversity, community structures monthly soil condition and productivity of herbaceous species of the study area.

4.7.3.2 Methodology

Community analysis was carried out during post monsoon season. In every study sites, 10 quadrats of 10 m X 10 m (100 sq. m) size were randomly laid to study tree species. The circumference of all the adult individuals [(≥30 cm circumference at breast height (CBH)] was measured with Freeman's tape. All individuals were enumerated and measured by species for each 10 m x 10 m quadrat, the number of species and density were recorded.

The study of communities was carried out by using qualitative characteristics and quantitative characteristics. Qualitative characteristic mainly involved presence/absence of the species, genera and family. This showed the community structures, composition and other characteristic can be readily described by visual observation without actual measurements. The quantitative analysis involved the structure and composition of vegetation across vegetation types and compared in terms of frequency, density, abundance and basal area of tree species.

The density, frequency abundance and basal area of tree species, were determined as per Curtis and McIntosh (1950).

(a) Density.

Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrates is divided by the total number of quadrates studied.

Density is calculated by the equation:

$$\textbf{Density} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates studied}}$$

(b) Frequency (%)

This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recorded the name of the species that occurred in each sampling units. It is calculated by the equation:

$$\textbf{Frequency (\%)} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrates studied}} \times 100$$

(c) Abundance

It is the study of the number of individuals of different species in the community per unit area. By quadrates method, samplings are made at random at several places and the number of individuals of

each species was summed up for all the quadrates divided by the total number of quadrates in which the species occurred. It is represented by the equation:

$$\textbf{Abundance} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates in which the species occurred}}$$

(d) Importance Value Index

This index is used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative dominance are summed up together and this value is designated as the Importance Value Index or IVI of the species (Curtis, 1959).

(e) Relative density

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\textbf{Relative density} = \frac{\text{Number of individual of the species X 100}}{\text{Number of individual of all the species}}$$

(f) Relative frequency

The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\textbf{Relative frequency} = \frac{\text{Number of occurrence of the species X 100}}{\text{Number of occurrence of all the species}}$$

(g) Relative dominance

Dominance of a species is determined by the value of the basal cover. Relative dominance is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.

$$\textbf{Relative dominance} = \frac{\text{Total basal area of the species X 100}}{\text{Total basal area of all the species}}$$

The total basal area was calculated from the sum of the total diameter of immerging stems. In trees, poles and saplings, the basal area was measured at breast height (1.5m) and by using the formula $\pi r2$.

The forest communities were identified on the basis of IVI values of trees. The single tree species representing >50% of the total IVI was designated as a single species dominated community, whereas two or more species contributing 50 or >50% of the total IVI were named as a mixed community.

4.7.4 Species diversity and species Evenness index

Species diversity and species evenness index is calculated by using the Shannon-Wiener Diversity Index formula and Evenness Index formula, respectively.

Shannon-Wiener Diversity Index (H) = - Σ pi ln (pi)

Where, pi is the proportion of total number of species made up of the ith species.

Evenness index (E): H/ ln S

Where, H is Shannon-Wiener Diversity Index of general diversity and S is number of species.

4.7.5 Survey Sites

To know the status of plant diversity of the study area, qualitative and quantative assessment has been carried out at 5 different locations all along the proposed alignment. The sampling locations showing on Google map in **Figure 4-9.**

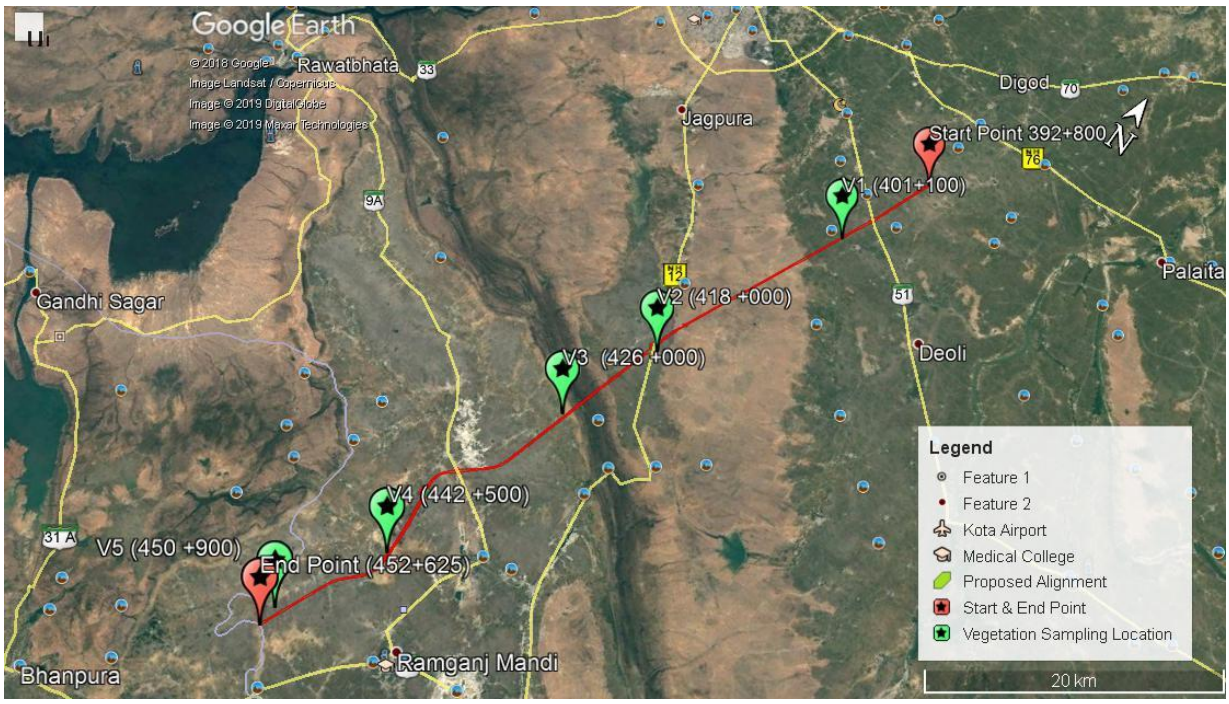


Figure 4-9: Vegetation Sampling locations

During the survey 72 plant species from 37 families were recorded in which Mimodaceae, Moraceae and Rubiaceae are dominant families followed by Boraginaceae, Caesalpiniaceae and Combretaceae all along the study area.

4.7.6 Species Diversity Index (H') & Evenness Index (E)

To understand species variation in community, diversity and evenness Index was calculated. Biodiversity assessment results showing that maximum diversity recorded at sampling site 2 followed by sampling site 3 and 1. Evenness index for trees were recorded maximum sampling site 4 and 5 respectively.

Table 4-17: Density, Frequency and Species Diversity Index (H') & Evenness Index (E)

Sampling site	Frequency	Density	Shannon-Wiener Diversity Index	Evenness
Sampling site 1	160	220	1.71	0.95
Sampling site 2	110	110	1.85	0.95
Sampling site 3	120	140	1.81	0.93
Sampling site 4	70	90	1.37	0.99
Sampling site 5	100	120	1.59	0.99

Table 4-18: List of Trees recorded in the study area

S. No.	Family Name	Scientific Name	S. No.	Family Name	Scientific Name
1	Anacardiceae	*Magnifera indica*	37	Mimosaceae	*Acacia senegal*
2	Anonaceae	*Plyalthia longifolia*	38	Mimosaceae	*Acacia leucophloea*
3	Anonaceae	*Anona squamosa*	39	Mimosaceae	*Leucoena leucocephala*
4	Apocynaceae	*Wrightia tinctoria*	40	Mimosaceae	*Albizzia procera*
5	Apocynaceae	*Halarrhena antidysenterica*	41	Mimosaceae	*Albizzia lebek*
6	Apocynaceae	*Wrightia tomentosa*	42	Mimosaceae	*Prosopis juliflora*
7	Apocynaceae	*Manikara hexandra*	43	Moraceae	*Ficus bengalensis*
8	Bignoniaceae	*Stereaspermum suavealens*	44	Moraceae	*Ficus glomerata*
9	Bignoniaceae	*Tercomelia undulata*	45	Moraceae	*Ficus tomentosa*
10	Biscaceae	*Flacourtia indica*	46	Moraceae	*Ficus rumphii*
11	Boraginaceae	*Cordia dichotoma*	47	Moraceae	*Morus alba*
12	Borginaceae	*Ehretia laevis*	48	Moraceae	*Morus indica*
13	Borginaceae	*Cordia gharaf*	49	Moringaceae	*Moringa concanensis*
14	Bruseraceae	*Commiphora wrightii*	50	Myrtaceae	*Syzygium cumini*
15	Burseraceae	*Boswella serrata*	51	Myrtaceae	*Eucalyptus globulus*
16	Caesalpiniaceae	*Cassia fistula*	52	Palmae	*Pheonix sylvestris*
17	Caesalpiniaceae	*Tamarindus indica*	53	Palmae	*Pheonix acaulis*
18	Caesalpiniaceae	*Bauhinia racemosa*	54	Papilionaceae	*Dalbergia lanceclaria*
19	Caesalpiniaceae	*Bauhinia variegota*	55	Papilionaceae	*Pongamia pinnata*
20	Capparidaceae	*Crataeva raligicea*	56	Papilionaceae	*Dalbergia sissoo*
21	Celastraceae	*Maytenus amarginata*	57	papilonaceae	*Butea monosperma*
22	Combretaceae	*Anogeissus latifolia*	58	Rhamnaceae	*Zizyphus mauritiana*
23	Combretaceae	*Anogeissus pendula*	59	Rhamnaceae	*Zizyphus glabarrima*
24	Combretaceae	*Anogeissus sericea*	60	Rubiaceae	*Mitrogyna parvifolia*
25	Combretaceae	*Terminalia arjuna*	61	Rubiaceae	*Gardenia turgida*
26	Ebenaceae	*Diospyros cordifolia*	62	Rubiaceae	*Hesperethusa crenulata*
27	Euphorbiaceae	*Emblica afficinalis*	63	Rubiceae	*Morinda tinctoria*
28	Euphorbiaceae	*Bridelia squamosa*	64	Rutaceae	*Aegle marmelos*
29	Gimarubaceae	*Ailanthus excelsa*	65	Rutaceae	*Feronia limonia*
30	Malvaceae	*Bombex ceiba*	66	Salvadoraceae	*Salvadra aleoides*
31	Meliaceae	*Melia azadiracht*	67	Sapindaceae	*Schleichera aleasa*
32	Meliaceae	*Azadrachea indica*	68	Simarubaceae	*Balanites aegyptica*
33	Mimodaceae	*Acacia nilotica*	69	Sterculiaceae	*Sterculia urens*
34	Mimosaceae	*Dichrostrachys cinerea*	70	Tamaricaceae	*Tamarix aphylla*
35	Mimosaceae	*Acacia catechu*	71	Tamaricaceae	*Tamarix dioca*
36	Mimosaceae	*Prosopis cineraria*	72	Urticaceae	*Haloptelea integrifolia*

4.7.7 Faunal Diversity Assessment

Finding the presence of mammals, Reptiles and Birds by using conventional methods like transect walk or plot search during the day. Mostly trails were used to survey the wild animals in the study area. The survey of wild animals conducted by using 10x50 prismatic field binocular and hand held GPS 72 in different habitat. The presence of wildlife was also confirmed from the local inhabitants depending on the animal sightings and the frequency of their visits in the catchment and study area. In addition to these, secondary sources mainly literature was also referred for preparing checklists and other analysis in the study of animals and wildlife in the region.

The methodology followed for the current survey is as follows:

- Direct sighting and indirect evidences such as calls, signs and trophies of mammals were recorded along the survey routes taking aid from Prater (1980).
- Interviews of local villagers for the presence and relative abundance of various animal species within each locality.
- Data collection on habitat condition, animal presence by direct sighting and indirect evidences.
- Checklist of birds was prepared based upon Ali & Ripley (1983) and Flaming et al. (1984) were used as field guides for the birds. In the survey stretches also recorded other animal evidences and general composition of the habitats.

a. Mammals

Domesticated animals mainly constitute the faunal population within the project area. The forest department have reported the presence of some wild & endangered animals in the nearby forest areas, however no such species were reported during the site reconnaissance and survey. Proposed alignment is passing through Darrah wildlife sanctuary. Darrah wildlife sanctuary is thronged with different kinds of wild animals. Some of the resident species of this mysterious sanctuary are wolf, cheetah, nilgai, deer and wild boar. Today, the Darrah Sanctuary boasts a rich wildlife population that includes leopards, wolves, sloth bears and chinkaras. The sanctuary is also home to a number of birds and reptiles. A list of mammals have been prepared by the help of secondary literature and consultation with villagers provided below.

Table 4-19: List of Mammals

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
1	Cercopithecidae	Rhesus macaque	*Macaca mulatta*	LC	II
2	Cercopithecidae	Common langur	*Pressbytis entellus*	LC	II
3	Felidae	Leopard	*Panthera pardus*	VU	I
4	Felidae	Jungle cat	*Felis chaus*	LC	II
5	Herpestidae	Common Mongoose	*Herpestes edwardsii*	LC	II
6	Canidae	Jackal	*Canis aureus*	LC	II
7	Canidae	Indian fox	*Vulpes bengalensis*	LC	II
8	Hyaenidae	Striped Hyaena	*Hyaena hyaena*	NT	III
9	Viverridae	Common Palm Civet	*Paradoxurus hermaphrodites*	LC	III

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
10	Mustelidae	Smooth Indian Otter	*Lutra persicillata*	VU	II
11	Bovidae	Blue Bull	*Boselaphus tragocamelus*	LC	III
12	Cervidae	Chital	*Axis axis*	LC	III
13	Cervidae	Sambhar	*Cervus unicolor*	vu	III
14	Suidae	Indian Wild Boar	*Sus scrofa*	LC	III
15	Sciuridae	Five Striped palam Squirrel	*Funambulus pennati*	NA	IV
16	Muridae	Common House Rat	*Mus booduga*	LC	V
17	Hystricidae	Indian porcupine	*Hystrix indica*	LC	II
18	Leporidae	Indian Hare	*Lepus nigricollis*	LC	IV
19	Soricidae	Grey musk shrew	*Suncus murinus*	LC	NA
20	Pteropodidae	Fruits Bat	*Ptetopus giganteus*	LC	V
21	Bovidae	Black Buck	*Antilope Cervicapra*	LC	I
22	Bovidae	Indian Gazelle	*Gazella Benneti*	LC	I
23	Felidae	Tiger	*Panthera Tigris*	EN	I
24	Canidae	Wild dog	*Cuon alpines*	NA	II
25	Canidae	Indian Wolf	*Canis lupus pallipes*	LC	I
26	Ursidae	Sloth Bear	*Melursus ursinus*	VU	I

b. Avifauna

During the survey, avifaunal species were directly sighted in their natural habitat composed by small bushy vegetation, bare stone grounds and forest area near Darrah wildlife sanctuary and close to human habitation. The study of avifaunal survey has revealed that large portion of bird species are comprised of resident birds in the project study area. House sparrow, Grey wagtail, Red vented, bulbul, House crow, Common myna, Black Drongo, House swift, Spotted dove, Common Peafowl and Cattle egret are commonly seen in the study area. On the basis of primary survey and secondary data an inventory of avifauna has been prepare and listed below.

Table 4-20: List of Avifauna

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
1	Ardeidae	Grey Heron	*Ardea cinerea*	LC	NA
2	Ardeidae	Pond Heron	*Ardea intermedia*	LC	NA
3	Ardeidae	Cattle Egret	*Bubulcus ibis*	LC	IV
4	Ardeidae	Large Egret	*Ardea alba*	LC	IV
5	Ardeidae	Smaller Egret	*Ardea intermedia*	LC	IV
6	Ardeidae	Little Egret	*Egretta garzetta*	LC	IV
7	Ardeidae	Night Heron	*Nycticorax nycticorax*	LC	NA
8	Ardeidae	Purple Heron	*Ardea purpurea*	LC	NA
9	Ardeidae	Little Bittern	*Ixobrychus minutes*	LC	IV
10	Accipitridae	Black winged Kite	*Elanus caeruleus*	LC	NA

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
11	Accipitridae	Pariah Kite	*Milvus migrans*	LC	NA
12	Accipitridae	Brahmini Kite	*Haliastur Indus*	LC	NA
13	Accipitridae	Shikra	*Accipiter badius*	LC	NA
14	Accipitridae	Tawny Eagle	*Aquila rapax*	VU	NA
15	Accipitridae	King Vulture	*Sarcogyps calvus*	CE	III
16	Accipitridae	Indian long billed Vulture	*Gyps fulvus*	LC	III
17	Accipitridae	Scavenger Vulture	*Neophron percnopterus*	EN	III
18	Falconidae	Kestrel	*Falco tinnunculus*	LC	NA
19	Pandionidae	Osprey	*Pandion haliaetus*	LC	III
20	Phasianidae	Grey Quail	*Coturnix coturnix*	LC	IV
21	Phasianidae	Common Peafowl	*Pavo cristatus*	LC	III
22	Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	LC	NA
23	Charadriidae	Spur winged Plover	*Vanellus spinosus*	LC	IV
24	Charadriidae	Yellow wattled Lapwing	*Vanellus malabaricus*	LC	NA
25	Charadriidae	Little ringed Plover	*Charadrius dubis*	NA	IV
26	Charadriidae	Kentish Plover	*Charadrius alexandrinus*	LC	IV
27	Scolopacidae	Common Redshank	*Tringa tetanus*	LC	NA
28	Scolopacidae	Green Shank	*Tringa nebutaria*	LC	NA
29	Scolopacidae	Common Sandpiper	*Tringa hypoleucos*	LC	IV
30	Scolopacidae	Black tailed Godwit	*Limosa limosa*	NT	NA
31	Scolopacidae	Spooted Redshank	*Tringa erythropus*	LC	NA
32	Scolopacidae	Fantail Snipe	*Gallinago gallinago*	LC	IV
33	Scolopacidae	Little Stint	*Calidris minuta*	LC	NA
34	Recurvirostridae	Black winged Stint	*Himantopus himantopus*	LC	NA
35	Burhinidae	Stone Curlew	*Burhinus oedicnemus*	LC	IV
36	Burhinidae	Great stone Plover	*Esacus racurvirostria*	NT	IV
37	Glareolidae	Small Indian Pratincole	*Glareola lacteal*	LC	NA
38	Laridae	Indian river Tern	*Sterna aurantia*	NT	NA
39	Laridae	Black bellied Tern	*Sterna acuticauda*	EN	NA
40	Laridae	Little Tern	*Sternula albifrons*	LC	NA
41	Columbidae	Blue rock Pigeon	*Columba livia*	LC	IV
42	Columbidae	Indian ring Dove	*Streptopelia decaocto*	LC	IV
43	Columbidae	Red turtle Dove	*Streptopelia tranquebarica*	LC	IV
44	Columbidae	Spotted Dove	*Spilopelia chinensis*	LC	IV
45	Columbidae	Little brown Dove	*Streptopelia senegalensis*	LC	IV
46	Psittacidae	Rose ringed Parakeet	*Psittacula krameri*	LC	IV

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
47	Psittacidae	Blossom headed Parakeet	*Psittacula cyanocephala*	LC	IV
48	Cuculidae	Palintive Cuckoo	*Cacomantis merulinus*	LC	IV
49	Cuculidae	Pied crested Cuckoo	*Clamator jacobinus*	LC	IV
50	Cuculidae	Koel	*Eudynamys scolopacea*	LC	NA
51	Cuculidae	Crow Pheasant	*Centropus sinensis*	LC	IV
52	Strigidae	Brown Fish Owl	*Bubo zeylonensis*	NA	IV
53	Strigidae	Spotted owlet	*Athene brama*	LC	IV
54	Caprimulgidae	Common Indian Nightjar	*Caprimulgus asiaticus*	LC	NA
55	Apodidae	House Swift	*Apus affinis*	LC	III
56	Alcedinidae	Pied Kingfisher	*Ceryle rudis*	LC	IV
57	Alcedinidae	Small blue Kingfisher	*Alcedo atthis*	LC	IV
58	Alcedinidae	White breasted King fisher	*Halcyon smyrnensis*	LC	IV
59	Meropidae	Green bee Eater	*Merops orientalis*	LC	NA
60	Meropidae	Blue tailed bee Eater	*Merops phililinus*	LC	NA
61	Coraciidae	Indian Roller	*Coracias benghalensis*	LC	IV
62	Upupidae	Hoopoe	*Upupa epops*	LC	NA
63	Bucerotidae	Common grey Hornbill	*Ocyceros birostris*	LC	III
64	Megalaimidae	Coppersmith	*Megalaima haemacephala*	LC	NA
65	Megalaimidae	Large green Barbet	*Megalaima zeylanica*	NA	IV
66	Picidae	Golden Backed Woodpecker	*Dinopium benghalensis*	LC	IV
67	Picidae	Yellow - crowned Woodpecker	*Leiopicus mahrattensis*	LC	IV
68	Pittidae	Indian Pitta	*Pitta brachyuran*	LC	IV
69	Alaudidae	Red winged bush Lark	*Mirafra erythroptera*	LC	IV
70	Alaudidae	Ashy crowned finch Lark	*Eremopterix grisea*	LC	IV
71	Alaudidae	Rufous tailed finch Lark	*Ammomanes phoenicura*	LC	IV
72	Alaudidae	Crested Lark	*Galerida cristata*	LC	IV
73	Hirundinidae	Common Swallow	*Hirundo rustica*	LC	IV
74	Hirundinidae	Wire tailed Swallow	*Hirundo smithii*	LC	IV
75	Laniidae	Grey Shrike	*Lanius excubitor*	LC	NA
76	Laniidae	Bay backed Shrike	*Lanius vittalus*	LC	NA
77	Laniidae	Rufous backed Shrike	*Lanius schach*	LC	NA
78	Laniidae	Brown Shrike	*Lanius cristatus*	LC	NA

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1972
79	Monarchidae	Paradise Flycatcher	*Terpsiphone paradise*	LC	IV
80	Dicruridae	Black Drongo	*Dicrurus adsimilis*	LC	IV
81	Dicruridae	White bellied Drongo	*Dicrurus caerulescens*	LC	IV
82	Sturnidae	Brahminy Myna	*Sturnus pagodarum*	LC	IV
83	Sturnidae	Pied Myna	*Gracupica contra*	LC	IV
84	Sturnidae	Common Myna	*Acridotheres tristis*	LC	IV
85	Sturnidae	Bank Myna	*Acridotheres ginginianus*	LC	IV
86	Corvidae	Indian Tree Pie	*Dendrocitta vagabunda*	LC	IV
87	Corvidae	House Crow	*Corvus splendens*	LC	V
88	Corvidae	Jungle Crow	*Corvus macrorhynchos*	LC	V
89	Vangidae	Common wood Shrike	*Tephrodornis pondicerianus*	LC	NA
90	Vangidae	Large cuckoo Shrike	*Coracina macei*	LC	NA
91	Aegithinidae	Common Iora	*Aegithina tiphia*	LC	IV
92	Pycnonotidae	Red vented Bulbul	*Pyncnonotus cafer*	LC	IV
93	Pycnonotidae	White cheeked Bulbul	*Pycnonotus leucogenys*	LC	IV
94	Leiothrichidae	Common Babbler	*Turdoides caudate*	LC	IV
95	Leiothrichidae	Large grey Babbler	*Turdoides malcolmi*	LC	IV
96	Cisticolidae	Tailor Bird	*Orthotomus sutorius*	LC	NA
97	Muscicapidae	Magpie Robbin	*Copsychus saularis*	LC	NA
98	Muscicapidae	Black Redstart	*Phoenicurus ochruros*	LC	NA
99	Muscicapidae	Indian Robin	*Saxicoloides fulicata*	LC	NA
100	Motacillidae	Yellow Wagtail	*Motacilla flava*	LC	NA
101	Motacillidae	Grey Wagtail	*Motacilla cinerea*	LC	NA
102	Motacillidae	Large pied Wagtail	*Motacilla maderaspatensis*	LC	NA
103	Deceidae	Thick billed Flower pecker	*Dicaeum agile*	LC	IV
104	Deceidae	Tickell's Flower pecker	*Dicaeum erythrorhynchos*	LC	IV
105	Nectariniidae	Purple Sunbird	*Nectarinia asiatica*	LC	IV
106	Passeridae	House Sparrow	*Passer domesticus*	LC	NA
107	Ploceidae	Baya	*Ploceus philippinus*	LC	IV
108	Emberizidae	Crested Bunting	*Melophus lathami*	LC	IV

c. Herpeto-fauna

Herpeto-fauna were sampled on the same transect marked for mammals and Birds. The sampling was carried in the study area by constrained Visual Encounter Rates (VES) method. A list of herpeto fauna reported in study area is prepared on the basis of primary survey and secondary data collected and listed below.

Table 4-21: List of Herpeto-Fauna

S. No.	Family	Common Name	Scientific Name	IUCN 3.1	WL Schedule 1992
1	Elapidae	Banded Krait	*Bungarus fasciatus*	LC	IV
2	Elapidae	Cobra	*Naja naja*	LC	II
3	Elapidae	Common Krait	*Bungarus caeruleus*	NA	IV
4	Pythonidae	Burmese Python	*Python bivittatus*	VU	II
5	Colubridae	Rat Snake	*Ptyas mucosus*	NA	II
6	Viperidae	Russell's Viper	*Piper russelli*	LC	II
7	Chamaeleonidae	Indian Chameleon	*Chamaeleo zeylanicus*	LC	II
8	Geoemydidae	Indian sawbaok	*Pangshura tecta*	LC	NA
9	Gekkonidae	Northern house gecko	*Hemidactylus flaviviridis*	NA	NA
10	Eublepharidae	Far tailed gecko	*Eublepharis maculariv*l	LC	NA
11	Agamidae	Common gardenlizard	*Calotes versicolor*	NA	NA
12	Scincidae	Common skink	*Mabuya carinata*	LC	NA
13	Boidae	Johr's earth boa	*Eryz johnii*	LC	NA
14	Pythonidae	Indian python	*Python molurus*	VU	II
15	Colubridae	Green keelback	*Macropisthodon plumbicolor*	NA	NA
16	Elapidae	Common Indian krait	*Bungarus caeruleus*	NA	IV
17	Agamidae	Spinytailed lizard	*Uromastyx hardwickii*	NA	NA

4.8 Socio-Economic Profile

Socio-economic analysis has been conducted for the state and project influence district (Kota) along the proposed project road. The population forms the basic planning parameter for the preparation of any transport related plan/study and also indicates the scale of required development. Rajasthan is situated in the North-Western part of India. It is bounded by Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Gujarat and Pakistan along Northern, North-Eastern, Eastern, South-Eastern, South-Western and Western sides respectively.

4.8.1 Population

The population of Rajasthan witnessed an increase of 1.2 crore from 2001 and has a population of 6.9 crore (Census, 2011). The state has a male population of 3.6 cr and female population of 3.3 cr. The child population (0-6 age) is 1,06,49,504 (15.5% of total population) in 2011 where as 1,06,51,002 (18.9% of total population) in 2001. Kota district shows the highest decennial growth rate of 24.37% with comparison to state and national level. The details of the population of the state and district are given below.

Table 4-22: Decadal Growth Rate

Districts/State	Decadal Growth Rate (%)
Kota	24.37
Rajasthan	**21.31**
India	**17.64**

Source: Census 2011

4.8.2 Population Density

The total area of Rajasthan is 3,42,239 sq. Km with a population density of 200 persons per sq km in 2011 which is lower than the national population density of 382 persons per sq. km. The project influence district of Kota have an average population density of 374 persons /sq.km, which is higher than Rajasthan and India's population density respectively.

Table 4-23: Population Density

Districts/State	Population Density (persons /sq.km)
Kota	374
Rajasthan	**200**
India	**382**

Source: Census 2011

4.8.3 Sex Ratio

The sex ratio in Rajasthan was 928 females for each 1000 males in 2011 where as it was 921 females for each 1000 males in 2001. The child sex ratio declined from 909 girls per 1000 boys in 2001 to 888 girls per 1000 boys in 2011.

Table 4-24: Sex Ratio

District/State	2001	2011
Kota	896	911
Rajasthan	**921**	**928**
India	**933**	**943**

Source: Census 2011

The sex ratio of the Kota district in 2011 improved in comparison to 2001 that indicates development of the society that can be achieved only through quality education, enhanced health facilities etc.

4.8.4 Literacy Rate

Literacy rate in Rajasthan has seen an upward trend and is 66.11% as per Census 2011 out of which, male literacy rate stands at 79.19% while female literacy rate is 52.12%. In 2001, literacy rate in Rajasthan stood at 60.41% out of which male and female literacy rate was 75.70% and 43.85% respectively. The literacy details of the state and district is given below:

Table 4-25: Number of Literates and Literacy Rate for State and Districts

State/Districts	Number of Literates*			Literacy Rate(%)		
	Persons	Male	Female	Persons	Male	Female
Kota	1298345	765396	532949	76.56	86.31	65.87
Rajasthan	**38275282**	**23688412**	**14586870**	**66.11**	**79.19**	**52.12**
India	**763638812**	**434763622**	**328875190**	**72.98**	**80.88**	**64.63**

**Literacy excludes the age group of 0-6 Years*

4.8.5 Work Participation Rate

The work participation rate in Rajasthan as per Census 2011 is 51.71% and 42.68% for male and female in rural areas, where it is 50.75% and 12.03% for male and female in urban areas

respectively. The work participation rate is notably slightly less as compared to the national average in both rural and urban areas with similar geographical conditions. The working population in Rajasthan increased from 23.76 million in 2001 to 29.89 million in 2011, witnessing an annual compound growth of 2.6%. The details of the work participation rate are given in table below.

Table 4-26: Work Participation Rate

States/Districts	Rural			Urban			Combined		
	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons
Kota	53.81	37.89	46.14	51.41	13.08	33.27	52.36	23.03	38.38
Rajasthan	**51.71**	**42.68**	**47.35**	**50.75**	**12.03**	**32.27**	**51.47**	**35.12**	**43.60**
India	**53.03**	**30.03**	**41.83**	**53.76**	**15.44**	**35.31**	**53.26**	**25.52**	**39.80**

Source: Census 2011

4.8.6 Employment Pattern

The Census 2011 further classifies the workers (both main and marginal) into four categories namely cultivators, agricultural labourers, household industries and other workers. The categorisation of the workers revealed that there was a declining share of the cultivators but increasing share of agricultural labourers, household industry and other type of worker. The employment pattern is given in table below.

Table 4-27: Employment Pattern of Main and Marginal Workers in Rajasthan

Industry Classification	2001 (million)	% share	2011 (million)	% share
Cultivators	13.14	55.29	13.6	45.57
Agricultural Labourer	2.52	10.62	4.94	16.53
Household Workers	0.68	2.85	0.72	2.41
Other Workers	7.42	31.24	10.61	35.49
Total Workers	**23.78**	**100**	**29.89**	**100**

Source: Census 2011

4.8.7 State Income

The net state domestic product (NSDP) has shown a cumulative annual growth rate (CAGR) of 5.47% while per capita NSDP was 3.97% over the period from 2011-12 to 2016-17. The annual growth rate of NSDP and per capita NSDP showed a slightly higher growth in 2016-17 over 2015-16 by 6.62% and 5.11% respectively and the details are given in table below.

Table 4-28: NSDP and Per Capita NSDP at Constant Price (2011-12)

Year	NFDP (Cr.)	Growth (%)	Per Capita (Rs.)	Growth (%)
2011-12	396710	--	57391	--
2012-13	410394	3.45	58526	1.98
2013-14	429044	4.54	60315	3.06
2014-15	455500	6.17	63123	4.66
2015-16	485646	6.62	66342	5.10
2016-17	517815	6.62	69730	5.11
CAGR%	**5.47**		**3.97**	

Source: Department of Economics and Statistics, Rajasthan

4.8.8 Structural Shift in GSDP

The sectoral Gross State Domestic Product (GSDP) in Rajasthan showed a paradigm shift towards secondary sector and service sector from primary sector. The share of primary sector in GSDP computed at constant (2011-12) prices declined to 26.15% in 2015-16 from 28.60 % in 2011-12. During this period, while the share of secondary sector declined from 32.73% to 29.76% with minor variations, the share of tertiary sector expanded from 38.67% to 44.09% and the details are given in table below.

Table 4-29: Sectoral Composition of GSDP by Industry Origin at Constant Price (%): Rajasthan

Sector	Year					
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (AE*)
Primary	28.6	28.24	28.57	27.6	26.15	26.09
Secondary	32.73	31.47	30.07	29.72	29.76	29.09
Tertiary	38.67	40.29	41.36	42.68	44.09	44.82

**AE=Advanced Estimates Source: Department of Economics and Statistics, Rajasthan*

A similar trend has been seen in the project influence districts of Kota.

4.8.9 Agriculture profile

Rajasthan can be divided into 4 major geographical regions, namely Western desert with barren hills, rocky plains and sandy plains; Aravalli hills running South-West to North-East; Eastern plains with rich alluvial soils and South-Eastern plateau. The major rivers in the state are Mahi, Chambal and Banas.

The major crops grown in different parts of Rajasthan are bajra, wheat, jowar, maize, cotton, rapeseed, mustard, groundnut and horticultural crops. The geographical area consists of ~57% desert and around 8% of forest area. The net area sown in the state has been largely fluctuating in past few years and has witnessed a declining trend. It reduced from ~175 lac ha in 2008-09 to ~170 lac ha in 2009-10. The categorisation of land use pattern in the state is given in table below:

Table 4-30: Categorization of Land Use Pattern

S. No.	Land Use Pattern	Area (in lac ha)
1	Net Cropped Area	183
2	Forest Strs	27
3	Not Available for Cultivation	43
4	Pastures & Grazing Land	17
5	Land Under Misc. Trees	0.21
6	Cultivable Waste Land	42
7	Fallow Land	30

The state has a net cropped area of ~183 lac ha, out of which ~75% of area is rain-fed and ~25% of the area is irrigated. However, the agricultural output constitutes of more than 50% of irrigated area's output. The sources of irrigation with their share are as follows:

- Open Wells: 31.62%
- Tube Wells: 41.91%

- Canals: 24.45%
- Tanks: 0.84%
- Other Sources: 1%

The irrigation pattern suggests that the groundwater is stressed enormously as ~73% of irrigation is dependent on tube-wells and wells.

Project Influence District

Kota District

The district has a total cultivated area of 5,14,560 ha (2015-16), out of which net area sown is 2,74,179 ha (2015-16). The major crops cultivated in the district are wheat, paddy, soyabean, maize and gram. The major horticulture (fruit) crops are mango, guava, orange, lime and aonla.

4.9 Industrial Profile

The economy of the state has shown a structural shift with manufacturing sector contributing considerably to net state domestic product (NSDP). Textile industry has a major contribution in state's overall production followed by large and medium industries.

The government of Rajasthan has set up various institutions like Bureau of Investment Promotion (BIP), Rajasthan State Industrial Development and Investment Corporation (RIICO), Rajasthan Financial Corporation (RFC), and Project Development Corporation to attract investments in the sector. Bureau of Investment Promotion (BIP) and Rajasthan Industrial Development and Investment Corporation (RIICO) are the two main institutes responsible for promoting investments and development of industrial infrastructure in the state.

Major industries in the state of Rajasthan are as follows:

- Cement Industry
- Auto and Auto-components Industry
- Ceramics Industry
- Textile Industry
- Agro-based Industry
- Gems and Jewellery
- Marble Industry

Kota District

The district has a wide range of industries with ~15,571 registered industrial units. The major manufacturing sectors are Kota stone, welding electrode, Kota Doriya textile, engineering fabrication, chemicals, edible oil and snacks industries. The major exportable items are rayon tyre yarn cord, rayon fabric, copper alloys, antimony, chemicals (calcium fluoride, calcium carbide and sulphate), lead alloys, natural stone, soya meal and textile machinery parts.

4.10 Socio-economic Profile of the Project Area

Social profile includes an overview of the population distribution, density of population, sex ratio, and literacy rate, details of scheduled caste/tribe population and work force participation rate of the project influence area along the proposed alignment.

4.11 Population Distribution

The annual average growth rate in population of project affected area is 3% which is higher than annual average growth rate of Rajasthan. Ladpura tehsil of Kota district has the highest population of 1,143,792.

Table 4-31: Population Distribution (Year, 2011)

Sl. No.	District	Tehsils	Population		Annual Average Growth Rate (%)
			2001	2011	
1	Kota	Ladpura	8,68,213	11,43,792	3.2
		Kanwas	--	--	--
		Ramganj Mandi	2,28,479	2,72,448	2
Project Affected Area			**10,96,692**	**14,16,240**	3
Rajasthan			**5,65,07,188**	**6,85,48,437**	**2.1**

Source: Census 2011

4.11.1 Population Density

The project influence area recorded average population density of ~621 persons/sq km (2011) which is higher compared to state's population density of ~200 persons/sq km (2011). The population density varies from 348 persons/ sq km (2011) in Ramganj Mandi tehsil to 764 persons/ sq km (2011) in Ladpura tehsil.

Table 4-32: Population Distribution and Density (Year 2011)

Sl. No.	District	Tehsils	Area (Sq.km.)	Population	Population Density (Persons/sq. km)
1.	Kota	Ladpura	1497	11,43,792	764
		Kanwas	--	--	--
		Ramganj Mandi	782	2,72,448	348
Project Affected Area			2279	14,16,240	621
Rajasthan			**3,42,239**	**6,85,48,437**	**200**

Source: Census of India, 2011

4.11.2 Sex Ratio

The project affected area has a sex ratio of 907 (2011), which is lower as compared to state's sex ratio of 928. Ladpura tehsil has the lowest sex ratio of 900 (2011).

Table 4-33: Sex Ratio

Sl. No.	District	Tehsils	Sex Ratio (2011)
1	Kota	Ladpura	900
		Kanwas	--
		Ramganj Mandi	903
Project Affected Area			**907**
Rajasthan			**928**

Source: Census of India, 2011

4.11.3 Vulnerable Groups

The schedule caste population in the project affected area is 2,79,682 (20%) and schedule tribe population is 94,801 (7%). Ramganj Mandi tehsil of Kota district has the highest schedule caste population ~27%.

Table 4-34: Vulnerable Groups

Sl. No.	District	Tehsil	Population (2011)		% to Total Population	
			Scheduled Caste	Scheduled Tribe	Scheduled Caste	Scheduled Tribe
1	Kota	Ladpura	2,07,033	68,410	18	6
		Kanwas	-	-	-	-
		Ranganj Mandi	72,649	26,391	27	10
Project Affected Area			**2,79,682**	**94,801**	**20**	**7**
Rajasthan			**1,22,21,593**	**92,38,534**	**18**	**13**

Source: Census of India, 2011

4.11.4 Literacy Rate

Literacy rate in Rajasthan has seen upward trend and is 66% as per Census of India, 2011. The project affected area has an average literacy rate of 79% (2011) which is higher as compared to state's average literacy rate. Ramganj Mandi tehsil has the lowest literacy rate of 70% (2011) in the project affected area.

Table 4-35: Literacy Rate

Sl. No.	District	Tehsil	Literate Population		Literacy Rate	
			2001	2011	2001	2011
1	Kota	Ladpura	5,77,807	8,12,242	78	81
		Kanwas	-	-	-	-
		Ramganj Mandi	1,30,054	1,63,135	70	70
Project Affected Area			3,50,290	**9,75,377**	**31**	**79**
Rajasthan			**2,77,02,010**	**3,82,75,282**	**60**	**66**

Source: Census of India, 2011

4.11.5 Work Participation Rate

Ladpura tehsil in project affected area, there is low work participation rate (~34%, 2011).

Table 4-36: Work Participation Rate

Sl. No.	District	Tehsil	Total Workers		AAGR of Workers	Work Participation Rate	
			2001	2011	(2001-2011)	2001	2011
1	Kota	Ladpura	2,62,623	3,88,532	5	30	34
		Kanwas*	-	-	-	-	-
		Ramganj Mandi	87,667	1,15,544	3	38	42
Project Affected Area			3,50,290	5,04,076	4	31	36
Rajasthan			**2,37,66,655**	**2,98,86,255**	**3**	**42**	44

Source: Census of India, 2011, *Information not available

4.11.6 Type of Workers

The project affected area has main working population of 2,10,57,968 (85%) and marginal working population of 74,771 (15%). Ladpura tehsil has the highest main working population ~88%.

Table 4-37: Type of Workers (Year 2011)

Sl. No.	District	Tehsil	Main worker		Marginal Worker	
			No.	In%	No.	In%
1	Kota	Ladpura	3,40,167	88	48,365	12
		Kanwas	-	-	-	-
		Ramganj Mandi	89,138	77	26,406	23
Project Affected Area			4,29,305	85	74,771	15
Rajasthan			**2,10,57,968**	**70**	**88,28,287**	**30**

Source: Census of India, 2011

4.12 Economic Profile of Project Influence District

The economic profile study provides a brief description of the agricultural and industrial scenario in the project influence district of Kota. The project influence district is Kota.

4.13 Agriculture Base

The major crops grown in different parts of Rajasthan are bajra, wheat, jowar, maize, cotton, rape seed, mustard, groundnut and horticultural crops. The geographical area consists of ~57% desert and around 8% of forest area. The net area sown in the state has been largely fluctuating in past few years and has witnessed a declining trend. It reduced from ~175 lac ha in 2008-09 to ~170 lac ha in 2009-10.

Kota District

The district has a total cultivated area of 5,14,560 ha (2015-16), out of which net area sown is 2,74,179 ha (2015-16). The major crops cultivated in the district are wheat, paddy, soyabean, maize and gram. The major horticulture (fruit) crops are mango, guava, orange, lime and aonla. The following table provides a brief profile of agriculture in the district and area cultivated under major crops.

Table 4-38: Agricultural Base of Kota (2015-16)

Description	Area (in ha)
Total Cultivated Area	5,14,560
Net Area Sown	2,74,179
Area Sown more Than One	2,40,381
Major Crops	
Wheat	1,41,604
Paddy	22,707
Soyabean	2,36,449
Maize	5,502
Gram	8,064

Source: Rajasthan Agricultural Statistics

4.13.1 Industrial Base

The district has a wide range of industries with ~15,571 registered industrial units. The major manufacturing sectors are Kota stone, welding electrode, Kota doriya textile, engineering fabrication, chemicals, edible oil and snacks industries. The major exportable items are rayon tyre yarn cord, rayon fabric, copper alloys, antimony, chemicals (calcium fluoride, calcium carbide and sulphate), lead alloys, natural stone, soya meal and textile machinery parts. The summary of industrial scenario of the district is shown in the table below:

Table 4-39: Industrial Profile of Kota (2015-16)

Sl. No.	Head	Particulars in No.
1	Registered Industrial Units	15571
2	Registered Medium & Large Industrial Units	20
3	Industrial Area	18
4	Estimated Avg. No. of Daily Worker Employed in Small Scale Industries	65310
5	Employment in Large and Medium Industries	8291

Source: Brief Industrial Profile of Kota District, MSME

4.14 Tourism

Tourism is one of the fastest growing sectors with highest contribution in state's revenue. The sector has increased the standard of living and provided platform to local artisans. The state has variety of tourist attractions such as forts, palaces, handicrafts, safari tours, wildlife sanctuary parks, heritage places, pilgrimage places and lakes.

Project influence district Kota is the major tourist destination in Rajasthan state. The details of domestic and foreign tourist arrival of Kota district during the year 2014-17 are shown in table below.

Table 3-40: Tourist arrival (Indian & Foreigner) in major tourist destinations

Districts	2014		2015		2016		2017	
	Domestic	Foreigner	Domestic	Foreigner	Domestic	Foreigner	Domestic	Foreigner
Kota	51,467	3,516	90,598	2,574	89,546	1,778	2,02,298	1,860

Source: Tourism Department Report 2017-18, Rajasthan

5 ENVIRONMENTAL IMPACT & MITIGATION PLAN

5.1 Introduction

This chapter assesses the nature, type and magnitude of the potential impacts likely on physical, biological and cultural environmental components along the project corridor and also discuss about suitable mitigation. For the assessment of impacts, the baseline information were collected based on primary surveys and secondary data.

The impacts on the various environmental components were assessed considering following stages of the project:

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

The description and magnitude of likely impacts on various environmental components are presented in the following sections along with suitable mitigation.

5.1 Physical Environment

5.1.1 Meteorological Parameters

5.1.1.1 Pre-Construction, Construction and Operation Stage

Impact

Project Highway is located in semi-arid region with high variation between summer and winter temperatures. Though no significant change in the macro-climatic setting (regional precipitation, temperature and wind) is envisaged due to the project, however, microclimate is likely to be temporarily modified by vegetation removal and the addition of increased pavement surface. There will be an increase in daytime temperature near the road surface due to loss of shade of trees and increased pavement surface, which in turn might lead to formation of heat islands especially along the inhabited sections. In addition, the removal of trees will increase the amount of direct sunlight resulting in higher temperatures along the highway.

This increase in the daytime temperature assumes significant especially in close vicinity of proposed highway, as the project area experiences temperatures as high as 46°C during summer season.

Mitigation

It must be noted that the impact is unavoidable. It shall be worth to mention that tree felling shall be limited for formation width of the proposed 8-lane highway. Further, avenue plantation shall be carried out alongside the proposed highway as per IRC SP-21:2009 to compensate the micro-climatic impacts.

5.1.2 Land

5.1.2.1 Physiography

Project highway mostly follows the plain and rolling terrain except the portion where it crosses the Mukundra Hills Tiger Reserve. Highway construction activities involve alterations in the local

topography and drainage patterns. The impacts on physiography may include de-stabilisation of slopes due to cut and fill operations. Cut-and-fills will be designed for improvement to the road geometry, and cross drainage structures will be added to improve drainage system of the project region. No significant impact on physiography of Mukundra Hill is likely as tunnel of 4.550km is proposed in this part of the project stretch.

5.1.2.2 Geology and Seismology

The entire stretch of the project highway traverses through Seismic Zone-II as defined by the Indian Standard (IS) seismic zoning classification system, i.e. low damage risk zone. Creation of tunnel may have an impact on geological stability of the Mukundra hills region. Separate subsidence study is being conducted for assessment of impact associated with proposed tunnel. Mitigation measures shall be developed based on outcome of subsidence study. Associated mining activities for construction material may alter the local geology to the some extent.

5.1.2.3 Quarries

Impact

Existing quarries that are already in operation with the required clearances have been recommended for this project. No new quarries are proposed and hence no major impacts, which arise in making new quarries operational, are likely. In case Contractor / Concessionaire decides in opening new stone quarries stipulated GoI norms should be followed as mining in non-scientific manner may unstable the soil condition and affect the terrain of the area.

Dust, in addition to being a health concern also reduces visibility thereby increasing safety concerns. As no new quarry is proposed to be opened for this project, therefore, no new impacts are likely to arise due to quarrying operations. It will be ensured that quarry contractor is following environment management system to take care of the working conditions of workers in the existing quarry areas selected for the project. Raw material requirements construction activities are detailed in Table below.

Table 5-1: Raw Material Requirement

S. No.	Description	Unit	Quantity
1	Earthwork	Cum	10194252
2	GSB	Cum	685603
3	WMM	Cum	350501
4	DBM	MT	1289312
5	BC	MT	317161
6	Bitumen	MT	70654
7	Emulsion	MT	3642
8	Cement	MT	154461
9	10 mm	Cum	330352
10	20 mm	Cum	374339
11	40 mm	Cum	215229
12	Dust	Cum	449514
13	Sand	Cum	175135
14	Filler	MT	20804

S. No.	Description	Unit	Quantity
15	Steel	MT	1092777

Source: Design report

The average lead distance of the quarries and other construction material in respect to complete Lot-4 stretch from is presented in Table and figure below.

Table 5-2: Material Source and Lead

Material	Source Lead Distance	Remarks
Aggregate	78 Km	Average Lead of 6 Quarries
Sand	50 Km	Average Lead of 6 Quarries
Bitumen	143 Km	Mathura Refinery
Emulsion	1513 Km	Haldia Refinery
Cement	176 Km	INAM-PRO
Steel	176 Km	SAIL

Source: Design Report

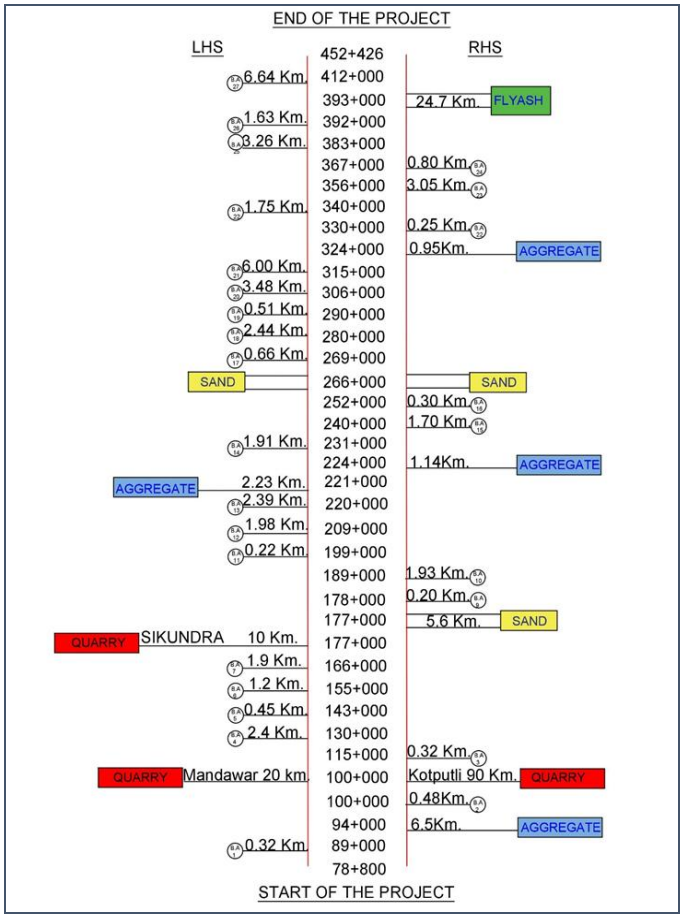


Figure 5-1: Material Lead Chart

Mitigation

Existing approved quarries which are already in operation with the required environmental clearances have been recommended for this project, hence no new quarries have been proposed. It needs however, to be noted that recommendation on use of quarries is a guideline only and has

been done to establish the feasibility of construction. The issue of dust generation etc. along the haul roads needs to be addressed through proper enforcement of dust suppression measures.

Sand required for the construction will mostly be procured from the approved operating river quarries. As an alternative to borrowing of sand from river bed the possibility of using stone crusher dust and fly ash shall be explored. Stone dust from crusher can be used for the construction works provided the quantity and the quality produced is certified by Monitoring consultant to be satisfactory for all construction works, else river sand shall be used from the identified quarry. The long leads mean that care would have to be taken to prevent spillage of material and damage to the haul roads during transportation. No additional adverse environmental impact except those resulting from spillage during transportation is expected to occur. Hence proper care for transportation should be taken into account.

Guidelines for Existing Quarry Management & Guidelines for New Quarry Management have been presented in Annexure 5.1 & Annexure 5.2 respectively.

5.1.2.4 Borrow Area

Impact

Borrow areas become potential breeding ground for mosquitoes and other bacterial infection disease. The transportation of borrow and quarry materials also cause dust nuisance. Top soil as removed from the borrow area may lose its fertility if not handled properly.

Mitigation

The borrow area are selected in a scientific manner with due care of local environment and social sensitivity. The excavation of soil shall be conducted as per the EMP and will be fully rehabilitated with proper NOC from the respective land owner / authority. The top soil from the borrow area shall be preserved separately and will be re-used for rehabilitation. MoEF&CC norms & guidelines shall be followed for borrow area opening and management. The detailed plan for borrow area management has been attached as Annexure 5.3. Tentative location for probable borrow areas as identified along the road has been presented in below table.

Table 5-3: Summary of Identified Borrow Area Locations

S. No.	Location (Ch.)	Direction	Name of Village	Lead from proposed alignment (km)	Latitude	Longitude	Quantity / Availability
1	392	LHS	Thoomra	1.63	25° 04' 56.2728'' N	76° 03' 41.2956'' E	Abundant
2	412	LHS	KalyaKheri	6.64	24° 51' 42.9768'' N	75° 58' 58.6488'' E	Abundant

Source: Design report

5.1.2.5 Soil Erosion

Pre-Construction Stage

Impact

The removal of vegetation will cause erosion, and increased run-off due to paved surface would in turn lead to erosion of productive soil from nearby areas. The direct impact of erosion is the loss of

embankment soil and danger of stability loss for the road itself. This impact is generally restricted to the RoW.

Mitigation

The project has taken care of this issue at the engineering design stage itself, as at design gradients of 1:2, the slopes of the embankments are perceived to be stable. Also, it may be mentioned that tree felling shall be limited for the formation width only. These remaining trees will provide stability to the embankment. High embankment section of the road shall be suitably turfed by stone pitching or any other suitable turfing materials.

Construction Stage

Impact

All high embankments sections along the bridges and the bridge approaches would be vulnerable to erosion and need to be provided proper slope protection measures to prevent erosion. Construction of new bridges involves excavation of riverbed and banks for the construction of the foundations and piers. If the residual spoil is not properly disposed off, increased sedimentation downstream of the bridge is likely.

Mitigation

Adequate slope protection measures are proposed as part of engineering design. Silt fencing shall be provided to prevent eroded material from entering watercourses. Though during construction period, drainage alteration and downstream erosion / siltation is anticipated, however, cross drainage structure based on hydrology study shall provide compensate the drainage alteration in the surrounding area. The regular cleaning of the drains by the Contractor will ensure that these structures will not be overloaded or rendered ineffective due to overload.

Operation Stage

No soil erosion is envisaged when the road is in operation as all the slopes and embankments of the project road shall be stabilised through sound engineering techniques.

5.1.2.6 Compaction of Soil

Impact

Compaction of soil will occur in the due to movement of heavy machinery and vehicles. Similarly, compaction will take place during setting up of construction camps and stockyards.

Mitigation

The movement of construction vehicles shall be limited to designated road. So that compaction of nearby productive land can be saved. Provision of reclaiming of nearby land has also been kept to cure the soil compaction in nearby productive lands. However, this is a short duration impact. Appropriate measures should be taken to minimise the area of soil compaction.

5.1.2.7 Contamination of Soil

Impact

Soil contamination may take place due to waste disposal from the labour camp set up during pre-construction stage. The sites where construction vehicles are parked and serviced are likely to be

contaminated because of leakage or spillage of fuel and lubricants. Fuel storage areas are also susceptible to the soil contamination by accidental spillage and run-off. Unwarranted disposal of construction spoil and debris will add to soil contamination. During the operation stage, soil pollution due to accidental vehicle spills or leaks is also having a low probability.

Mitigation

Following mitigation strategies are proposed to control soil contamination.

- The fuel shall be stored in separately designated covered area with RCC surface to prevent any soil contamination due to spillage
- Overflow of service and washing areas shall be passed through the oil interceptors
- Septic tank with soak pit facility will be provide in labour camps to prevent any soil contamination due to sewage discharge
- Waste management system was per Solid Waste Management Rules, 2016 will be adopted in construction camps
- Scarified bitumen waste shall be disposed-off at designated landfill site only

The quality of the soil shall be monitored on regular basis to find out the effectiveness of the mitigation measures and further improvement in measures if required. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Management Plan.

Guidelines for Identification of Debris Disposal Sites & Precautions and Guidelines for Rehabilitation of Dumpsites & Quarries have been attached as Annexure- 5.4 & Annexure- 5.5 respectively.

5.1.3 Air Quality

Air quality along the project corridor will be impacted both during the construction and operation stages of the project. Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the down wind direction. Operation stage impacts will not be as severe as the construction stage impacts and will be confined generally to a band of upto 100m from the edge of the lane on either side of the corridor.

5.1.3.1 Generation of Dust

Pre-Construction Stage

Impact

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

- Site clearance and use of heavy vehicles and machinery etc.
- Transport of raw materials from quarries to construction sites
- It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.

Mitigation

If adequate measures are taken such as sprinkling of water near site clearance activities and transportation of construction material in covered trucks especially those carrying sand & dust, then the impacts can be reduced to a great extent.

Construction Stage

Impact

Construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is likely to be generated due to the various construction activities including:

- Construction and allied activities
- Mixing of construction materials;

Mitigation

Generation of dust is a critical issue and is likely to have adverse impact on health of workers working in dust generation activities. The Environmental Action Plan to be prepared by Contractor/Concessionaire must lay emphasis on enforcement of measures such as provision of pollution masks, regular sprinkling of water to suppress dust to mitigate this impact.

Operation Stage

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

5.1.3.2 Generation of Exhaust Gases

Impact

Generation of exhaust gases is likely during the pre-construction stage due to movement of heavy vehicles & machinery, oil tankers, etc. SO2, NO2 and HC are likely to be emitted from hot mix plant operations. Volatile toxic gases are also released through the heating process during bitumen production. Although the impact is much localized however, it can spread downwind depending on the wind speeds. Construction vehicles shall also be releasing exhaust gases.

The major impact on air quality during operation stage will be due to plying of vehicles. The impacts on air quality will at any given time depend upon traffic volume / rate of vehicular emission within a given stretch and prevailing meteorological conditions. Air pollution impacts arise from two sources: (i) inadequate vehicle maintenance; and (ii) use of adulterated fuel in vehicles.

Mitigation

- Regular maintenance and pollution check is proposed for construction vehicles and machineries
- No bad quality fuel shall be used in construction vehicles and machinery
- Hot mix Plant to be installed in down wind direction from nearby settlement at minimum 1000m distance.
- Broad-leaved pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, shall be planted as they help settle particulates with their higher surface areas along with thick foliage.

- Cassia fistula (Amaltas), *Ficus religiosa* (Peepal), *Ficus bengalensis* (Banyan), *Tamarindus indica* (Imli) and *Azadirachta indica* (Neem) are recommended. However, plantation shall be carried out in close communication with the forest dept. with the help of native species.
- Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and upkeep, educating drivers about driving behaviour. However, these methods are beyond the scope of the project but will be far more effective in reducing the pollutant levels. NHAI together with the Motor vehicles Department and SPCB can arrange for provision for inspection for PUC certificates at all the major junctions.

5.1.3.3 AAQ Impact Prediction Modelling of CO Using CALINE 4 Dispersion Model

CALINE 4 (Caltrans, 1989) is a simple line source Gaussian plume dispersion model that predicts air impacts near roadways. The model is broadly divided into five screens such as Job Parameters, Run Conditions, Link Geometry, Link Activity and Receptor Positions.

Job Parameters

Run Type: determine averaging times and how the hourly average wind angle(s) will be determined. In the present case modeling exercise were made to predict the impact on worst case scenario. Multi-Run / Worst Case Hybrid type was used for CO impact modeling.

Aerodynamic Roughness Coefficient: determine the amount of local air turbulence that affects plume spreading. CALINE 4 offers the 4 choices for aerodynamic roughness Coefficient namely; Rural, Suburban, Central Business District and Other. For the present modelling rural roughness options have been considered.

Altitude above Sea Level: Define the altitude above mean sea level. This input is used to determine the rate of plume spreading.

Run conditions

Wind Speed: Expressed in meters per second. USEPA recommends a value of 1 m/s as the worst-case wind speed.

Wind Direction: The direction the wind is blowing from, measured clockwise in degrees from the north. As the model study is on “Worst Case scenario”, therefore CALINE 4 will consider this input.

Link Geometry

Link Type: 5 choices available such as At Grade, Fill, Depressed, Bridge and Parking lot. In this particular model study At Grade link type is used.

Link Height: For the project link height is being considered as zero.

Mixing Zone Width: Mixing zone is defined as the width of the roadway, plus 3m on either side.

Link Activity

Traffic Volume: The hourly traffic volume anticipated to travel on each link, in units of vehicles per hour.

Emission Factor: The weighted average emission rate of the local vehicle fleet, expressed in terms of grams / mile per vehicle.

Receptor Positions

Receptors positions expressed in Cartesian (x, y) coordinate system. Z value can also be provided to assess the proposed impacts at various heights. For the present case incremental GLCs were assessed at every 10m interval from the edge of the project highway.

Approach and Methodology

Emission Factors were arrived using standard values prescribed by The Automotive Research Association of India, Pune under Air Quality Monitoring Project-Indian Clean Air Programme (ICAP). Project Stretch is the part of three traffic sections 10, 11 & 12, separated by interchanges. Traffic load and emission factors were estimated for both the traffic sections. Table below presents the Traffic and emission factor considered for the project.

Table 5-4: Traffic and emission factors for traffic sections

Year	Traffic volume per day	Emission Factor (gm/mile) for CO
Section 10 (km 398.240 to km 417.809)		
2059-60	61299	7.54
Section 11 (km 417.809 to km 434.825)		
2059-60	55636	7.71
Section 12 (km 434.825 to km 452.425)		
2059-60	54787	7.72

Results

Dispersion model software was run by using data as discussed above. The output results at various distances along the project highway for projected year 2059-60 are presented in Table below.

Table 5-5: Predicted Pollutant Concentration

Location	Resultant CO Concentration (mg/m^3)					
	10m	20m	40m	60m	80m	100m
Section 10	0.43	0.37	0.29	0.24	0.21	0.19
Section 11	0.44	0.37	0.30	0.25	0.22	0.19
Section 12	0.44	0.37	0.30	0.25	0.22	0.21

Conclusion

Considering the maximum baseline ambient concentration of CO i.e. 0.82 mg/m3 and predicted incremental concentration of 0.44 mg/m3 at row edge (nearest possible receptor), the maximum resultant CO concentration shall be in the tune of 1.26 mg/m3 in respect to 2 mg/m3 of Ambient Air Quality Standards. Hence, predicted CO concentration including ambient level shall remain well within the National Ambient Air Quality Standards for the projected years 2059-60.

5.1.4 Water Resources

5.1.4.1 Physical Loss of Surface Water Bodies

Impact

- The surface water bodies along the project road might be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project.
- Alteration of the surface water regime is expected due to proposed highway construction

- nos. of ponds are likely to be affected due to the proposed highway. The details are shown in below table.

Table 5-6: Pond Likely to be affected due to Proposed Road

Chainage (km)	Side	Total Area of the Pond (m^2)	Affected area within RoW		Measures Adopted
			(m^2)	(%)	
397+350	LHS	697	697	100.0	Culvert
398+650	RHS	15525	0	0.0	Culvert
416+750	RHS	4374	1791	40.9	Major Bridge
430+540	LHS	9945	1527	15.4	Major Bridge
442+050	LHS	6029	4153	68.9	Major Bridge

Mitigation

- 5 Major bridge, 17 Minor bridges and 86 culverts are proposed to construct for maintaining the natural drainage system of the area. Cross drainage structures are designed to avoid any compromise on the flow part.
- Cross drainage structures are proposed at all the pond location to limit the affected area and to maintain the catchment unaffected. Compensatory digging is proposed to maintain the storing capacity of the ponds.
- Continuous unlined drain in rural sections and covered line drain urban sections has been proposed. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.
- Silt fencing will be provided between road and water bodies to avoid any siltation due to run-off from construction area.

5.1.4.2 Water Required for the Project

Impact

The most likely significant impact on water during construction is depletion of water table. The construction works requires a considerable quantity of potable water for the various activities including construction of the pavement, dust suppression, curing etc. The total demand of water to be used during the construction phase will be around 28,01,120 KL. The demand though is only indicative in nature and shall differ during the lean period of construction. The demand shall be met through availability of supply both from surface and ground sources. However, mostly surface water shall be used for the construction work as all the blocks in the project area falls under water scarce zones as per Ground Water Information Booklet, CGWB.

Also ground water depletion is likely due to reduction in groundwater recharge areas by an increase in impervious layers after proposed highway construction.

Mitigation

Efforts will be made for the use of only surface water during construction phase. Prior approval for taking adequate quantities of water from surface and ground water sources shall be taken from respective authority before start of construction. The depletion of water is predominantly restricted to the construction phase. Rain water harvesting structures are proposed at every 500m interval to

conserve the precious rain water. The road operation does not make a demand on the available water resources apart from time to time requirement during works such as maintenance of road side tree plantations. However, it is more likely that water from rivers / canals not be tapped at all for this purpose.

5.1.4.3 Loss of Drinking/Household Water Resources

Impact

The impact on the local water supply sources like hand pumps, wells and tanks is likely due to proposed development. 01 hand-pump shall be relocated due to proposed highway construction. Relocations cost shall be paid as per contract provisions.

Mitigation

The losses have been covered under the utility relocation process. Compensatory water supply sources will be set up before the start of construction with location of the new point as close to the original as possible.

5.1.4.4 Water Quality

Impact

Due to site clearing activities, soils around the surface water regime will be exposed, due to which, the suspended sediments and the associated pollutants can be transported in to these water sources. The impacts due to the increased sediment load will be significant to some extent. Contamination of groundwater is another likely impact of road construction and allied activities. The contamination of the water resources due to the project is likely from following reasons:

- Concentration of suspended solids in receiving water bodies due to soil erosion from site clearing area
- Run-off from the construction site near the water bodies and sources of water supply
- Disposal of solid and liquid wastes by labour, spills or leaks can affect the water quality
- Run-off from fuel storage and work-shop area as Oil and grease form a film on the water surface and hinder the transfer of oxygen into water
- Contamination by fuel and oil containing discharge or accidental spillage from construction vehicles or bitumen from hot-mix plants
- Sewage discharge from the labour camp

Increased sediment load, lesser sunlight, difficulty to settle, etc. will make the surface water more turbid. If the concentrations are higher, smaller fish may be harmed. Large, heavy sediment, particularly with slow moving water may smother algae and eventually alter the nature of the sub-stratum. Excessive sediment loads may also mean disruption to areas where fish lay their eggs. The water quality of surface drainage channels is likely to be impaired as long as the construction period continues.

Mitigation

The engineering design shall ensure protection of embankment slopes. Loose soil and construction material heaps around the construction sites are 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.

Silt fencing shall be provided along the all major water bodies including the pond. Silt fencing shall be provided on either side of the crossing water body to the affected length plus 5m on either side to control the sediment load. However, for pond or any other stagnant water body silt fencing shall be provided all along the water body. Locations of silt fencing as identified are presented in Table below.

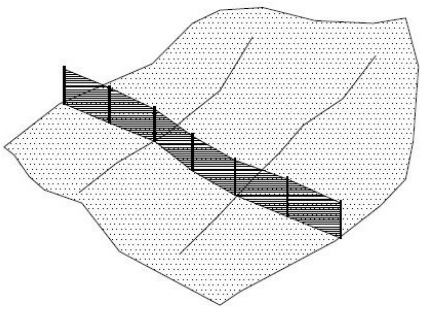
Table 5-7: Silt Fencing Location

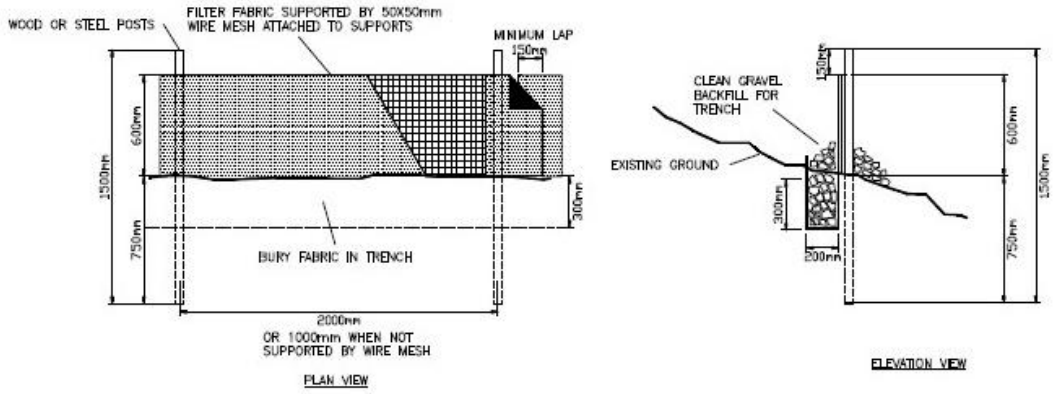
S. No.	Chainage	Type of Water Body	Crossing Length / Perimeter	Approx. Silt Fencing Length
1	397+350	Pond	110	110
2	398+650	Pond	540	540
3	401+313	Local stream	15	50
4	408+701	Local stream	110	260
5	410+306	Local stream	20	60
6	413+941	Local stream	35	90
7	416+750	Pond	270	270
8	420+811	Local stream	60	140
9	427+816	Takli River	65	150
10	430+540	Pond	390	390
11	437+650	Local stream	25	70
12	439+190	Local stream	20	60
13	442+050	Pond	6030	6030

Silt fencing of about of about 8220 m will be provided to prevent sediments during construction period near the water bodies. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. It is expected a single person will be able to drive the angles by pressing from the top. The frame will be installed at the edge of the water body along which construction is in progress. The number of such units to be installed shall be decided depending upon the length of the water body along the side of the road construction.

Guidelines for Sediment Control has been attached as Annexure 5.6

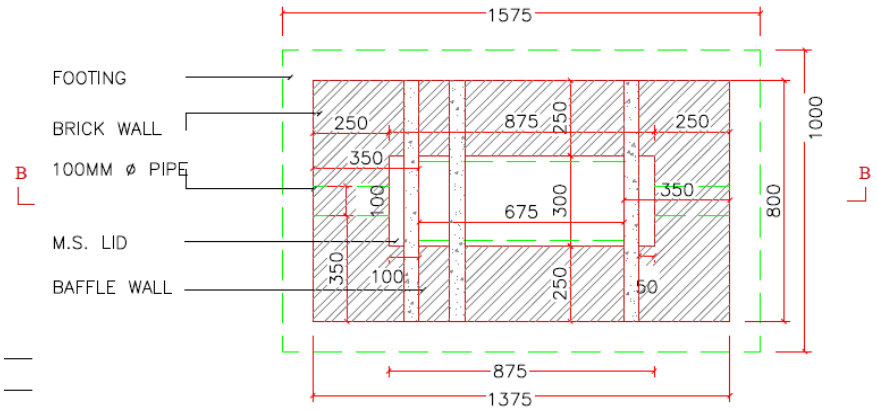
Figure 5-2: Schematic diagram of Silt Fencing





Oil interceptor: Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations, and vehicle parking areas of construction camps. Waste having hazardous properties will be stored in designated area only. 6 nos. (2 for each construction package site) of oil interceptors shall be provided at camp sites to arrest oil and grease, as per above figure. The arrested oil and grease shall be disposed as per MoEF&CC and SPCB guidelines. The location of fuel storage and vehicle cleaning area will be at least 500 m from the nearest drain / water body.

Figure 5-3: Schematic diagram of Oil Interceptor



No contamination of any water source is envisaged during the operation period. However, water quality may be impacted due to washing of the vehicles near the rivers, water bodies etc. Washings from road can contain oil, which may end up reaching into local water bodies.

5.1.5 Noise levels

5.1.5.1 Pre-construction and Construction Stage

Impact

Site clearing activities, movement of man and machineries, crusher & mixing plants operation, etc. are likely to increase the noise level of project region. Noise pollution is matter of concern, where alignment passes nearby to settlement areas.

About 90 dB (A) of noise shall be generated from construction activity which shall attenuate to less than 55 dB(A) i.e. day time prescribed noise level at about 100m and less than 45 dB (A) i.e. night time prescribed noise level at about 300 m. Comparison of distance vs Noise level (considering two

Noise source of Intensity 90 dB(A) are working in parallel) for day and night time are shown in Figures below.

Figure 5-4: Day-time Construction Noise Intensity vs Distance from the Source

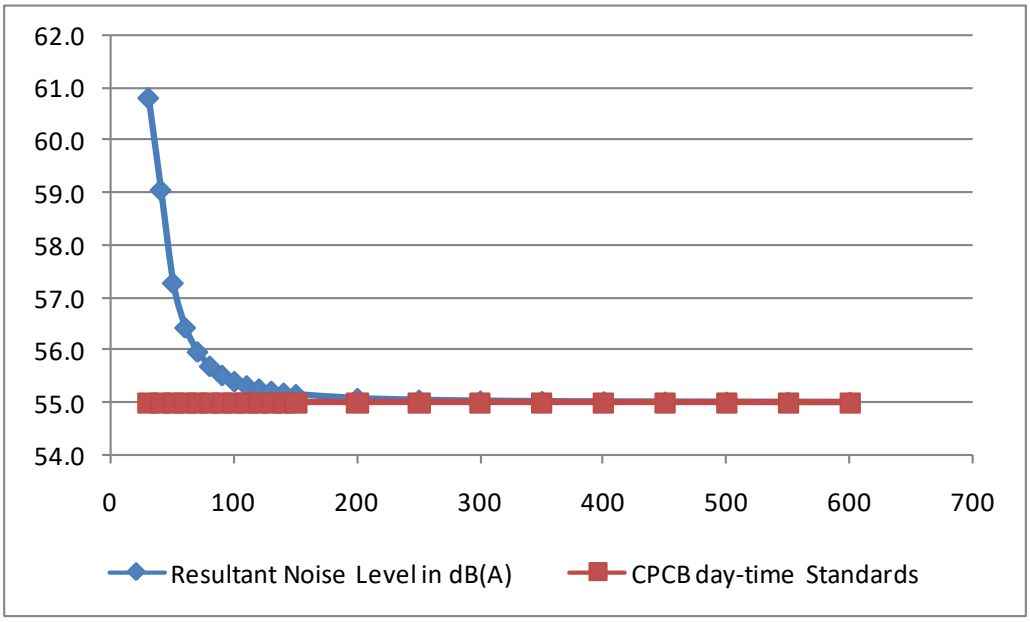
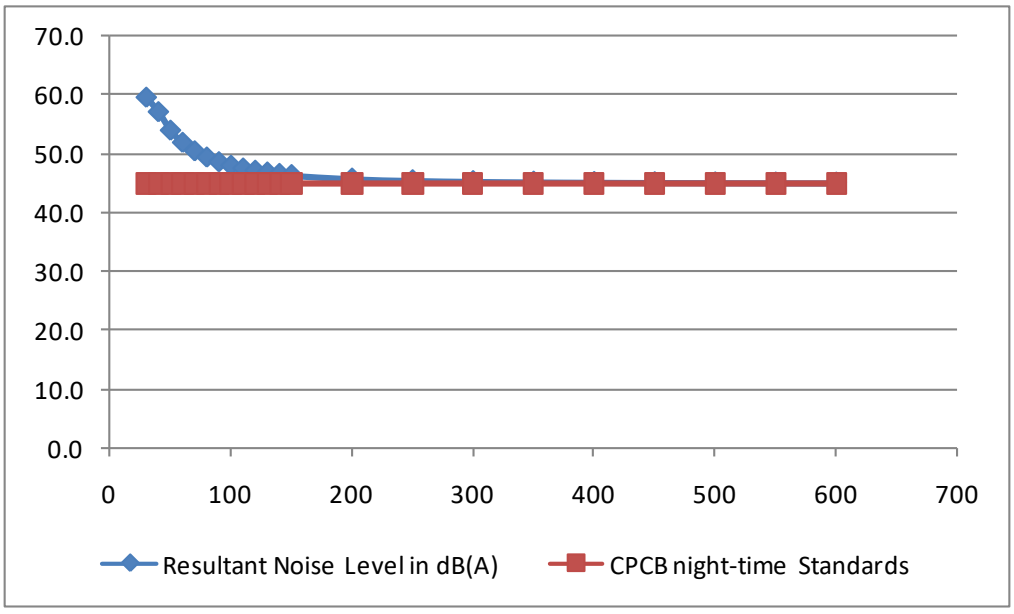


Figure 5-5: Night-time Construction Noise Intensity vs Distance from the Source



Prior mitigation measures shall be required for neutralizing the affects near settlement areas.

Mitigation Measures

Construction camp shall be established at least 1000m away from nearest habitation and forest area. Temporary noise barriers should be provided surrounding the high noise generating construction equipment during work near to settlement area. Stationary noise source like generator sets shall be provided with an acoustic shield around them. The plants, equipment and vehicle used

for construction should strictly conform to CPCB standards. Vehicles and equipments used should be fitted with silencer and maintained accordingly.

Noise generating activities should be scheduled based on community welfare. Noise level should regularly be monitored as per monitoring plan and if the noise level at any time found to be higher, then immediate measure to reduce noise in that area should be ensured. The following mitigation measures as given in table below need to be worked out for the noise impacts associated with the various construction activities.

Table 5-8: Summary of Mitigation Measures for Construction Stage

Source of Noise Pollution	Impacts	Generic Mitigation Measures
• Utilization of heavy construction machinery; • Construction of structures and facilities; • Crushing plants, asphalt production plants; and • Loading, transportation and unloading of construction materials	Increased Noise Levels causing discomfort to local residents and workers	• All construction equipment, plants, machinery and vehicles will follow prescribed noise standards. • All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB (A). If required, machinery producing high noise as concrete mixers, generators etc. must be provided with noise shields; • At construction sites within 500 m of human settlements, noisy construction activities shall be stopped between 9.00 PM and 6.00 AM; • Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum; • Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB (A) per 8 hour shift; • Hot mix plant, batching or aggregate plants shall not be located within 1000 m of sensitive land use and settlements; • The project road designed is 8 lane carriageway + Granular Shoulder. Wider carriage shall help in reducing the impact of highway noise

5.1.5.2 Operation Stage

Impact

Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface. Noise is a major area of concern, especially since sensitive receptors (forest, habitation, etc.) have been identified in close proximity of the road.

CoRTN (Calculation of Road Traffic Noise) model developed by up UK Department of Transport is used for assessment of Noise Impact Intensity at various distances from the proposed highway. Traffic Noise has been estimated for uninterrupted traffic flow condition.

Limitations

Metrological conditions are not taken into account and also model does not take background noise into account.

Classification of Vehicles

In CoRTN model vehicles are classified onto two categories:

- Light vehicles
- Heavy vehicles

Approach, Methodology & Validation

The model has been validated for Indian Conditions by CSIR Central Road Research Institute and published the validation in 2008 vide paper titled "Validation of Noise Prediction Model for an Urban Area". The present model used for the project is derived from the CSIR CRRI validated and modified model.

Input Traffic

CoRTN model software was run by using traffic forecast data of year 2059-60. The assessment of traffic along the corridor is based on the interchanges proposed along the road, as they are going to act as points where traffic will join or leave the highway. The Table below lists the sections based on interchanges.

Table 5-9: Homogenous sections based on nodes and interchanges

Section	Chainage (km)		Length (km)	Projected Traffic 2059-60 (AADT)
	From	To		
S10	398.240	417.809	19.569	61,299
S11	417.600	434.825	17.016	55,636
S12	434.820	452.425	17.600	54,788

Result Discussion

Considering individual sections have different traffic intensity, therefore, variation in the noise level increments is observed along the proposed corridor. The increment noise level will attain to the standards of residential i.e. 55 dB(A) at a distance of 45m from the RoW edge.

Table and figures below shown the Noise level due to traffic activities at various distances against the Noise standards for Rural and residential areas across various traffic sections.

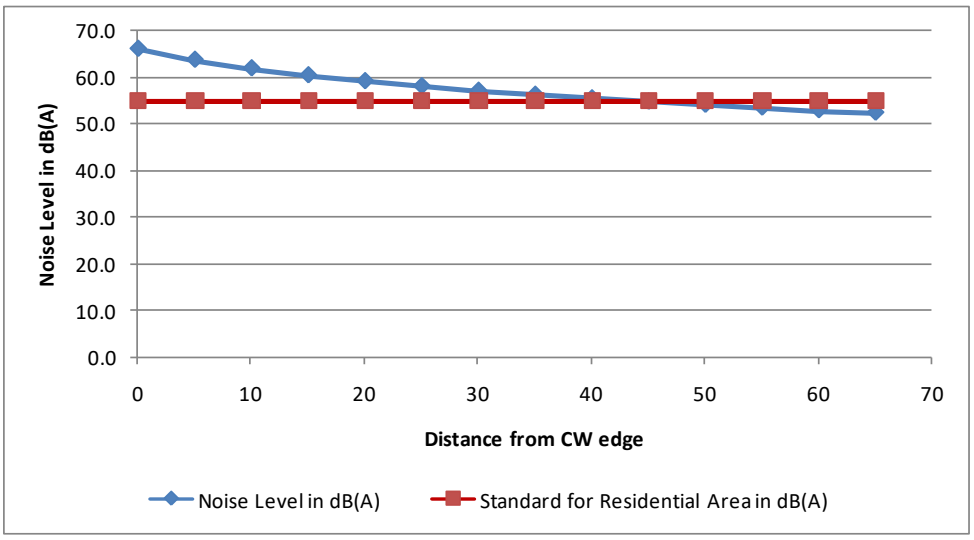
Table 5-10: Noise Level due to Vehicular Traffic (Year 2059-60)

Dist. from RoW edge (m)	Section Wise Noise Level in dB(A)			Noise Standards for day time in dB(A)
	S10	S11	S12	
0	66.1	65.8	65.7	55
5	63.8	63.4	63.4	
10	62.0	61.6	61.6	
15	60.5	60.1	60.1	
20	59.2	58.9	58.8	
25	58.1	57.8	57.7	
30	57.2	56.8	56.8	
35	56.3	56.0	55.9	
40	55.5	55.2	55.1	
45	54.8	54.5	54.4	

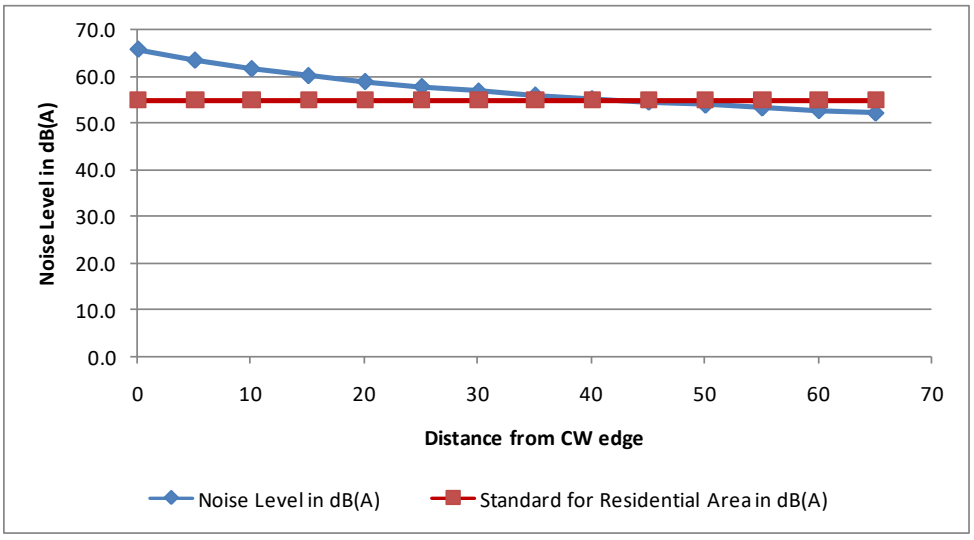
Dist. from RoW edge (m)	Section Wise Noise Level in dB(A)			Noise Standards for day time in dB(A)
	S10	S11	S12	
50	54.2	53.8	53.8	
55	53.6	53.2	53.2	
60	53.0	52.6	52.6	
65	52.5	52.1	52.1	

Source: Outcome of Mathematical Modeling

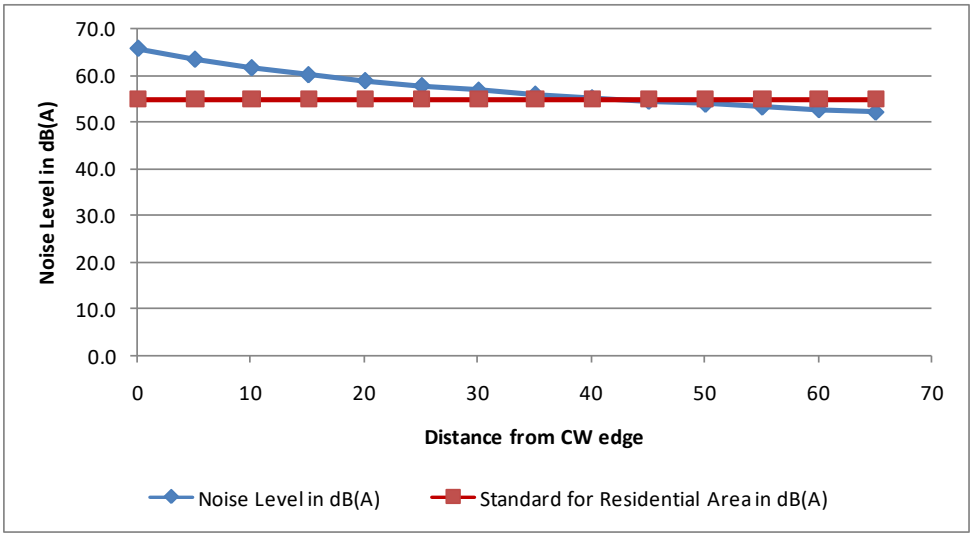
Figure 5-6: Noise Intensity due to Vehicular Operation vs Noise Standards during year 2059-60



Section 10



Section 11



Section 12

Mitigation Measures

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface. Noise is an area of concern, specifically near to the settlement areas and eco-sensitive area like Mukundra Hills. Tunnel is proposed in Mukundra Hills. Tunnel shall be based on advance engineering and shall have noise and vibration dampening features. At most of the places, proposed highway alignment is passing through sufficiently away from the nearest settlement, however, at the crossing of SH-51 and SH-9A some existing settlement are located in very close vicinity of the highway. Noise barrier for about a length of 390m shall be provided.

Detail of sensitive receptors with proposed length of Noise Barrier along the proposed highway is presented in Table below.

Table 5-11: Noise Barrier Location and Tentative Length

Type of Receptor	Chainage (km)	Side	Approx. distance from Alignment (m)	Approx. Length of Noise Barrier (m)
Habitation Area	398+250	RHS	Adjacent	90 m
Habitation Area	434+850	Both	Adjacent	300 m

Mitigation measures as suggested during operation stage are tabulated below.

Table 5-12: Mitigation Measures during Operation Stage

S. No.	Item	Impact	Reason	Mitigation / Enhancement
1	Sensitive receptors	Direct impact	Increase in noise pollution Man, material and machinery movements	• Noise barrier will be provided at all the noise sensitive receptors • Speed Barriers near sensitive receptors • No Horn Zone sign poster
2	Noise	Marginal	Due to increase in traffic	• Will be compensated with the

S. No.	Item	Impact	Reason	Mitigation / Enhancement
	Pollution (Operation Stage)	Impact	(due to improved facility)	uninterrupted movement of vehicles • Provision of about 390m length of noise barrier near habitation areas; and • Tunnel is proposed in Mukundra Hills
3	Noise Pollution Monitoring	-	Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

5.2 Biological Environment

5.2.1 Protected Areas

Proposed alignment is passing through the Mukundra Hills Tiger Reserve (MHTR) and crossing two hillocks and a valley portion in between. About 34.34 ha of protected is likely to be diverted MHTR. Chainage wise detail is provided in Table below.

Table 5-13: Chainage wise affected Protected Area

S. No.	Chainage		Length (Km)	Dist Name	Forest Block Name	Affected Area (ha)
	From	To				
1	422+284	425+690	3.406	Kota	Mukundra Hills Tiger Reserve	34.34

The actual extent of forest land to be diverted shall be furnished after completion of Land Acquisition Plan. The measures proposed in protected area are listed below.

- In order to obviate the needless bisection of the MHTR, an underground tunnel will be constructed.
- Both the end faces of the tunnel may be placed about 500m away from the boundary of protected area of Critical Tiger Habitat (Core of Mukundra Hills Tiger Reserve) by implying “Cut & Cover Technique to avoid disturbance in the vicinity of the tiger reserve
- Length of the tunnel, the slope of the highway in this stretch and its depth will dependent on the technical feasibility study of the valley area.

5.2.2 Forest Areas

Need for diversion of forest land has been envisaged for this project. Hence Forest Clearance under the purview of Forest (Conservation) Act, 1980 is applicable. About 147.12 ha (including Mukundra Hills Tiger Reserve) of forest land is likely to be diverted due to proposed development. In addition to break-up provide in Table 5.13, about 112.78 ha of forest area is proposed to be diverted in Barkalji Reserved Forests. Alignment passes through the Barkalji Reserved Forests for about 11.290km of length near Chainage km 404+300 to km 415+590.

5.2.3 Impact on Flora

The principal impact on flora involves the removal of trees for the creation of a clear zone within the Corridor of Impact. The felling 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.

A far less contentious issue, which normally takes the back seat, is the importance of the ecosystems supported by the trees. Not only would the removal of trees lead to erosion, it would also mean that the micro-ecosystems developed in the project region with the birds, animals and insects using the plantation over the years would be lost too. About 1905 trees located in the proposed RoW are need to be felled.

Though the loss of these trees is an irreversible and long-term impact, the loss of the roadside plantations shall have to be compensated in accordance to the principles of the Forest (Conservation) Act and Forest Policy. Compensatory afforestation shall be undertaken with native species and proper care of the saplings will be taken to ensure survival.

Avenue and median plantation shall be undertaken as per SP-21:2009. Adequate provisions for monitoring of the same must be worked out. Co-operation of locals to ensure that local cattle do not damage the saplings during the early stages of growth will be required. Plantation along the proposed highway shall act as the new habitat for avifauna, lesser mammals, herpetofauna & insects. List of species recommended for taking up afforestation has been presented in below tables. Local authority and populace may also be consulted for selection of species types.

Table 5-14: Species Recommended in Settlement Areas

Scientific name	Common Name	Reason
Azadirachta indica	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
Cassia fistula	Indian laburnum	Landscaping, Flowering plant, Pollution sink
Ficus bengalensis	Banyan	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus religiosa	Peepal	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Magnifera indica	Mango	Noise barrier, Pollution sink, Economic Value, Shade

Table 5-15: Species Recommended in other areas

Scientific Name	Common Name	Reason
Azadirachta indica	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
Ficus bengalensis	Banyan	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Ficus religiosa	Peepal	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
Magnifera indica	Mango	Noise barrier, Pollution sink, Economic Value (fruit bearing)
Syzygium cumini	Jaman	Pollution sink, Economic Value (fruit bearing)
Tamarindus indica	Tamarind	Noise barrier, Pollution sink, Economic & Medicinal Value
Terminalia arjuna	Arjun	Noise barrier, Pollution sink

Tree Plantation strategy has been attached as Annexure 5.7.

5.2.4 Impact on Fauna

Presence of Endangered / Schedule - I species is reported in Mukundra Hills Tiger Reserve. Tunnel is proposed in Mukundra Hills Tiger Reserve to avoid man animal conflict in wildlife and protected area. Micro-ecosystems developed in the project region with the birds, animals and insects using the plantation over the years would be lost due to loss of their habitat. Plantation along the proposed highway shall act as the new habitat for avifauna, lesser mammals, herpetofauna & insects.

Conceptual drawing of Roadside Signage is presented in Annexure 5.8 & format for reporting of Road kill is provided in Annexure 8.1.

5.2.5 Aquatic Ecology

Contamination of the surface water due to spillage of construction material, sediment loading & increased turbidity shall result in decline in the number and diversity of aquatic flora and fauna and thus the food web species during construction period. Adequate provisions shall be undertaken while working near major water bodies. Silt fencing are proposed to avoid the sediment load due to run-off from construction area near water bodies.

5.3 Social Environment

5.3.1 Land Acquisition & Extent of Loss to Properties

The Land required for construction of proposed highway is 718.01ha.

5.3.2 Project Affected Families

About 23 nos. residential structures, 793 nos. of Titleholder's families are likely to be affected due to proposed development. Compensation shall be provided as per LARR, 2013. Details of mitigation measures are provided in SIA & RAP report being submitted separately with this EIA report.

5.3.3 Public Amenities

All public utilities like electricity lines, telephone lines or electric transformer which are likely to be impacted shall be replaced before the start of work. About 289 electric poles, 53 transformers, 01 Hand Pump, HT Lines 02 and 14 OFC poles are likely to be shifted before start of construction. The poles will be shifted after taking approval from the concerned dept.

5.3.4 Cultural and Community Properties

There is no place of archaeological importance along the road. About 4 nos. of structure having religious importance and 2 government structures (School & Anganwadi kendra) are affected. Detailed impacts on Cultural & Religious properties are elaborated in SIA & RAP.

5.3.5 Land use Change

Considering the access controlled status, ribbon development near the proposed highway is having very less possibility. However, interchanges location are likely to induce ribbon development. 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 proposed highway.

5.3.6 Exploitation of Resources

Improvement in the connectivity will have an impact on the natural resources. Easy accessibility of the area will increase the population of the region. This means more and more exploitation of the natural resources like ground water, fuel, etc. While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous. Separate labour camp away from habitation shall be constructed. All day to day need shall be

procured from nearby city markets. No tree cutting shall be permitted for the cooking and other purpose.

5.3.7 Traffic congestion during construction

Traffic congestion due to construction activities is common phenomena for any developmental activities. Safe and convenient passage for vehicles, pedestrians and livestock to and from crossing roads and property access connecting the project highway is the mostly required. The construction activities that shall affect the use of crossing roads and existing access to individual properties shall not be undertaken without providing adequate provisions.

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

Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Monitoring consultant. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. The road safety measured to be adopted during construction for traffic control and safety during construction are provided under Annexure 5.9.

5.3.8 Working conditions

Contractor is required to comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention No.62 as far as those are applicable to this contract. Contractor supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. Contractor shall to comply with all regulation regarding sage scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

5.3.9 Risk from Electrical Equipment

Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public.

5.3.10 Risk at Hazardous Activity

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc, will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. The use of any toxic chemical, if any will be strictly in accordance with the manufacturer's instructions. The Monitoring consultant will be given at least 6 working days' notice of the proposed use of any toxic chemical.

5.3.11 Malarial Risk

Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometre or so of their breeding place. Pits dug up nearby settlement will be adequately drained to prevent water logging. Similarly compensatory measures for filling up part of the water bodies situated adjacent to the project corridors will be directed towards deepening of the water bodies concerned. This way

the capacity of the water body remains the same, while water surface available for breeding of mosquitoes is reduced.

5.3.12 First Aid

At every workplace, a readily available first-aid and unit including an adequate supply of sterilised dressing material and appliances will be provided as per the Factory Rules.

5.3.13 Potable Water

In every workplace at suitable and easily accessible places a sufficient supply of temperate potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided.

5.3.14 Construction Camp

Contractor during the progress of work will provide, erect and maintain necessary living accommodation and ancillary facilities for labour to standards and scales approved by monitoring consultant. All temporary accommodation shall be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp shall be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses take place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins shall be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner. Guidelines for Sitting and Layout of Construction Camp have been presented in Annexure 5.10.

5.3.15 Safety

Project would be the access controlled and no entry shall be provided to the highway except interchange locations. Further, road geometry will be helpful in reduction of accident probability.

5.4 Conclusion

Based on the analysis of environmental impacts in the above sections, it can be concluded that the project is anticipated to cause the following environmental impacts:

- As per site survey, 23 nos. of residential structures, 4 are religious structures and remaining 2 are government structures.
- Approx. 718.01 ha of land required for proposed highway shall affect livelihood of 793 nos. title holders farmers carrying out agricultural activities in project RoW
- Partial physical damage to 5 nos. ponds has been envisaged. Design modification to avoid acquisition of pond is recommended.
- Since the Project is categorized as Category A as per EIA Notification 2006 (amended thereof), environmental clearance is required to be taken
- Project passes through the Mukundra Hills Tiger Reserve and required diversion of about 7.713 ha of protected area
- Compensatory afforestation and avenue plantation shall be undertaken to mitigate the loss associated with tree felling in the RoW of proposed highway

6 ENVIRONMENTAL MONITORING PROGRAMME

6.1 General

The environmental monitoring programme is devised to ensure that the envisaged purpose of the project is achieved and results in the desired benefit to the target population. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Broad objectives of the monitoring programme are:

- To evaluate the performance of mitigation measures proposed in the EMP;
- To suggest improvements in the management plans, if required;
- To satisfy the statutory and community obligations; and,
- To provide feedback on adequacy of Environmental Impact Assessment

6.2 Monitoring Indicators

The monitoring programme contains monitoring plan for all performance indicators, reporting formats and necessary budgetary provisions. Physical, biological and environmental management components identified as of particular significance in affecting the environment at critical locations have been suggested as Performance Indicators. The Performance Indicators shall be evaluated under three heads as:

- Environmental condition indicators to determine efficacy of environmental management measures in control of air, noise, water and soil pollution;
- Environmental management indicators to determine compliance with the suggested environmental management measures.
- Operational performance indicators have also been devised to determine efficacy and utility of the mitigation/enhancement designs proposed

For each of the environmental condition indicator, the monitoring plan specifies the parameters to be monitored, location of the monitoring sites, frequency and duration of monitoring. The monitoring plan also specifies the applicable standards, implementation and supervising responsibilities.

The Environmental Monitoring Programme has been detailed out in ***Annexure 9.2*** along with stipulated standards. Successful implementation of the Environmental Monitoring Program is contingent on the following:

The Monitoring Consultant to request the Concessionaire / Contractor to commence all the initial tests for monitoring of air, water quality, soil and noise levels early in the contract to establish the 'baseline' *i.e*. to assess the existing conditions prior to effects from the Construction activities being felt. The Monitoring Consultant to request the Concessionaire / Contractor to submit for approval a proposed schedule of subsequent periodic tests to be carried out. Monitoring by the Monitoring Consultant of all the en*vir*onmental monitoring tests, and subsequent analysis of results.

Where indicated by testing results, and any other relevant on-site conditions, Monitoring Cons*ul*tant to instruct the Concessionaire / Contractor to:

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

6.3 Monitoring of Earthworks Activities

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in ***Annexure 5.1, 5.2, 5.3, 5.4, 5.5 & 5.6.*** Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimize detrimental effects (*e.g.* erosion) due to run-off, and safety aspects related to Works implementation.

6.4 Monitoring of Concessionaire / Contractor's Facilities, Plant and Equipment

All issues related to negative environmental impacts of the Concessionaire / Contractor's facilities; Plant and equipment are to be controlled through the Concessionaire / Contractor's self-imposed quality assurance plan Regular / periodic inspection of the Concessionaire / Contractor's plant and equipment Monthly appraisal of the Concessionaire / Contractor.

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the Concessionaire / Contractor's operation. The Monitoring Consultant is to review all monthly appraisal reports, and instruct through team leader to the Concessionaire / Contractor to rectify all significant negative environmental impacts.

7 ADDITIONAL STUDIES

7.1 Public Consultation

7.1.1 General

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

Well planned public consultation meeting can lead to reduced financial risks of time and cost over-run, legal disputes, and negative publicity, direct cost savings, increased market share through good public image, and enhanced social benefits to the affected local communities. Public Consultation Meeting (PCM) provides an opportunity for the general public, private and community bodies to know the environmental and social impacts as a result of project implementation.

Major purpose of the public consultation of environmental issues in the EIA study is to appraise the stakeholders on potential environmental impacts and collect their feedback so that adequate safeguards can be considered during the planning phases. The objectives of consultation sessions, the procedure adopted and the outputs of the consultation conducted have been described in the following sections.

7.1.2 Objectives

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

- To obtain the information on baseline scenario;
- Promote public awareness and improve understanding of the potential impacts of proposed projects;
- Identify alternative designs, and mitigation measures;
- Solicit the views of affected communities / individuals on environmental and social problems;
- Improve environmental and social soundness;
- Identify contentious local issues which might jeopardize the implementation of the project;
- Establish transparent procedures for carrying out proposed works;
- Inform the affected populace about the entitlement framework and to settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation

7.1.3 Type of Stakeholders

For the project road, following major groups of stakeholders were identified for consultations at screening stage:

Primary Stakeholders are local people including project affected people, local residents, shopkeepers, farmers, *etc*.; and

Institutional Stakeholders such as concerned Govt. departments *etc*.

The stakeholder consultation adopted was rapid appraisal methodology which included community meetings and in-depth interviews institutional stakeholders.

Consultations was undertaken using various tools including, interviews with government officials, dialogues were set-up with the community through structured questionnaire and general environment & social aspects related questions. The public consultation carried out at the various stages of the study has been summarized in this section.

7.1.4 Methodology

Arrangement: Major settlements located close to proposed highway were selected for conducting public consultation. Affected communities and potential stakeholders such as local residents, panchayat members, school children's and teachers *etc*. were invited to attend the meeting. Effort was made to make the gathering representative of the local population directly or indirectly affected by the potential impacts. During the meetings, no person is prevented from entering and /or leaving the PCM as he / she shall so desire.

Discussions, Questions and Answers: During consultation meeting, the participants were explained the proposed improvement proposal and potential environmental impacts due to the proposed green field highway. Thereafter, a session for question and answer was kept to facilitate interaction with the stakeholders, exchange of information & direct communication and collect their opinion on the environmental issues. The issues broadly covered in questionnaire included the following topics

- Disturbance due to present traffic scenario with respect to environmental pollution and road safety
- Anticipation of disturbance due to the proposed green field highway with respect to environmental pollution and road safety
- Expectation on road safety measures in the improvement proposal
- Accidents and conflicts involving wildlife, if any
- Preference of avenue trees, if any
- Forest, Wildlife and environmental sensitive area.
- Historical and Archaeological sites
- Flora & fauna of the area

7.1.5 Consultations with Institutional Stakeholders

The institutional level consultations were held with representatives of institutions having stakes in implementation of the project. The institutions namely field officials of State Forest Department, State Wildlife Department *etc.* were consulted. Several meetings were held with state Forest and Wildlife Officials and their inputs have been incorporated in the Reports. Details of Consultations with Institutional Stakeholders are given in below table.

Table 7-1: Consultations with Institutional Stakeholders

S. No	Contacted Officials	Discussed points
1	**Mr. T Mohan Raj** **Wildlife Warden (WW), Mukundra Hills Tiger Reserve, Kota**	• Wildlife/eco sensitive protected area within 10 km radius of the proposed project • Information on presence of forest land along the road and Flora of the area • Presence of Notified Protected Area (covered under Wildlife Protection Act, 1972) • Record of sighting of Endangered/Migratory species in the vicinity of Project Area • Forest Map showing the alignment • Wildlife crossing/ corridor crossing the project area • Endemic / Keystone Species • Project impact
2.	**Chief Conservator of Forest (CCF), (Territorial), Kisoripura, Kota**	

7.1.6 Consultations with Community / Primary Stakeholders

The extent or the likely level of adverse impacts was one of the major criteria in deciding locations for public consultation sessions. Consultations were held with the affected population and community residing in near the vicinity of project. Details of Participants attended the public consultation meeting are enclosed as **Annexure 7.1.** Details of consultation along with outcome are presented in tables below.

7.1.7 Outcome of the Consultation with Institutional Stakeholders

The suggestion / observation of the public were recorded and summarized in below table. Proposed project activities and further impact on social and environment aspects were discussed during consultation. Probable Management plan to avoid or minimize the negative impacts were also discussed during consultation.

Table 7-2: Outcome of the Consultations with Community / Primary Stakeholders

Outcome of the Discussion	
	
Consultation at Parlya village, Kota	**Consultation at Balapura village**

Outcome of the Discussion	
 **Consultation at Arlya Jageer Village**	• Surrounding environment is quite satisfactory • Ground Water available • Drought is the frequent phenomena • Overpass at existing village road should be developed • Vehicular underpass should be provided for day to day activities • Drainage and sewerage line near habitation area • Drinking water facility can be developed as part of CSR activity

Source: Primary survey

7.1.8 Key Findings & Recommendations

Major findings related to key issues such as general perception about the project; suggestions to mitigate hardships resulting from dislocation and loss of livelihood are presented below:
It was observed that people are not only aware of the project but also welcomed the project in general.

- The project road lies in water scarce region. People uses bore wells for drinking water and irrigation purpose. Availability of Ground Water is very low and not suited for drinking purpose. People requested for provision for drinking and irrigation purpose.
- People suggested for development of irrigation system (Canal) along the side of proposed highway as social service to the community.
- Affected people demanded for vehicular underpass for day to day activities, village and market access.
- Air & Noise pollution is not a big concern in the project area. However dust pollution in dry season and noise due to traffic movement sometime disturbs immediate roadside dwellers.
- Stakeholders are concerned about the traffic noise and anticipate that increase of green field highway may lead to increased noise level after project implementation.
- The potential PAPs in general were very much concerned about the mode of compensation and employment.
- People suggested that adequate safety measures should be provided. In brief, it was felt during consultation that regular meeting with the local population / community could easily resolve any dispute between the community people and implementing agency settlements.
- Green Belt development along the highway
- Site specific EMP has been designed to address environmental and social related issues

7.1.9 Conclusion

The Public Consultation is ongoing process which starts from the inception stage and continues throughout the construction; till completion of project. All the above feasible suggestions have been addressed in DPR and Environment Management Plan. Public Consultation has been conducted in all the districts through which proposed highway are passing in accordance with EIA Notification 2006

for obtaining the prior environmental clearance for the project.

7.2 Public Hearing

7.2.1 Purpose of Public Hearing

Public consultation is an integral part of project requiring prior Environmental Clearance. Public consultation is the process by which the concerns of local affected persons and others who have reasonable stake in the environmental impacts of the project or activity are ascertained. Proposed project that comes in the Category 'A' activities shall undertake Public Hearing as per the provisions of EIA Notification 14th September 2006 amended thereof. The project proponent has to be submitted the draft EIA report along with executive summary in Hindi and English to Rajasthan Pollution Control Board for its wide circulation.

7.3 Disaster Management, Risk Assessment & Mitigation Procedures

7.3.1 General

Government of India has decided to develop ~42,000 km of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under the Bharatmala Pariyojana. Delhi-Mumbai Greenfield Highway via Vadodara which is one of the projects under Bharatmala Pariyojana. Bharat mala project is planned by the Government of India is mega project which includes several types of construction viz. road, bridges, tunnels, road on stilts, and Interchanges. It is therefore, important to formulate a project specific Risk Assessment & Disaster Management Plan in order to be in a state of preparedness to respond in a structured and systematic manner to the disasters when they occur, so that loss of human life is minimized and recovery is possible within a short time after any major disaster in proposed road project.

7.3.2 Definition of Disaster

The United Nations Office for Disaster Risk Reduction (UNISDR, 2009) defines disaster as:

"A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."

UNISDR considers disaster to be a result of the combination of many factors such as the exposure to hazards, the conditions of vulnerability that are present, and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injuries, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

7.3.3 Scope

This document describes the provisions which have been kept in the project components viz. Tunnels, roads and Bridges, in order to mitigate the effects of Disaster and also for providing an early warning system to the concerned authority / personnel on occurrence of accidents/impending disaster. In addition, it also describes, in general, the measures and actions which should be incorporated in the Disaster Management Plan for the Project during Construction & Operation phase of Tunnel, Roads & Bridges. It is imperative that the DMP for the construction and operations phases should be finalized and amended as required, after due consultation with all the stakeholders

and agencies involved in Disaster Management. The document also gives the Standard Operating Procedures (SOPs) to be followed during the construction Phase. These (SOPs) are based on the provisions of MORT&H Specifications & IRC Special Publication, which are commonly used for the construction of Highway/Bridge & Tunnel Projects in India.

7.3.4 Types of Disasters/Hazards

Primarily disasters are triggered by natural hazards or human-induced, or result from a combination of both. In particular, human-induced factors can greatly aggravate the adverse impacts of a natural disaster. Even at a larger scale, globally, the UN Inter-Governmental Panel on Climate Change (IPCC) has shown that human-induced climate change has significantly increased both the frequency and intensity of extreme weather events. While heavy rains, cyclones, or earthquakes are all natural, the impacts may, and are usually, worsened by many factors related to human activity. The extensive industrialization and urbanization increases both the probability of human-induced disasters, and the extent of potential damage to life and property from both natural and human-induced disasters. The human society is also vulnerable to Chemical, Biological, Radiological, and Nuclear (CBRN) disasters.

7.3.4.1 Natural Hazards

The widely accepted classification system used by the Disaster Information Management System of DesInventar classifies disasters arising from natural hazards into five major categories (DesInventar, 2016):

- **Geophysical:** Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hydro-meteorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes, and other geological events, they are essentially an oceanic process that is manifested as a coastal water-related hazard.
- **Hydrological:** Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up
- **Meteorological:** Events caused by short-lived/small to meso-scale atmospheric processes (in the spectrum from minutes to days)
- **Climatological:** Events caused by long-lived meso- to macro-scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)
- **Biological:** Process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Substances that may cause loss of life, injury or illness

A brief description of these five major categories of the disasters arising from natural factors with the sub-categories is given in Table below. The below classification is not a water tight one. In real life situations, many disasters are a combination of different types of disasters. In addition, secondary disasters may occur after a disaster has occurred.

Table 7-3: Categories of Natural Hazards

S. No.	Family	Main Event	Short Description/ Secondary Disaster
1	Geophysical	Earthquake/Mass	• Landslide following earthquake;

S. No.	Family	Main Event	Short Description/ Secondary Disaster
		movement of earth materials	• Urban fires triggered by earthquakes; • Liquefaction - the transformation of (partially) water-saturated soil from a solid state to a liquid state caused by an earthquake; • Mass movement of earth materials, usually down slopes; • Surface displacement of earthen materials due to ground shaking triggered by earthquakes.
		Tsunami	A series of waves (with long wavelengths when traveling across the deep ocean) that are generated by a displacement of massive amounts of water through underwater earthquakes, volcanic eruptions or landslides. Tsunami waves travel at very high speed across the ocean but as they begin to reach shallow water, they slow down and the wave grows steeper.
2	Hydrological	Flood, Landslides and Wave Action	• **Coastal Erosion-** The temporary or permanent loss of sediments or landmass in coastal margins due to the action of waves, winds, tides, or anthropogenic activities • **Coastal flood-** Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeksFlash Flood Hydrological - Heavy or excessive rainfall in a short period of time that produce immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall • **Flood Hydrological-** A general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than normal levels along thecoast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell (flash floods) • **Wave Action-** Wind-generated surface waves that can occur on the surface of any open body of water such as oceans, rivers and lakes, etc. The size of the wave depends on the strength of the wind and the travelled distance (fetch).
3	Meteorological	Hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that may last for minutes to days	• Cyclone, Storm Surge, Tornado, Convective Storm, Extratropical Storm, Wind Lightning, Heavy Rain
4	Climatological	Unusual, extreme weather conditions	• Extreme hot/cold conditions • Subsidence

S. No.	Family	Main Event	Short Description/ Secondary Disaster
		related to long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal (long-term) climate variability	
5	Biological	Exposure to germs and toxic substances	• Epidemics: viral, bacterial, parasitic, fungal, or prion infections • Insect infestations

7.3.4.2 Human-Induced Disasters

The NPDM (2009) notes that rise in population, rapid urbanization and industrialization, development within high-risk zones, environmental degradation, and climate change aggravates the vulnerabilities to various kinds of disasters. Due to inadequate disaster preparedness, communities, and animals are at increased risk from many kinds of human-induced hazards arising from accidents (industrial, road, air, rail, on river or sea, building collapse, fires, mine flooding, oil spills, etc.). Chemical, Biological, Radiological, and Nuclear (CBRN) hazards rank very high in among the human-induced risks. Terrorist activities and secondary incidents add to these risks and call for adequate preparedness and planning.

7.3.4.3 Levels of Disasters

The disaster management and its planning at various tiers must take into account the vulnerability of disaster-affected area, and the capacity of the authorities to deal with the situation. Using this approach, the High Power Committee on Disaster Management, in its report of 2001, categorized disaster situations into three 'levels': L1, L2, and L3. The period of normalcy, L0, should be utilized for disaster risk reduction.

Level-L1: The level of disaster that can be managed within the capabilities and resources at the District level. However, the state authorities will remain in readiness to provide assistance if needed.

Level-L2: This signifies the disaster situations that require assistance and active mobilization of resources at the state level and deployment of state level agencies for disaster management. The central agencies must remain vigilant for immediate deployment if required by the state.

Level-L3: This corresponds to a nearly catastrophic situation or a very large-scale disaster that overwhelms the State and District authorities.

The categorization of disaster situations into levels L0 to L3 finds no mention in DM Act 2005. Further, the DM Act does not have any provision for notifying any disaster as a national calamity or a national disaster.

7.3.5 Project Specific Provisions for Disaster Management Plan/provisions:

7.3.5.1 Nodal Operation Control Rooms:

Nodal Control Canters will be equipped with the latest Communication facilities and will be manned 24 x 7 during the Construction and Operations Phase. During the Construction Phase, these rooms

will be manned by the Contractor's personnel along with the Supervisory staff of the Disaster Management Cell.

These Nodal Operation Control Rooms will maintain effective communication at all times with the various agencies listed in Disaster Management Plan viz.

- Police Commissionerate
- Traffic Police
- Municipal Corporation
- Home Guards and Civil Defence
- District Collectorates (City & Suburban)
- Indian Meteorological Department (Regional Office)
- Railways (Central & Western)
- Fire Brigade
- BSNL
- Mobile Service Providers
- Hospitals
- Radio & TV Centre

7.3.5.2 Safety Measures during Construction of Tunnels

The Standard Operating Procedures/Safety practices to be followed during the construction of the Tunnels will be in accordance with the provisions of Clause 6.0 – Safety during Construction of Tunnels – IRC SP: 91 – 2010. A summary of provisions is given below. The Tunnel Contractor will formulate an elaborate Health & Safety Manual covering at least the following aspects before the commencement of construction activities.

Table 7-4: General Requirement of Health and Safety Manual

Sl. No.	Description	Reference Clause No. of IRC SP 91 – 2010 – Tunnel Design
1	General – Background, Applicable Regulations, Project Safety Plan	6.1
2	Basic Aspects – Basic Philosophy, Personal Protective Equipment, Signage, Access Control Systems, Safety Systems	6.2
3	Drilling & Blasting – Drilling Operations, Blasting Operations, Inspection after Blasting, Misfires, Scaling & Mucking, Installation of Supports,	6.3
4	Ventilation & Noise Protection,	6.4
5	Lighting	6.5
6	Communication System – Warning Signs & Notice Boards, Telephone Systems, CCTV System,	6.6
7	Protection against Fire – General, Fire System, Electrical Installations,	6.7
8	Housekeeping – General, Traffic Control, Pipes & Cables, Water Control	6.8
9	Emergency Management System	6.9

7.3.5.3 Supervisory Control & Data Acquisition (SCADA) Control Rooms for Tunnels (Operations Phase)

The tunnel monitoring systems viz. Fire Detection & Fire Fighting System, Ventilation System, Video Camera Control System, Emergency Communication System, Carbon Monoxide Detection System etc. will be housed in the Control Rooms for Tunnels. These Control Rooms will be located at the Entry/Exit of the Tunnels and will be manned 24 x 7 by the O & M staff. Communication links will be established between these Control Rooms and all the agencies above as well as with the Nodal Control Rooms.

The Tunnel Control Rooms with SCADA will play a vital role in ensuring safe operations in the Tunnel during the Operations Phase. The various provisions to be kept in the instrumentation are described in detail later in the manual.

7.3.5.4 Standard Operating Procedures to be followed during construction of Road

Standard Operating Procedures (SOPs) as stipulated in MORT&H Specifications – Revision 5, a document which is largely used in India for construction of Highways, shall be used during the Construction Phase. These also include precautions to be taken for safeguarding the environment. A summary of provisions is given below.

Table 7-5: SoP Requirement

Sl. No.	Description	Reference Clause No. of MORT&H Specification
1	Borrow Pits for Embankment Construction	111.2
2	Quarry Operations	111.3
3	Control of Soil Erosion, Sedimentation & Water Pollution	111.4
4	Pollution from Plants and Batching Plants	111.5
5	Substances hazardous to health	111.6
6	Use of Nuclear Gauges	111.7
7	Environment Protection	111.8
8	Occupational Health and Safety of the Workforce	111.9
9	Control & Disposal of Waste	111.10
10	Transport of hazardous materials	111.11
11	Emergency Response	111.12

It is expected that the Contractor will prepare an exhaustive project specific Health & Safety Management Plan before commencement of Construction activities and implement the same rigorously.

7.3.6 Highway Traffic Management System (HTMS) during Operations Phase

Highway Traffic Management System will control the traffic monitoring and movements on the Road. The following outdoor units will be installed as a part of HTMS:

a) Emergency Call Boxes
b) Variable Message Signs
c) Meteorological Data Systems
d) Close Circuit TV Camera System

e) Traffic Counting, & classification and transmission system

Indoor units will comprise of the following:

1) Large Display board with Central Computer and Network monitoring system
2) CCTV System
3) Uninterrupted Power Supply

The system shall meet the following objectives:

- Smooth and uninterrupted Traffic flow
- Enhanced Road Safety
- Real-time information and guidance to road users
- Round the clock 24hrs emergency assistance
- Alerts for abnormal road and weather conditions
- Reduced journey time and reduced driving fatigue

7.3.7 Approach to Disaster Management Plan

Environmental risks are inherent in design and operation of a complex project. Any major failure in the system could lead to a disaster resulting in loss of human life, loss to property and damage to ecology. Growing concern has resulted Risk Assessment as a mandatory requirement during project reviews of MOEF&CC.

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. Maximum Credible Accident (MCA) analysis, Hazard Analysis, Assessment and Evaluation, Disaster Management Plan (DMP) and Emergency Preparedness Plan (EPP).

7.3.7.1 Maximum Credible Accident (MCA) Analysis

The word MCA stands for Maximum Credible Accident or in other words, an accident with a maximum damage distance, which believed to be probable. MCA analysis does not include quantification of the probability of occurrences of an accident. In practice the selection of accident scenarios for MCA analysis is carried out on the basis of engineering judgment and expertise in the field of risk analysis especially in accident analysis.

7.3.7.2 Hazard Analysis, Assessment and Evaluation

Less and more hazard prone sections of each unit are decided based on the FEI, TI and inventory analysis. Safety of less hazard prone section is studied using check list approach while detailed Hazard and Operability (HAZOP) studies is carried out for most hazardous sections.

The purpose of HAZOP analysis is to detect any predictable undesired event in a process to achieve a systematic study of the operations carried out for each process step involved and also the way in which the various components involved interact. This exercise is particularly important in the case of process for which there is no or only limited actual operating experience.

The HAZOP studies indicate all possible events and their consequences. In multi component systems, it is important to analyse the possible mechanisms for failure and to perform probabilistic analysis for the expected rate of such failures. Fault Tree Analysis (FTA) is a technique by which many events that interact produce other events that can be related using simple logical relationships which permit a methodical building of a structure that represents the system. Majority of the primary

events that could lead to the failure of a unit (known as top event) could be derived from HAZOP studies.

Applications of reliability engineering especially in the process control instrumentation are of recent origin. System performance can be evaluated by Assessment of Pathway reliability of each vulnerable process section. The quantitative estimation of pathway reliability helps in deciding reliability improvement strategies.Whilst the quantitative assessment of reliability (or for that matter estimation of top event probability of an occurrence of an event using FTA and Monte Carlo Simulation) uses mathematical theories, it is hindered in practice by the lack of failure rate data from chemical-control instruments, equipment. This is of relevance, especially in the Indian context while adopting quantitative risk analysis approach. Generation of Indian Data base on failure rate date is therefore of vital significance.

7.3.8 Disaster Management Plan (DMP) and Emergency Preparedness Plan (EPP)

7.3.8.1 Disaster or Emergency and its Possibility

A disaster, and therefore an emergency, occurring as a result of a malfunction of the normal operating procedures or an intervention of an outside force such as a cyclone, flood or sabotage, that may affect several sections within it and/or may cause serious injuries, loss of lives, extensive damage to property or serious disruption outside the works.

Apart from earthquakes, cyclones, flood, major fire and disruption, serious accidents may take place through explosion in Gas/Fuel Tankers, heavy leakage and subsequent fire in the oil tankers etc. near or inside the tunnel.

7.3.8.2 Objective of Disaster Management Plan

In order to be in a state of readiness to face any accident or disaster caused during the project operation, a Disaster Management Plan shall be prepared. Such a plan ought to cover possible disaster, on and off-site emergency preparedness plan, establishment of Emergency Control Centres (ECC), location of emergency services, and duties of the officers/staff during emergency.

7.3.8.3 Basic Contents of DMP

Basically, the DMP will contain the following aspects:

i) Description of the Site
ii) On-site Emergency Plan
iii) Off-site Emergency Plan

7.3.8.4 On-Site Emergency Plan

Objective and Contents

The objective is to combat emergency caused by an accident, the effects of which are confined to the Site involving only the people working on the project. This project road especially tunnel section, essentially consists of an action plan which includes identification of key personnel; defined responsibilities of key personnel; designated ECCs and assembly points; declaration of emergency; all clear signal; actions to be taken by non-key Personnel during emergency.

Appointment of Key Persons and their Role

1. Site Controller (SC)

The General Manager (however called) or his nominated deputy will assume overall responsibility for the Site and its personnel.

2. Incident Controller (IC)

A Production Manager or an Officer of similar rank will be nominated to act as the IC. Immediately on learning about an emergency, he will rush to the incident site and take overall charge and report to the SC.

3. Liaison Officer (LO)

Personnel/Administrative Manager or his nominated Officer of deputy rank will work as LO and will be stationed at the Nodal Control Centres during emergency to handle Police, Press and other enquiries.

4. Forward Area Controller (FAC)

Departmental In charge of the concerned area will be the FAC to take care of the respective departments during emergency.

5. Team Leader (TL)

As number of specified activities may have to be carried out, for which specific teams have to be formulated and their roles or duties defined, each of them will be headed by a TL. The following teams are suggested:

- Task Force
- Repair Team
- Fire Fighting Team
- Communication Team
- Security Team
- Manpower Team
- Safety Team
- Transport Team
- Medical Team

Emergency Control Centres Centres (ECC)

Emergency Control Room is to be set up and marked on the site plan for the knowledge of all concerned. ECC is the focal point and it should be well connected with internal and external telephones and furnished with list of personnel and their addresses.

- **Assembly Points**

Assembly points, the pre-determined safe places, where people will be directed after evaluation from the hazardous locality, have to be set up and marked on the site plan. Escape routes from assembly points have to be clearly defined and depicted.

- **Alarms**

Suitable sirens will be provided at Site, which could be operated from the Nodal Control Rooms. The coding of the siren should be as per the standards and well circulated within the facility.

- **Tie Ups for Aid with Institutions (Hospitals, Wards, Police Stations etc.)**

It is essential to have mutual aid arrangements among the industries in the neighbourhood which would help in the case of a major disaster.

- **Training and Mock Drills**

Proper training of the key personnel and other non-key personnel, who will take part in case of an emergency, should be arranged. Mock drills will be performed to test the performance of the procedure laid

7.4 Risk Matrix

Table 7-6: Risk Matrix

S. No.	Family	Main Event	Short Description/ Secondary Disaster	Probability of occurrence	Proposed Actions
1	Geophysical	Earthquake / Mass movement of earth materials	Landslide following earthquake; Urban fires triggered by earthquakes; Liquefaction - the transformation of (partially) water-saturated soil from a solid state to a liquid state caused by an earthquake Mass movement of earth materials, usually down slopes Surface displacement of earthen materials due to ground shaking triggered by earthquakes	Rajasthan falls in Earthquake Zone II which is consider most stable zone. Earthquakes have not been very frequent in Rajasthan.	Structures will be designed considering the seismic provisions as per Codal provisions Mock Drills. Quick Evacuation of Site Workers and Staff Contact to be maintained with nearest hospitals and Fire Stations for taking casualties for treatment and for rescue operations
2	Hydrological	Flood Landslides Wave Action	Heavy or excessive rainfall in a short period of time that produce immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall Flood Hydrological - A general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or	Flooding: The alignment does not pass through the chronic Flooding spots. Infact, the proposed alignment Road will offer a good and safe evacuation passage for the public, in general. Landslides: There is low probability of landslides getting triggered due to	Contact to be maintained with the regional office of IMD Early warnings to the project workers/staff to be given, when applicable. Quick evacuation of Site Workers and staff

S. No.	Family	Main Event	Short Description/ Secondary Disaster	Probability of occurrence	Proposed Actions
			near the point where the flash floods occurred. Wave Action: Wind generated surface waves that can occur on the surface of any open body of water such as rivers and lakes, etc. The size of the wave depends on the strength of the wind and the travelled distance (fetch).	earthquakes or floods.	
3	Meteorological	Hazard caused by short-lived, micro- to meso- scale extreme weather and atmospheric conditions that may last for minutes to days	Cyclone, Storm Surge, Tornado, Convective Storm, Extratropical Storm, Wind Lightning, Heavy Rain	Rajasthan is prone to send storm, high wind during summer season	Contact to be maintained with the regional office of IMD Early warnings to the project workers/staff to be given, when applicable. Quick evacuation of Site Workers and staff
4.	Climatological	Unusual, extreme weather conditions related to long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal (long-term) climate variability	Extreme hot/cold conditions Subsidence	Low Probability	Contact to be maintained with the regional office of IMD Early warnings to the project workers/staff to be given, when applicable. Quick evacuation of Site Workers and staff
5	Biological	Exposure to germs and toxic substances	Epidemics: viral, bacterial, parasitic, fungal, or prion infections Insect infestations	Low probability	Proper hygiene to be maintained in the Worker's Camps, Canteens and Work areas. Close co-ordination to be maintained with the City hospitals and Health Authorities.
6	During Construction	Accidents	Accidents during construction of Road / Bridges / Tunnels / reclamation	Medium	Formulation of Safety Policy and strict implementation of the sameduring construction phase.

S. No.	Family	Main Event	Short Description/ Secondary Disaster	Probability of occurrence	Proposed Actions
					Provision of safety planning and Tool-Box talk before start of any work at sites Provision of First Aid at worksites Arrangements with nearest hospitals for emergency treatment in case of accidents Provision of Ambulances

7.4.1 Approach to Risk Assessment

PHASE I: MCA ANALYSIS

- Process Information Study
- Study of Process Engineering Details
- Detailed Study of Plot Plan/Layout
- Hazard Identification through
- Inventory
- Effects Calculations

PHASE II: HAZARD ANALYSIS, ASSESSMENT AND EVALUATION

- Checklist approach for less hazard prone areas/sections
- HAZOP Studies
- Failure Frequency Analysis
- Data Collection
- Pathway Reliability Approach
- Protective System Hazard Analysis
- Evaluation of Hazards.

PHASE III: DISASTER MANAGEMENT PLAN (DMP)

- Suggest Preventive and Corrective Measure

PHASE IV: EMERGENCY PREPAREDENESS PLAN (EPP)

- Study of Existing EPP
- Emergency Preparedness
- Onsite

7.4.1.1 Risk Analysis Matrix for Proposed Road Project

Table 7-7: Risk Mitigation Measures for Tunnels during Operations Phase

Perceived Risks	Occurrence	Risk Mitigation Methods
Environmental		
Area prone to flooding	Once a Year	All entry points to be covered from above to prevent rain water from directly falling on the ramps; Provide efficient drainage system with collection; Provide Sumps to trap any water coming within the tunnel; Provide pumps to transfer any such water to external drains; Install systems to prevent entry of traffic into the tunnel in case of any eventuality; Install emergency communication methods for traffic to organize and evacuate themselves; Install quick evacuation methods for vehicles; Install dedicated emergency communication Systems at every 100 meters.
Earthquake	Once in 20Years	Install systems to prevent entry of traffic into the tunnel in case of any eventuality; Install emergency communication methods for traffic to organize and evacuate Install quick evacuation methods for vehicles; Install dedicated emergency communication systems at every 100 meters.
Internal Air Quality (IAQ)	Daily	Install CO2 and CO sensors at every 15 meters; Provide sufficient fresh air supply fans and provide effective exhaust fans.
User Related Risks		
Accidents	Weekly	Install cameras at every 30-50meters; Install incident reporting systems with ability to recognize stoppage in traffic flow, reverse traffic flow etc. in lanes; Identify methods to enable emergency services to access accident sites quickly; Install emergency communication methods for traffic to organize and evacuate themselves; Install quick evacuation methods for vehicles; Install dedicated emergency communication system at every 100 meters.
Congestion/Breakdown/Stoppage/ Lane Changing/Drunk/ Rash Driving/Over Speeding	Daily	Install variable message system Install fixed sign system Install cameras at every 30-50meters; Install incident reporting systems with ability to recognize stoppage in traffic flow, reverse traffic flow etc. in lanes and provision of escape routs; Identify methods to enable emergency services to access accident sites quickly; Install systems to prevent entry of traffic into the tunnel in case of any eventuality; Install emergency communication methods for traffic to organize and evacuate themselves;

Perceived Risks	Occurrence	Risk Mitigation Methods
		Install quick evacuation methods for vehicles; Install pedestrian exit routes at every 500 meters; Install dedicated emergency communication systems at every 100 meters.
Hazardous/ Poisonous Gases	Rare	Prevent entry of tankers, articulated long trucks and oversized vehicle into the tunnel; Provide margin for vehicular rejection at least 50 meters before tunnel entry to divert these vehicles to other lanes Install sign boards outside the tunnel for vehicles to Organize themselves and move to other lanes. Provide sufficient fresh air supply fans; Provide effective exhaust fans.
Operational/Maintenance Risks		
Fire	Once a Year	Install SCADA systems for monitoring all Equipment installed in the tunnels; Ensure only 'Plug and Play' equipment's are installed; Install quick response fire detection systems in the tunnel; Install cameras with ability to recognize fire hazards every 30 – 50 m; Install Fixed Fire Fighting (FFF) and automatically Systems within the tunnel; Install smoke evacuation systems; Identify methods to enable emergency services to access accident sites quickly; Install systems to prevent entry of traffic into the tunnel in case of any eventuality; Install emergency communication methods for traffic to organize and evacuate themselves; Identify quick evacuation and provision of escape route for vehicles; Identify quick evacuation methods for pedestrians; Install dedicated emergency communication system at every 100 meters.
Power Outage in Tunnels	Once in 6 Months	Provide power supply through HT line for running of all the equipment's like lighting and exhaust system Provide UPS supply to all emergency equipment and at least 1/3 rd. of the lights; Provide secondary source of power supply like DG sets;
Equipment Failure	Monthly	Install SCADA systems for monitoring all Equipment installed in the tunnels; Ensure only 'Plug and Play' equipment are installed; Ensure adequate spare parts/ replacements to Minimize equipment downtime.
Security Risks		

Perceived Risks	Occurrence	Risk Mitigation Methods
Terrorist Attacks	Once in 2 Years	Install cameras at every 30-50meters; Install incident reporting systems with ability to recognize stoppage in traffic flow, reverse traffic flow etc. in lanes; Install systems to prevent entry of traffic into the tunnel in case of any eventuality; Install emergency communication methods for traffic to organize and evacuate themselves; Identify quick evacuation methods for vehicles; Identify quick evacuation methods for pedestrians; Install dedicated emergency communication systems at every 100 meters.

7.4.1.2 Risk Assessment for Tunnel

Risk assessment is essential part of tunnel services and structural design. This has been considered in related to various incident scenarios which may occur during operation of the proposed tunnels. Risk analysis is based on risk rating of various incidents and their impact on the proposed tunnel structure and users.

Table 7-8: Risk Assessment for Tunnel

Structural measures	Twin tubes Mandatory where a 15-year forecast shows that traffic > 10 000 vehicles /lane.	Twin/ Multiple Unidirectional tunnels proposed
		Gradients shall be restricted to 4%
	Emergency walkways are mandatory where no emergency lane is provided	Provision of emergency walkway is proposed
	Emergency exits every 500m are mandatory	Cross connections proposed at every 500m
	Mandatory cross-connections for	Cross connections proposed at every 500m
	emergency services at least every 1 500 m	
	Crossing of the central reserve outside each portal (mandatory requirement)	It is proposed to provide continuous cut section to adopt the same
	Drainage for flammable and toxic liquids is mandatory where such goods vehicles are allowed	Although such inflammable and toxic goods carrying vehicles will be rejected. Drainage provisions have been made underneath the pavement
	Fire resistance of structures is mandatory where local collapse of structure may have disastrous effect	Complied by making such provisions
Lighting	Normal Lighting	Proposed as per CIE 88, 2004
	Safety lighting	Proposed as per CIE 88, 2004
	Evacuation lighting	Provided over footways

Ventilation	Mechanical ventilation	Proposed longitudinal ventilation by providing jet fans
	Mandatory semi transverse ventilation for tunnels of more than 3000m length	Provisions made through supply ducts and ventilation shafts.
Emergency stations	Mandatory provision of emergency stations at 150m equipped with telephone and two fire extinguishers necessary	Provision to be made at every 150m.
Water supply	At every 250m	Water supply pipe attached to water tank to be provided with supply point at every 150m to match location of emergency station.
Road signs	Mandatory	Provided with road signs
Control Centre	Surveillance of several tunnels may be centralized into a single control centre.	Control centres shall be provided to cover two tunnel sections. The Control Centres are located at start of tunnel as well as end of the tunnel and entire stretch with provision of SCADA.
Monitoring systems	Video	CCTV cameras shall be provided along tunnels as well as along Road
	Automatic incident detection and/or fire detection	SCADA system connected to CCTV equipped with automatic incident detection system and response is proposed.
Equipment to close tunnel	Traffic signals before the entrances	The mandatory provision is to be complied by provision of gate controlled from Control centre
	Traffic signals inside the tunnel	It is proposed to provide traffic signals at every 500m before every cross connection to enable traffic diversion to parallel tunnel in case of incident.
Communications system	Radio re-broadcasting for emergency services	Provisions made connected to SCADA system
	Emergency radio messages for tunnel users	Provisions made connected to SCADA system
	Loudspeakers in shelters and exits	Provisions made connected to SCADA system
Emergency power supply	Mandatory	It is proposed to equip control centre with necessary capacity of standby generators with necessary fuel storage
Fire resistance of equipment	Mandatory	All tunnel fixtures and fitting shall be fire resistance compliant.
Additional Provisions	Drainage	It is proposed to provide sump and pumping arrangement to collect seepage/ storm water at lowest point of tunnels and dispose the same to sea.

	Leaky feeder cable	It is proposed to provide leaky feeder cable to enable use of mobile services within tunnels.
	Environmental monitoring censors	It is proposed to provide environmental monitoring censors to monitor visibility levels, air quality and smoke detection
	Linear Heat Detection	Linear heat detection is proposed through adoption of OFC cables cross looped to detect exact location of fire.
	Variable Message signs	It is proposed to provide VMS system attached to SCADA at control centre to enable safe tunnel operation.

7.4.1.3 Risk response strategies

Vehicle related incidents: Tunnels are designed to carry traffic loading and there are events of varying probability which may affect safe operation of the tunnel.

- **Fire in the Tunnel:**

Fires in tunnel are a serious risk and the probability of such incidence is based on likelihood of a serious accident occurring inside the proposed tunnel and the vehicle involved catching fire. Tunnel alignment have been maintained as straight alignment with maximum grade of 4% allowing high visibility distance.

- **Accidents:**

Probability of occurrence of accident in a unidirectional tunnel is very unlikely. To reduce the probability of same to extremely unlikely event, alignment of the tunnels has been designed as straights with maximum grade of 4%. This will ensure high visibility to stopping vehicle/ debris on road. It is also proposed to restrict the vehicle speeds to 80Kmph for entire road and enforce the same through speed detection cameras.

- **Breakdown and debris on road:**

Risk of occurrence of such event is similar to accidents. Automatic incident detection system shall be implemented to reduce the impact of such event

- **Oversize vehicles:**

It is proposed to restrict entry of all oversized vehicles on Road to eliminate such risk. Non Vehicle related incidences

Non Vehicle related incidences

- **Vandalism:**

It is necessary to provide for securitization of likely entry points to the tunnels by pedestrians. Such a vandalism event may have very high impact on tunnel services. Therefore control room shall be provided with automatic incident detection system to report stoppage of vehicles and presence of pedestrian inside tunnel. Control rooms shall be manned 24x7 to register and act on such incidence.

However to eliminate risk of this high impact event, the SCADA software shall be capable of sending message to enforcement agency automatically with details of location.

- **Terrorist Attack:**

Impact of such event on tunnel operation would be disastrous and would require immediate action by local police who would be informed by the personnel manning the Emergency Control Centres. The method of reducing risk of such event shall be discussed with the Authority. System will be provided so that the information will be intimated to the Police within a short period of time.

- **Traffic Queues:**

Risk of occurrence of traffic queues is unlikely considering adequate number of lanes has been proposed with adequate distances from tunnel entry/ exit points from proposed interchanges. However, event of traffic queuing is unlikely to impact on tunnel services. Environmental monitoring sensors are proposed to adjust level of tunnel services such as lighting and ventilation.

8 PROJECT BENEFITS

8.1 Introduction

Community will accrue the benefit from proposed development project by way of improvement in the physical infrastructure; social infrastructure; development of economy; reduced pollution, vehicle maintenance, fuel saving; employment potential and other tangible benefits.

In general Project will have following benefits at national and regional level:

- **High-speed connectivity and access:** The projected corridor is a proposed 8-lane, access-controlled highway. This will avoid traffic congestion and speed-up the freight movement. It is expected that overall, the proposed Delhi-Mumbai corridor will reduce the travel time between the two economic hubs by half.
- **Aiding economic growth:** The seamless connectivity will provide better access to vehicles as a link to the National Highways. The Project will reduce travel time and provide boost to trade and commerce linked to the regions connected through this highway.
- **Growth of backward areas:** The biggest strength of the alignment is that it plans to cover backward districts of Rajasthan. As a result of connectivity and access to other parts of the country, these backward areas will be aided to integrate with other part of India. Further, freight and passenger traffic on the highway will help promoting ancillary economy of these regions.
- **Decongestion of existing National and State Highways:** The proposed corridor will take away traffic pressures from existing SH and NH passing through various cities. Also, long-distance traffic will shift to the proposed highway, thereby reducing traffic and congestion on the existing NH and SH for regional and local usage.
- **Usage shift:** Long-distance traffic will shift from existing National Highways to the proposed highway, resulting in lesser congestion leading to higher fuel savings and reduced travel time on these highways
- **Improved safety**: Due to access control, the Roadway & Travel Safety of the traffic connecting the cities will be enhanced as there will be minimum distractions & conflict zones
- **Support to industry:** Different types of industries like Manufacturing, Tourism *etc*. along the proposed corridor will be facilitated in their business operation and reachability.

Detailed environmental and social benefits associated with the proposed highway development are described in sections below.

8.2 Efficient and Safe Connectivity Option

The Project is a part of the proposed 8-lane access-controlled Greenfield Delhi-Mumbai highway corridor (~1,335 km) interlinking different State & National highways while connecting Delhi to Mumbai. The Project is planned as high-speed corridor which provides high speed connectivity between states of North India and states of West & South India, more importantly giving a reliable access to the country's prominent economic and social hubs like Mumbai, Delhi, Vadodara, Jaipur and Kota *etc.*

The proposed highway will provide better connectivity to several towns and cities *viz.* Gurgaon, Alwar, Dausa, Sawai Madhopur, Bundi and Kota *etc.* and give an infrastructure boost to the states of Delhi, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Maharashtra. The highway will be access-controlled and ensure high speed traffic movement from Delhi to Mumbai. The proposed alignment is selected so as to cover one of the most important North-South arterial connectivity in the country, further interspersed with feeder highways on its either sides.

At present, the connectivity between Delhi and Mumbai is either via NH-48 or via NH-19 & NH-47, which are 4/6 lane. The new proposed highway shall bring down the travel distance by approximately 95 km (as compared to alternate routes) and result in time savings of over 2 hours. Moreover, the new highway facility is access controlled and hence will provide good riding quality, better safety and a reliable infrastructure. All of these elements will result in cost savings and efficiency improvement.

8.3 Traffic Decongestion

A traffic study has been conducted across various locations of the proposed highway and the alternate routes. It has observed that the traffic along NH-48 (Delhi-Jaipur-Ajmer route) 30% higher than the IRC guidelines for highway ideal performance (Max. 60,000 PCUs) and is currently congested with below acceptable Level of Service performance. The route (NH-48) currently being the main connector between Delhi and Mumbai, there is a strong need for finding alternate access between the two cities to ease connectivity and travel time.

As an alternate, it has observed that traffic on Alwar - Sawai Madhopur - Kota str*etc*h (Average Annual Daily Traffic of less than 16,000 PCUs per day) is within reasonable and accepted traffic standards. Hence, it may be used as optimum alignment for the proposed Delhi – Vadodara - Mumbai highway.

Following major types of traffic load are expected to accrue the maximum benefit from the project:

- **Commercial and Industrial**: Traffic on the existing roads is driven by local, commercial and industrial traffic. Industries such as cement, chemicals and minerals are present along and around the proposed corridor as it traverses through Haryana, Rajasthan, Madhya Pradesh and Gujarat. These industries are expected to benefit from the highway.
- **Tourist**: Passenger traffic will be generated due to many places of tourist interest in the districts connected by the project corridor. Apart from places of historical importance such as forts and palaces, traffic would be augmented due to several famous religious places and wildlife parks and safari like Mukundra Hills Tiger Reserve/ Mukundra National Park/Darrah Wildlife Sanctuary.
- **Health and Education:** Faster connectivity and accessibility to Delhi NCR will help in higher flow of traffic from Rajasthan, especially for higher education, tertiary healthcare and specialized treatments. Reduction in travel time will allow patients to avail OPD / other medical services from the national or state capital region.

8.4 Savings in Travel Time and Cost

The proposed highway is expected to reduce the distance to be travelled between Delhi-Mumbai by ~95 km, leading to the following cost savings for users:

- Vehicle Operation Cost (VOC)
- Travel Time (VOT)
- Toll costs

8.5 Benefit to Local Trade and Economy

The proposed Project plans to link Delhi NCR to Jaipur, Kota, Vadodara and Mumbai. The strong regional connectivity proposed through the Project will further increase regional trade and economic growth. The regions to be connected through the Project have their distinct economic profiles:

- Delhi NCR has industrial catchment focused on agriculture and processed food, automotive & auto ancillary, home consumables, and appliances, metals and minerals *etc.*
- Vadodara industrial belt is concentrated with industries like textiles, chemicals & petrochemicals, pharmaceuticals and bio-technology *etc*.

These regions source their raw materials as well as transport their finished goods to various parts of the country. The corridor will provide efficient access to various markets by ensuring smooth flow of goods and services.

The highway will also support the local businesses and economy along the project corridor. Kota district has 12908 number micro & small industrial units with ~49613 industrial employees. About 19 industrial areas in other connected districts also stand to be benefited by use of this proposed highway.

8.6 Employment Generation (Direct and Indirect)

The highway project is expected to generate employment during construction phase. It is estimated that ~2200 man-powers shall get employment opportunity during construction of the highway. Further, due to ecosystem which will be created during construction and operations phase of the project, the highway will also create considerable indirect employment opportunities in form of transportation of construction materials, greenbelt development, ancillary facilities like canteens, dhabas *etc.*

During operations phase, the Project will largely have indirect employment benefits in form of highway amenities and through economic & social hubs developed around the highway. Efficient reach and connectivity to distant markets will further enhance economy of the districts and create employment opportunities.

9 ENVIRONMENTAL MANAGEMENT PLAN

9.1 General

The Environmental Management Plan (EMP) is required to ensure managing environment impacts within acceptable limits in addition to environmental enhancement during construction and operational phases. EMP is location and time specific. In general, NHAI (with assistance from Contractor/Concessionaire and Monitoring Consultant) is the responsible entity for ensuring that the mitigation measures are carried out. Impact mitigation measures are provided under in ***Annexure 9.1.*** The list provides reference (MoRT&H specification), implementing organization and responsible entity.

9.2 Specific Activities by Contractor/Concessionaire and Monitoring Consultant

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

- NOC from Rajasthan State Pollution Control Board under Air and Water Act by Contractor/Concessionaire
- Permission from Forest / District Administrative Department for felling of trees by Contractor/Concessionaire.
- Supervision of implementations of EMP through Contractor/Concessionaire and Monitoring Consultant

9.3 Specific Activities by Concessionaire/Contractor

The activities to be performed by the Concessionaire/contractor to implement the EMP shall comprise the following:

- Confirm the Tree Cutting Schedule based on the final design and provide the same to NHAI
- Felling of trees after NHAI secures Forest Department's/ District Administrative Department's permissions
- Selection of material sources (quarry, water, sand *etc*).
- Selection, design and layout of construction areas, hot mix and batching plants, labour camps *etc*.
- Apply for and obtain all the necessary clearances from the agencies concerned after finalizing the locations of the sites.
- Planning traffic diversions and detours including arrangements for temporary land utilization on lease basis
- Plant and maintain of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for the entire duration of the contract period
- Planting and maintenance of ornamental, medicinal & flowering plants and shrubs for the entire duration of the contract period

9.4 Site Specific Management Plan

9.4.1 Cultural Properties

The relocation & mitigation issue of the cultural properties directly or partially impacted shall be taken up in RAP. Where ever possible the Concessionaire/contractor shall try to enhance the aesthetic of the area.

9.4.2 Sensitive Features

- Noise barriers have been proposed near settlement areas
- 5 Nos. of ponds are likely to be affected due to propose highway development. Elevated structures are proposed along the water body crossing.
- The Contractor/Concessionaire shall provide proper cautionary/information sign board or other facilities like barricading near schools & hospitals (if found necessary during construction).

9.4.3 Water Quality

- Silt fencing at proper locations have been proposed.
- Oil Interceptor at Camp site have been proposed.

9.4.4 Wildlife Movement Sections

- In order to obviate the needless bisection of the MHTR, an underground tunnel will be constructed.
- Both the end faces of the tunnel may be placed about 500m away from the boundary of protected area of Critical Tiger Habitat (Core of Mukundra Hills Tiger Reserve) by implying “Cut & Cover Technique to avoid disturbance in the vicinity of the tiger reserve
- Length of the tunnel, the slope of the highway in this stretch and its depth will dependent on the technical feasibility study of the valley area.
- A record shall also be maintained to store data in case any accidental killing happens.

9.4.5 Community properties

- The relocation / rehabilitation of affected community resources shall be as per the RAP
- Rest areas are proposed

9.5 Implementation EMP

The Environmental Officer of the Concessionaire/Contractor should be available for the entire duration of the project. The Environmental Officer shall be primarily responsible for compliance of EMP. The Environmental Specialist of the Monitoring Consultant who should ideally be deployed for the entire duration shall monitor the compliance of the EMP. The key issues that require special attention along with the mitigations and enhancement measures to be implemented have been detailed in ***Annexure 9.1***.

9.6 Environmental Monitoring Programme

The Environmental Monitoring Programme has been detailed out in ***Annexure 9.2*** along with stipulated standards. Successful implementation of the Environmental Monitoring Program is contingent on the following:

- The Monitoring Consultant to request the Concessionaire / Contractor to commence all the initial tests for monitoring of air, water quality, soil test and noise levels early in the contract to establish the 'base line' *i.e.* to assess the existing conditions prior to effects from the Construction activities being felt.
- The Monitoring Consultant to request the Concessionaire / Contractor to submit for approval a proposed schedule of subsequent periodic tests to be carried out.
- Monitoring by the Monitoring Consultant of all the environmental monitoring tests, and

subsequent analysis of results.

- Where indicated by testing results, and any other relevant on-site conditions, Monitoring Consultant to instruct the Concessionaire / Contractor to:
  - Modify the testing schedule (dates, frequency)
  - Modify (add to or delete) testing locations
  - Verify testing results with additional testing as/if required
  - Require recalibration of equipment, *etc*., as necessary
  - Request the Concessionaire / Contractor to stop, modify or defer specific construction equipment, processes, *etc*., as necessary, that are deemed to have contributed significantly to monitoring readings in excess of permissible environmental "safe" levels.

9.6.1 Monitoring of Earthworks Activities

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimize the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in ***Annexure 5.1, 5.2, 5.3, 5.4, 5.5 & 5.6.*** Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimize detrimental effects (*e.g.* erosion) due to run-off, and safety aspects related to Works implementation.

9.6.2 Monitoring of Concessionaire / Contractor's Facilities, Plant and Equipment

All issues related to negative environmental impacts of the Concessionaire / Contractor's facilities; Plant and equipment are to be controlled through:

- The Concessionaire / Contractor's self-imposed quality assurance plan
- Regular / periodic inspection of the Concessionaire / Contractor’s plant and equipment
- Monthly appraisal of the Concessionaire / Contractor.

Other environmental impacts are to be regularly identified and noted on the monthly appraisal inspection made to review all aspects of the Concessionaire / Contractor's operation. The Monitoring Consultant is to review all monthly appraisal reports, and instruct through team leader to the Concessionaire / Contractor to rectify all significant negative environmental impacts.

9.7 Budget

The EMP cost has been presented in below table. The budgeted cost of EMP is Rs. 16.957 Cr.

Table 9-1: Project Environmental Budget

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
1	**MITIGATION / ENHANCEMENT COST**						
1.1	**Pre-construction Stage**						
1.1.1	Land acquisition		Covered in RAP Budget			0.00	0.000
1.1.2	Water	Relocation and construction of affected hand pumps, water storage tanks, open wells, water taps, OHT etc.	Covered in Utility Shifting Budget			0.00	0.000
1.2	**Construction Stage**						
1.2.1	Horticulture	Planting of flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area @ 1584 numbers per Km. (As per Letter No. NHAI/GHD/02/01/02-22/2016/50 Dated 17.01.2018) and Green Highways (Plantation & Maintenance) Policy-2015 in rural areas	No.	94446	1,500.00	14,16,69,000.00	14.167
1.2.2							
1.2.3		Landscaping and aesthetics of junctions and at other loactions as per design, drawings and direction of the Environmental Engineer / Environmental Specialist of the Engineer	LS	-	5,00,000.00	5,00,000.00	0.050
1.2.5	Slope / Embankment protection	Turfing of embankment with grasses and herbs.	sq.m. (Covered in Engineering Cost)			0.00	0.000
1.2.6	Soil & Ground Water	Providing Oil Interceptors as per design and drawing at vehicle parking areas	Nos.	6	30,000.00	1,80,000.00	0.018
1.2.7	Surface Water	Silt Fencing for Water Bodies adjacent to the road	running m	8220	1,100.00	90,42,000.00	0.904

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
1.2.8	Flora	Cost of transport & distribution of cooking fuel to construction workers to prevent indiscriminate felling of trees	Months	24	20,000.00	4,80,000.00	0.048
1.2.9	Air	Dust Management with sprinkling of water, covers for vehicles transporting construction material	Km	59.625	30,000.00	17,88,750.00	0.179
1.2.10	Noise	1) provision of and Noise Barriers near to settlement areas	running m	390	8,000.00	31,20,000.00	0.312
1.2.11	Solid Waste Disposal	Disposal of Sewage and other wastes in the construction yard and labour camps as per directions of the Environmental Specialist of the Monitoring / Supervision Consultant	Month	24	15,000.00	360000.00	0.036
1.2.12	Cultural properties	Relocation of cultural properties	Covered in RAP Budget				0.000
1.2.13	Roadside amenities	Construction of Bus Bays	Covered in Engineering Cost			0.00	0.000
1.2.14	Wildlife	Signage – Information (size 900 x 1800 mm) including lettering as per IRC code: as per the direction of Environmental Specialist of the Monitoring / Supervision Consultant	No	2	25000	50000.00	0.005
1.2.15		Signage – Information (size 1200 x 600 mm) including lettering as per IRC code as per the direction of Environmental Specialist of the Monitoring / Supervision Consultant	No	2	15000	30000.00	0.003
1.2.16		Cautionary/ Warning signs (900 mm Eq. triangle) as per IRC code: as per the direction of Environmental Specialist of the Monitoring / Supervision Consultant	No	2	6000	12000.00	0.001
1.2.17		Mandatory / Regulatory sign (60 cm circular) as per IRC code: for entire section of project road for every 2 Km at alternate	No	2	5000	10000.00	0.001

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
		side / as per the direction of Environmental Specialist of the Monitoring / Supervision Consultant					
TOTAL MITIGATION / ENHANCEMENT COST						**15,72,41,750.00**	**15.724**
2	**MONITORING COST**						
2.1	**Construction Stage**						
2.1.1	Air	Sampling and monitoring ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at 3 locations including approved hot mix plant locations, sensitive area and chainages as per direction by Environmental Specialist of the Monitoring / Supervision Consultant for three seanosn a year for 3 years as per the Monitoring Plan given in EMP	No. of Samples	108	2,000.00	2,16,000.00	0.022
2.1.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 and CPCB mannual.	No. of Samples	108	4,000.00	4,32,000.00	0.043
2.1.3	Water Quality	Collection of grab samples of water quality at 3 locations at chainages identified by the engineer for 3 years (twice a year) in pre & post monsoon seasons as per the Monitoring Plan given in EMP / Environmental Specialist of the Monitoring / Supervision Consultant	No. of Samples	18	400.00	7,200.00	0.001
2.1.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, turbidity COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA	No. of Samples	18	6,000.00	1,08,000.00	0.011
2.1.5	Noise	Monitoring Noise level at Equipment Yards, Sensitive area	Nos.	18	1,500.00	27,000.00	0.003

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
		and Settlements using hand held noise meters at 3 locations at chainages identified by the Environmental Specialist of the Monitoring / Supervision Consultant for three seasons in a year for 3 years as per the Monitoring Plan given in EMP					
2.1.6	Soil	Sampling Soil at 3 locations at chainages identified by the Engineer as per directions of Environmental Specialist of the Monitoring / Supervision Consultant for twice a year for 3 years as per the Monitoring Plan given in EMP	Nos.	18	2,000.00	36,000.00	0.004
2.1.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during construction period	L.S.	-	2,25,000.00	2,25,000.00	0.023
2.2	**Operation Stage**						
2.2.1	Air	Sampling and monitoring ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at 3 locations including sensitive area and chainages as per direction by Environmental Specialist of the Monitoring / Supervision Consultant for once in a month for 3 months every year for 10 years	No. of Samples	90	2,000.00	1,80,000.00	0.018
2.2.2		Analysis charges of Ambient air from samples collected for parameters as per AAQ Standards Notification, 2009 in consultations and directions of the Consultant and PWD as per MoEF&CC charges.	No. of Samples	90	4,000.00	3,60,000.00	0.036
2.2.3	Water Quality	Collection of grab samples of water quality at 3 locations at chainages for twice a year in pre & post monsoon seasons in every alternate year for 10 years as per direction of Environmental Specialist of the Monitoring / Supervision Consultant	No. of Samples	60	400.00	24,000.00	0.002
2.2.4		Analysis of water quality at locations in the monitoring plan for pH, Turbidity, total solids, COD, BOD, DO, Chlorides,	No. of	60	6,000.00	3,60,000.00	0.036

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
		Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform and faecal coliform etc. as specified in "Standard Methods for Examination of Water and Wastewater" published by WEF, AWWA and APHA as per direction of Environmental Specialist / Environmental Engineer of the Consultant and as per MoEF rate list.	Samples				
2.2.5	Noise	Monitoring Noise level at Sensitive area and Settlements using hand held noise meters at 3 locations for twice in a year for 10 years as per directions of Environmental Specialist of the Monitoring / Supervision Consultant	Nos.	60	1,500.00	2,25,000.00	0.023
2.2.6	Soil	Soil sampling at 3 locations at chainages identified by Environmental Specialist of the Monitoring / Supervision Consultant of the Engineer for once a year for 10 year as per the Monitoring Plan given in EMP	Nos.	30	2,000.00	60,000.00	0.006
2.2.7	Transportation Cost	Transportation cost for monitoring of noise, air and water during operation period for 10 years considering every alternate year.	L.S.	-	50,000.00	50,000.00	0.005
TOTAL MONITORING COST						**22,90,200.00**	**0.231**
3	**MISCELLANEOUS COST**						
3.1	Training	Training	L.S.	-	2,50,000.00	2,50,000.00	0.025
3.2	Advocacy and Policy Making	Holding meetings for policy planning and subsequent review meetings with Revenue Department, Forest Department, local representatives, NGOs, etc. regarding development controls.	Year	12	15,000.00	1,80,000.00	0.018
3.3	Administrative Charges	Maintenance of vehicle with the Environment Cell, Data processing, administrative support, stationery etc.	Months	36	35,000.00	12,60,000.00	0.126

Item No.	Component	Description	Unit	Quantity	Unit cost (INR)	Total cost (INR)	
						Detail Cost	Cost in Cr.
	including logistics						
3.4	Miscellaneous Items	Digital Camera for the Environment Cell	No.	1	5,000.00	5,000.00	0.001
3.5		Portable sound level meter	No.	1	2,50,000.00	2,50,000.00	0.025
TOTAL MISCELLANEOUS COST						**19,45,000.00**	**0.195**
TOTAL COST						**16,14,96,950.00**	**16.150**
Contingency @ 5% on Total Environmental Cost						**8074847.50**	**0.807**
GRAND TOTAL						**169571797.50**	**16.957**
Rate per kilometer						**2843971.45**	**0.28**

9.8 Corporate Environmental Responsibility (CER)

As per the OM file No. 22-65/2017-IA.III dated 1st May 2018, CER cost will be calculated 0.5% of the total project cost. Hence, CER cost for the project will be ~ 11.62 Crore.

10 EXECUTIVE SUMMARY

The Project shall start from Banda Hera village (Ch. Km 392.800) and near Moondiya village (Ch. Km 452.625) Section of NH-148 N (Total length 59.625 Km), under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan.The project proponent for the Project is National Highways Authority of India (NHAI).

10.1 Need of The Project

The Project is a part of the proposed 8-lane access-controlled Greenfield Delhi-Mumbai highway corridor (~1,335 km) interlinking different State & National highways while connecting Delhi to Mumbai. The Project is planned as ambitious high-speed corridors which provide high speed connectivity between states of North India and states of West & South India, more importantly giving a reliable access to the country's prominent economic and social hubs like Mumbai, Delhi, Vadodara, Jaipur and Kota *etc*.

The proposed highway will provide better connectivity to several towns and cities viz. Gurgaon, Alwar, Dausa, Sawai Madhopur, Bundi and Kota. Proposed project will give an infrastructure fillip to the states of Delhi, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Maharashtra.

At present, the connectivity between Delhi and Mumbai is either via NH-48 or via NH-19 & NH-47, which are 4/6 lane. The new proposed highway shall bring down the travel distance by approximately 95 Km (as compared to alternate routes) and result in time savings of over 2 hours. Moreover, the new expressway facility is access controlled and hence will provide good riding quality, better safety, and a reliable infrastructure. All of these elements will result in cost savings and efficiency improvement.

10.2 Project Area

The project section is the part of Kota district of Rajasthan state.

10.3 Environmental Impact Assessment (EIA) Study

The study methodology for the EIA employs a simplistic approach in which the important environmental issues have been identified before initiation of the baseline study. Based on the identification baseline data was collected during the study period from March to May 2018. This data has analysed to predict and quantify the impacts and suggest best suited mitigation measure to mitigate the identified impacts.

10.4 Policy, Legal and Administrative Framework

As part of the project execution, developer shall take the following clearances and NOCs:

- The proposed project is a development of new National Highway, Hence Environmental Clearance will be required under the purview of EIA Notification 2006 & amended thereof.
- Prior permission for tree felling need to be obtained from Forest dept. /District Authorities.
- Need of land acquisition is envisaged to accommodate the proposed development
- Affected households shall be compensated as per entitlement matrix based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act

2013.

- NOC and Consents under Air & Water Acts for establishing and operating the "Construction Camps" from Rajasthan State Pollution Control Board
- NOC under the Hazardous And Other Wastes (Management and Trans-boundary Movement) Rules, 2016 from SPCB
- PUC certificate for use of vehicles for construction from Transport department
- NOC for ground water extraction for construction and allied works from Central Ground Water Board/Authority

Apart from the above clearances, developer also has to comply with the following:

- Clearance of monitoring consultant for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of monitoring consultant for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan shall be prepared by the Contractor and approved by the Monitoring consultant for accidents responding to involving fuel & lubricants before the construction starts.

10.5 Baseline Environmental Profile

10.5.1 Physical Environment

Physical environmental components along the project road are described below.

Climatology

According to the CGWB Report 2017, the year in Rajasthan can be divided into three major conventional seasons as follows:

- The Hot- Weather Season (March to end of June)
- Monsoon Season (End of June to September)
- The Cold- Weather Season (October to February)

The India Meteorological Department has further sub-divided the cold season into two divisions, *i.e.*

- The Season of retreating monsoon (October to December)
- The cold season (January to February)

These seasonal variations have been broadly based on temperature and rainfall conditions in different months.

Physiography and Terrain

Kota district is located in the south-east of Rajasthan State. Its shape is something like a cross. The land slopes gently from south to north and is drained by the Chambal and its tributaries. Hills are seen in north, south and eastern portions. Bundi district is in West. The Mukandara range of Vindhyan Hills, which is 145 km long, is located in the district. At many places, it has a curious double formation of two separate ridges, running parallel to each other at a distance of more than two kilometers. The portions lying between these ridges are often covered with dense forests.

The proposed road alignment follows mostly plain and rolling terrain. Elevation varies from about 207m above MSL to 283m above MSL.

Geology

The project district is not rich in minerals. The building stone is the most important and main mineral found in the Kota district.

The only major mineral found in the Kota district is Lime Stone. This is very important mineral which is being used for cement and for white cement flooring, plaster of Paris and in making fabulous film sets. It is also used in textile industry and building construction.

Soil

Soil of the Kota districts is deep black clayey and deep brown clayey and loamy suitable for production of cotton, rapeseed, mustard and wheat.

Ambient Air Quality (AAQ)

Ambient air quality monitoring has been done at evenly distributed (6) six locations along the proposed alignment. The results indicate that all air quality parameters are within the standards specified in the NAAQS.

Ambient Noise Level (ANL)

Noise monitoring has been carried out once during the entire study period at (6) six locations along the alignment for a period of 24 hours. Day & Night time Leq has been computed from the hourly Leq values as per standards. The Noise quality result show Leq Day time varies from 43.7 to 58.2 dB(A) and Leq Night time varies from 37.0 to 47.8 dB(A).

Surface Water

Surface water quality of the entire project str*etc*h has been monitored as per the parameters laid down by Central Pollution Control Board for surface water quality criteria classes A, B, C, D & E. The water quality at all three (3) locations were found satisfactory and can be used for irrigation & industrial propose along the proposed alignment.

Ground Water

Keeping in view the importance of ground water to the local population, (6) six representative ground water sampling locations were identified and analysed for assessment of ground water quality. pH ranging from 6.16 to 7.0 in ground water samples taken along the proposed alignment. The chloride content varies from 39.99 to 69.98 mg/l. The Fluoride content in the Kota district is found within 0.43 to 0.61mg/l.

The concentration of Nitrate ranges from 5.01 mg/l to 6.84 mg/l. Nitrate values in major part of the district are within 45 mg/l, the maximum permissible limit in drinking water as prescribed by BIS.

The concentration of iron in ground water has been found to vary from 0.141 to 0.284 mg/l.

10.5.2 Biological Environment

Forest

The recorded forest area of the state is 32,737 m^2, which is 9.57% of its geographical area. The Reserved, Protected and Unclassified forests are 38.11%, 55.64% and 6.25% respectively of the recorded forest area. However, as the digitized boundary of recorded forest area from the state covers only an area of 23,105 m^2. (Rajasthan State of Forest Report 2017)

The proposed alignment passing through Mawasa Arandkheda Binyani A protected forest and Barkalaji Reserve forest in kota forest division.

Protected Areas / Eco-sensitive Zones/ Animal Corridor

Proposed alignment passing through Darrah Wildlife sanctuary from chainage 422+304 to 425+752 km (Total length 3.448Km.)

10.5.3 Social Environment

Census Profile

As per census 2011, the state of Rajasthan having 6.9 Cr population, it is witnessed an increase of 1.2 Cr from 2001 population.

Workforce in Project area

The people in the villages are mostly engaged in the agricultural work and economy is largely based on agricultural activities. Some people are also working as a labourer in nearby area.

Educational Institutes

There is one educational institutes shall get affect due to the proposed development.

Cultural Properties

4 no. of Cultural & Religious Properties have not been observed along the project road section.

10.6 Public Interactions & Consultation

Public Interactions & consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level.

10.7 Potential Environmental Impacts

The environmental components are mainly impacted during the construction and operational stages of the project and have to be mitigated for and incorporated in the engineering design. Environmental mitigation measures represent the project's endeavour to reduce its environmental footprint to the minimum possible. These are conscious efforts from the project to reduce undesirable environmental impacts of the proposed activities and offset these to the degree practicable. Enhancement measures are project's efforts to gain acceptability in its area of influence. They reflect the pro-active approach of the project towards environmental management.

10.7.1 Impacts on Climate

Slight change in the micro-climate of the area is expected due to Heat Island Effect as unpaved area will be converted into the paved road. However, Impact on the climate conditions from the proposed road project will not be significant in long run as removal of vegetation will be compensated by compensatory plantation to the tune of double the area denuded.

10.7.2 Impact on Air Quality

There will be rise in PM levels during the construction activities, which shall again be within prescribed limit after the construction activities are over. The level of CO is likely to be increase, however level shall remain within prescribed standards.

10.7.3 Impact on Noise Levels

The area is likely to experience an increment in noise level due to increase in vehicle density after road strengthening. Locations of sensitive receptors were identified and noise barriers in the form of compound wall are proposed at these locations to mitigate the noise level up to acceptable levels.

10.7.4 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Design made to avoid physical loss to the water bodies to the extent possible.

Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants. This will be more prominent in case of locations where the project road crosses rivers, nallahs, *etc*. Mitigation measures have been planned to avoid contamination of these water bodies.

10.7.5 Impact on Ecological Resources

Trees within ROW are likely to be affected due to the proposed development leading temporally loss of micro ecosystem. However, on the long run the impacts will be compensated in terms of compensatory and avenue plantation.

10.7.6 Impact on Land

During the construction of the proposed project, the topography will change due to cuts & fills for project road and construction of project related structures *etc*. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project. Land acquisition is proposed at realignment and bypass locations

10.8 Analysis of Alternatives

Detailed analyses of the alternatives have been conducted taking into account both with and without project. The proposed strengthening of the road is likely to have a positive impact on the economic value of the region. However, there are certain environment and social issue, these needs to be mitigated for sustainable development.

10.9 Mitigation Avoidance &Enhancement Measures

Mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 500 m away from nearby habitations. Construction yard, hot mix plants, *etc*. will also be located more than 500 m away from habitations and in downwind directions. Existing cross drainage structures have been planned to maintain for proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 *i.e.* for every tree to be cut, two trees will be planted. The project shall also witness the plantation of trees for providing

aesthetic beauty and shade. As the space for compensatory plantation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for three years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies *etc*. In order to avoid contamination of water bodies during construction Silt fencing, oil interceptors at storage areas and at construction yard have been proposed.

10.10 Institutional Requirements & Environmental Monitoring Plan

The responsibility of implementing the mitigation measures lies with Environment Team duly appointed by the Contractor/Concessionaire. The overall supervision of Environmental monitoring works during construction and operation stage shall be carried out by NHAI with the help of the Monitoring Consultant.

To mitigate the potential negative impacts of proposed development and measurement the performance of mitigation measures, an Environmental Monitoring and Management Plan is developed. The formulation of an appropriate environmental monitoring plan and its diligent implementation are keys to overall success for the project.

10.11 Environmental Management Plan

Project specific environmental management plan have been prepared for ensuring the implementation of the proposed measures during construction phase of the project, implementation and supervision responsibilities. The cost forenvironmental management during construction has been indicated in EMP. The project impacts and management plan suggested thereof are summarized in next section.

10.12 Environment Impact & Management Matrix

Table 10-1: Environment Impact & Management Matrix

Particulars	Stages	Potential Impacts	Mitigation Measures
Physiographic Environment			
Topography	Preconstruction & Construction	• Slight changes are expected due to development of the road • Impacts are marginal, but permanent.	• Proper planning to keep the land reformation upto bare minimum • No new quarry for the project
Geology	Preconstruction & Construction	• Impacts are moderate because of extraction of sand	• No mitigation measure is required.
Climate			
Temperature/Rain fall/Humidity	Preconstruction & Construction	• Tree felling will have an impact of micro-climate of the area • Heat island effect due to increase in paved roads • Low spatially restricted	• Compensatory plantation of triple of the trees to be cut • With the proposed avenue plantation scheme, the micro climate of the project corridor will be smoothening

Particulars	Stages	Potential Impacts	Mitigation Measures
		short-term impact	
Land			
Loss of Other Land	Design, Preconstruction & Construction	• Loss of Property & Livelihood	• Compensation as per RAP
Induced Development	Preconstruction & Construction	• Insignificant change in the land use pattern	• Civil authorities to plan and guide any induced development using the prevailing regulatory framework
Soil			
Soil Erosion	Preconstruction, Construction & Operation	• In Road slopes and spoils • Erosion in excavated areas	• Embankment protection through pitching & turfing • Regular water sprinkling in excavated areas
Contamination of Soil	Preconstruction, Construction & Operation	• Scarified bitumen wastes • Oil and diesel spills • Emulsion sprayer and laying of hot mix • Production of hot mix and rejected materials • Residential facilities for the labour and officers	• Hazardous And Other Wastes (Management and Trans-boundary Movement) Rules, 2016 • Oil Interceptor will be provided in storage areas for accidental spill of oil and diesel • Rejected material to be laid as directed by monitoring consultant. • Septic tank to be constructed for waste disposal.
Water			
Impact on Water Resource	Design, Preconstruction, Construction & Operation	• Depletion of ground water recharge • Contamination from fuel and lubricants & waste disposal in camp area • Contamination of surface water system due to run-off from road construction area	• Provision of Storage/harvesting structure of water, wherever feasible • Oil Interceptor and Septic tank in construction camp • Enforcement of Hazardous And Other Wastes (Management and Trans-boundary Movement) Rules, 2016 • Both side drain facility to suitably divert the run-off from roads
Air			
Dust generation	Preconstruction& Construction	• Shifting of utilities, removal of trees & vegetation, transportation of material	• Regular Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Hot mix plant to be installed in down wind direction with at least 1000m distance from nearby settlement. • Regular monitoring of particulate matter in Ambient

Particulars	Stages	Potential Impacts	Mitigation Measures
			Air
Gaseous pollutants	Preconstruction, Construction & Operation	• Operation of Hot mix plant and vehicle operation for material transportation	• Air pollution Norms will be enforced. • Only PUC certified vehicle shall be deployed • Labourers will be provided with mask. • Regular gaseous pollution monitoring in ambient air
Ambient air quality	Operation	• Air pollution from traffic • CO level is likely to increase	• Compliance with statuary regulatory requirements
Noise			
Pre-Construction Activity	Pre-Construction	• Man, material and machinery movements • Establishment of labour camps, onsite offices, stock yards and construction plants	• No Horn Zone sign, Speed Barriers near sensitive receptors • Camps will be setup more than 500m away from settlements.
Construction Activity	Construction	• Operation of high noise equipment like hot mix plant, diesel generators *etc*. • Community residing near to the work zones.	• Camp will be setup more than 1000m away from the settlements, in down wind direction. • Noise pollution regulation to be monitored and enforced.
Operation Stage	Operation	• Indiscriminate blowing of horn near sensitive area	• Restriction on use of horns • No Horn Zone sign.
Ecology			
Flora	Preconstruction, Construction	• Loss of vegetation cover • Felling of 434 nos. of trees	• Felling of only unavoidable trees • Compensatory Plantation in the ratio of 1:3
Fauna	Preconstruction, Construction & Operation	• Loss of insect, avian and small mammalian species due to felling of trees • Accidental run over	• Compensatory Plantation • Speed breaker, Signage and limit in sensitive areas
Social			
Socio Environment	Design, Preconstruction & Construction	• Loss of Property & Livelihood • Loss of CPRs, Religious Structures	• Compensation as per RAP • Relocation of CPRs, Religious Structures to suitable place
Public Health and Road Safety			
Health and safety	• Preconstruction, Construction & Operation	• Psychological impacts on project affected people • Migration of worker may lead to sanitation problem creating congenial condition for disease vectors • Discomfort arising of air	• Continued consultation with PAPs and the competent authority for speedier settlements of appropriate compensation package and resettlement. • Ensuring sanitary measures at construction camp to prevent

Particulars	Stages	Potential Impacts	Mitigation Measures
		and noise pollution • Hazards of accident	water borne disease and vector borne disease. • Provision for appropriate personal protective equipments like earplugs, gloves gumboot, and mask to the work force. • Safe traffic management at construction area. • Drive slow sign and speed barriers near community facilities like school, hospital, *etc*.

10.13 Conclusions

Based on the EIA study and surveys conducted for the Project, it can be concluded that associated potential adverse environmental impacts can be mitigated to an acceptable level by adequate implementation of the measures as stated in the EIA Report. Adequate provisions shall be made in the Project to cover the environmental mitigation and monitoring requirements, and their associated costs as suggested in environmental budget. The proposed project shall improve Road efficiency and bring economic growth. In terms of air and noise quality, the project shall bring considerable improvement to possible exposure levels to population.

11 DISCLOSURE OF CONSULTANT

Declaration by Experts contributing to the Environment Impact Assessment Study for Development of 8 lane (Greenfield highway) from Banda Hera village (Ch. 392.800 Km) to Moondiya village (Ch. 452.625 Km) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan.

I, hereby, certify that we were part of the EIA team in the following capacity that developed the above EIA.

Signature : 

Name of EIA Coordinator : Dr. Raj Kumar Singh

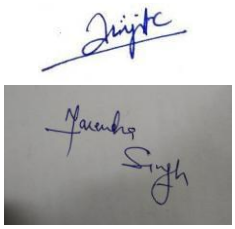
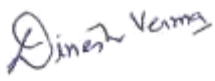
Date : 12.07.2019

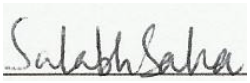
Period of Involvement : February, 2018 to till date

Contact Information : Dr. R.K.Singh
General. Manager
Feedback Infra Pvt. Ltd.
15th Floor, Tower 9B,
DLF Cyber City Phase III, Gurgaon

Functional Area Experts:

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task)	Signature & Date
1	**AP**	Dr. R. K. Singh/ Navneet Kumar	February, 2018 to till date **Task:** a) Preparation of Scope for baseline study b) Crosschecking of monitoring c) Impact assessment for air quality d) Mitigation measures for air pollution	
2	**SE**	Dr. Gandikota Ananda / Munna Kumar	February, 2018 to till date **Task:** a) Socio-economic survey of the area b) Impact on inhabitants c) Management plan	

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task)	Signature & Date
3	**EB**	Arijit Choudhury Narendra Singh Rathore	February, 2018 to till date **Task:** a) Ecology & biodiversity survey of the study area b) Preparation of inventory of flora and fauna c) Consultation with institutional and community d) Impact and mitigation measures for ecology	
4	**HG**	Aruna Tageja/Dinesh Kumar Verma	February, 2018 to till date **Task:** a) Review of Hydro- geological pattern of the area b) Assessment of project impacts c) Development of Management plan	
5	**Noise / Vibration**	Saurabh Kumar Garg / Arijit Choudhury	February, 2018 to till date **Task** a) Noise monitoring scoping b) Noise impact analysis c) Preparation of management plan	
6	**RH**	Pintu Kumar	February, 2018 to till date **Task:** a) Hazard Identification b) Risk Assessment c) Preparation of management plan	
7	**WP**	Pintu Kumar	February, 2018 to till date **Task:** a) preparation of Scope for baseline study b) Crosschecking of monitoring c) Impact assessment for water quality d) Mitigation measures for water pollution	
8	**AQ**	Saurabh Kumar Garg/ Pintu Kumar	February, 2018 to till date **Task:** a) preparation of Scope for baseline study b) Crosschecking of monitoring c) Impact assessment for water quality d) Mitigation measures for water pollution	
9	**SC**	Dr. Raj Kumar Singh	February, 2018 to till date **Task:** a) preparation of Scope for baseline study b) Crosschecking of monitoring c) Impact assessment for water quality d) Mitigation measures for Soil	

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task)	Signature & Date
			pollution	
10	**LU**	Virender Kumar	February, 2018 to till date **Task:** e) preparation various Land Use Map f) Crosschecking of Maps g) Impact assessment of Land USE h) Mitigation measures for land Use	
11	**Geo**	Salabh Saha	May, 2018 to till date **Task:** i) Geological study of the project j) Impact assessment with respect to Geological feature k) Mitigation measures with respect to geology	
12	**SHW**	Saurabh Kumar Garg	February, 2018 to till date **Task:** l) Preparation of SHW Report m)Impact assessment for SHW n) Mitigation measures for water SHW	
13	**EIA Expert & Report Reviewer**	Dr. Raj Kumar Singh	February, 2018 to till date **Task:** a) Project Management b) Report Review	

Declaration by the Head of the Accredited Consultant Organization / Authorized Person

I, **Pranav Ranjan**, hereby, confirm that the above-mentioned experts prepared the EIA for Declaration by Experts contributing to the Environment Impact Assessment Study for Declaration by Experts contributing to the Environment Impact Assessment Study for 'Development of 8 lane (Greenfield highway) from Banda Hera village (Ch. 392.800.000 Km) to Moondiya village (Ch. 452.625 Km) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan. I also confirm that I shall be fully accountable for any misleading information mentioned in this statement.

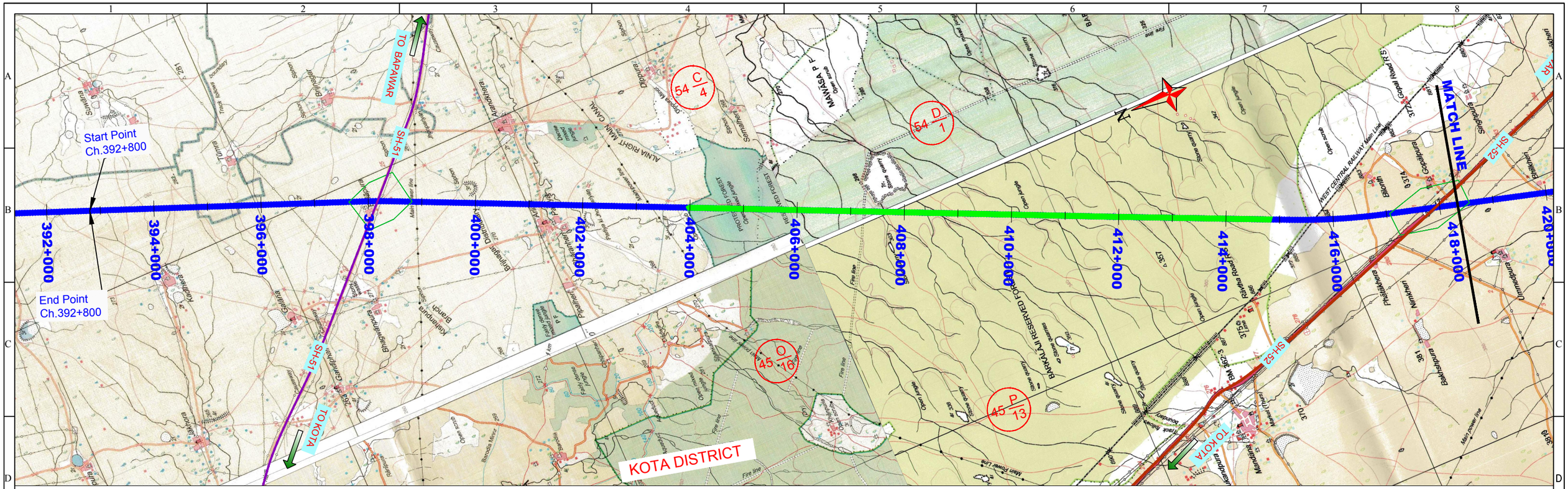
Name: **Pranav Ranjan**

Designation: **COO**

Name of the EIA Consultant Organization: **Feedback Infra Pvt. Ltd.**
NABET Certificate No. & Issue Date: **NABET/EIA/1821/RA0116 dated 11th Jan 2019**

S. No.	Functional Area Code	Complete name of the Functional Areas
1.	**AP**	Air Pollution Monitoring, Prevention & Control
2.	**WP**	Water Pollution Monitoring, Prevention and Control
3.	**SE**	Socio-Economics
4.	**EB**	Ecology and Biodiversity
5.	**HG**	Hydrology, Ground Water & Water Conservation
6.	**NV**	Noise and Vibration
7.	**AQ**	Meteorology, air quality modeling & prediction
8.	**RH**	Risk Analysis and Hazard Management
9.	**GEO**	Geology
10.	**SHW**	Solid and Hazardous Waste Management
11.	**LU**	Land Use
12.	**SC**	Soil Conservation

LIST OF ANNEXURE



REV	DATE	DESCRIPTION OF REVISIONS	BY

LEGEND:-
- Proposed Alignment
- Effected Forest area
- District Boundary
- 10.0Km Buffer of Reserve Forest
- Existing Road (SH)
- Existing Road (SH)

CLIENT:

NATIONAL HIGHWAYS AUTHORITY OF INDIA
(Ministry of Road, Transport & Highways)
Government of India
G - 5 & 6, Sector - 10,New Delhi - 110075

CONSULTANT:

FEEDBACK INFRA
Making Infrastructure Happen

Feedback Infra Private Limited
15th Floor, Tower 9B
DLF Cyber City Phase-III, Gurgaon
122 002

Approved By:	AG	AG
Checked by:	AG	AG
Designed by:	JR	JR
Drawn by:	SK	SK

Scale: 1:50000
Date: Sep-2018

STATUS:

PROJECT: "Development of 8 lane (Greenfield Highway) from Banda Hera (Ch. 392.800 Km) to Moondiya (Ch. 452+425 Km) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in Rajasthan State"

TITLE: PROPOSED ALIGNMENT ON TOPO SHEET Ch.From 392+800 to 444+000

DRG NO.: FVPL/HW/NH/FA-TS-FO-08 | REV. | SHEET:

28/09/2018 – 12:33pm
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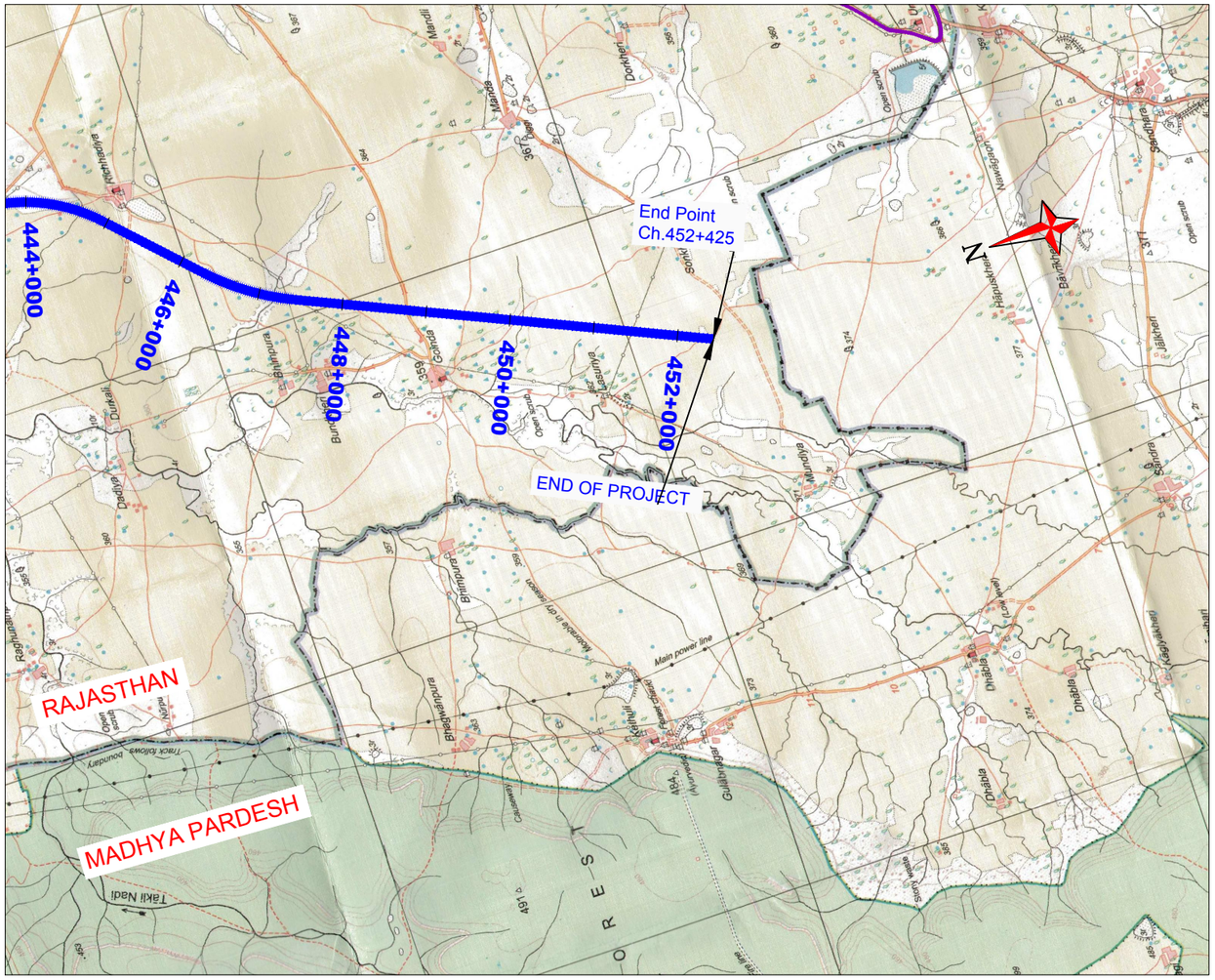

REV	DATE	DESCRIPTION OF REVISIONS	BY

LEGEND:-
- Proposed Alignment
- Effected Forest area
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Approved By:	AG	AG	
Checked by:	AG	AG	
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Drawn by:	SK	SK	
Scale:	1:50000		
Date:	Sep-2018		

STATUS:	
PROJECT:	**"Development of 8 lane (Greenfield Highway) from Banda Hera (Ch. 392.800 Km) to Moondiya (Ch. 452+425 Km) Section of NH-148 N (Total length 59.625 Km), Under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in Rajasthan State"**
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REV.	
SHEET:	

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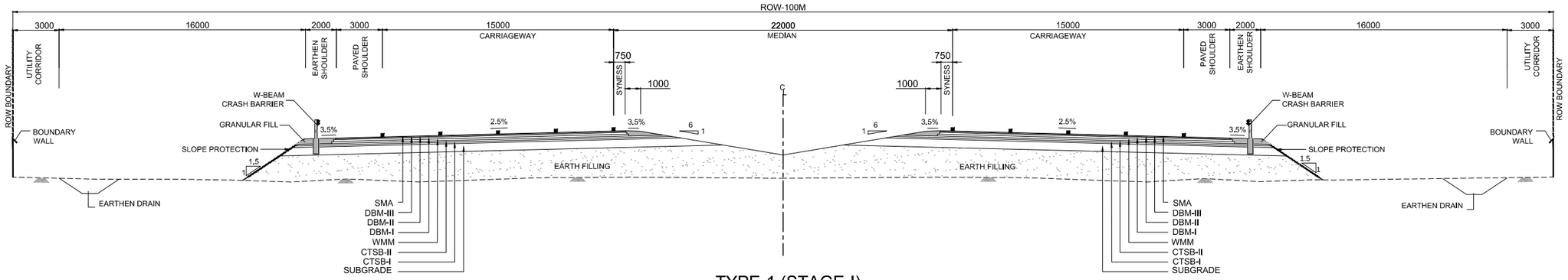
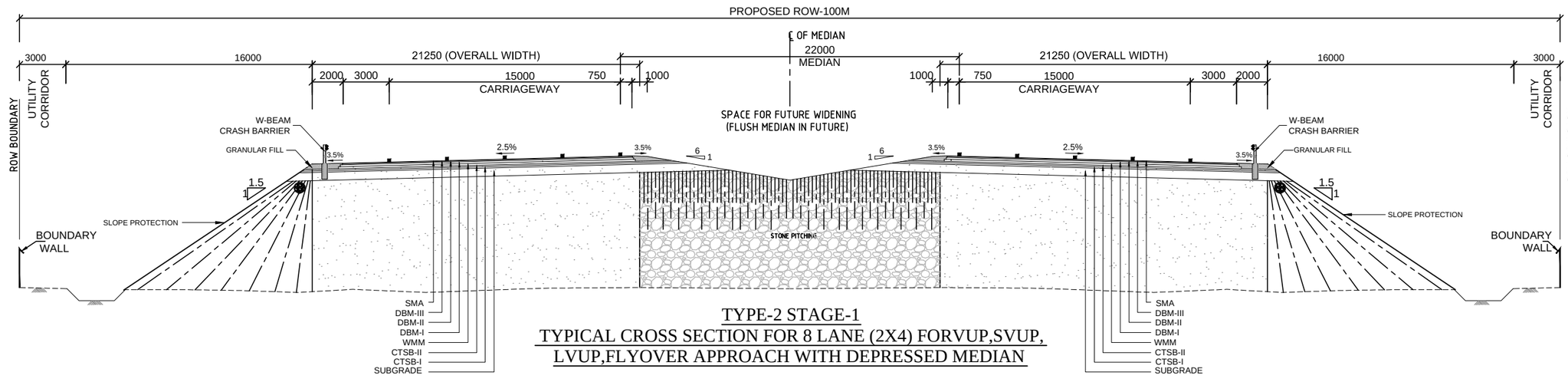


TYPE-1 (STAGE-I)
TYPICAL CROSS SECTION FOR 8 LANE (2X4) IN PLAIN & ROLLING TERRAIN
WITH DEPRESSED MEDIAN WITH EMBANKMENT HEIGHT UP TO 2.5 M.



TYPE-2 STAGE-1
TYPICAL CROSS SECTION FOR 8 LANE (2X4) FORVUP,SVUP,
LVUP,FLYOVER APPROACH WITH DEPRESSED MEDIAN

1. ALL DIMENSIONS ARE IN MILLIMETERS, UNLESS OTHERWISE MENTIONED.
ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.

REV	DATE	DESCRIPTION OF REVISIONS	BY

CLIENT:

NATIONAL HIGHWAYS AUTHORITY OF INDIA
(Ministry of Road, Transport & Highways)
Government of India
G - 5 & 6, Sector - 10,Dwarka, New Delhi - 110075

CONSULTANT:

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Gurgaon 122 002

Drawn by:	KA	
Designed by:	KP	
Checked by:	RM	
Approved By:	PR	
Scale:	NTS	
Date:	October- 2018	

STATUS:	FEASIBILITY REPORT
PROJECT:	Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-4/ Package-4) Development of Delhi-Vadodara Highway NH-148N in Rajasthan State)
TITLE:	TYPICAL CROSS SECTION OF TYPE-1&2 (INNER SIDE WIDENING)
DRG NO.:	FIPL/HW/LOT-4/TCS - 01
REV.	0
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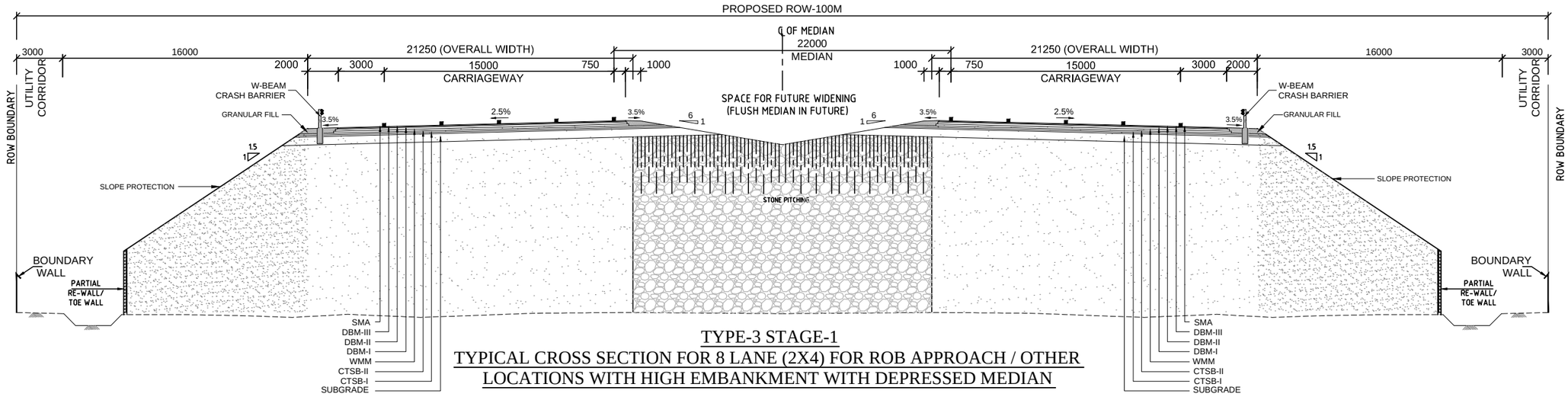
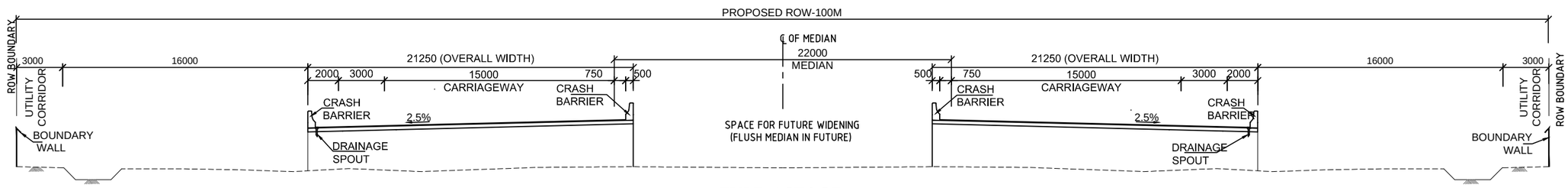
INSIDE WIDENING



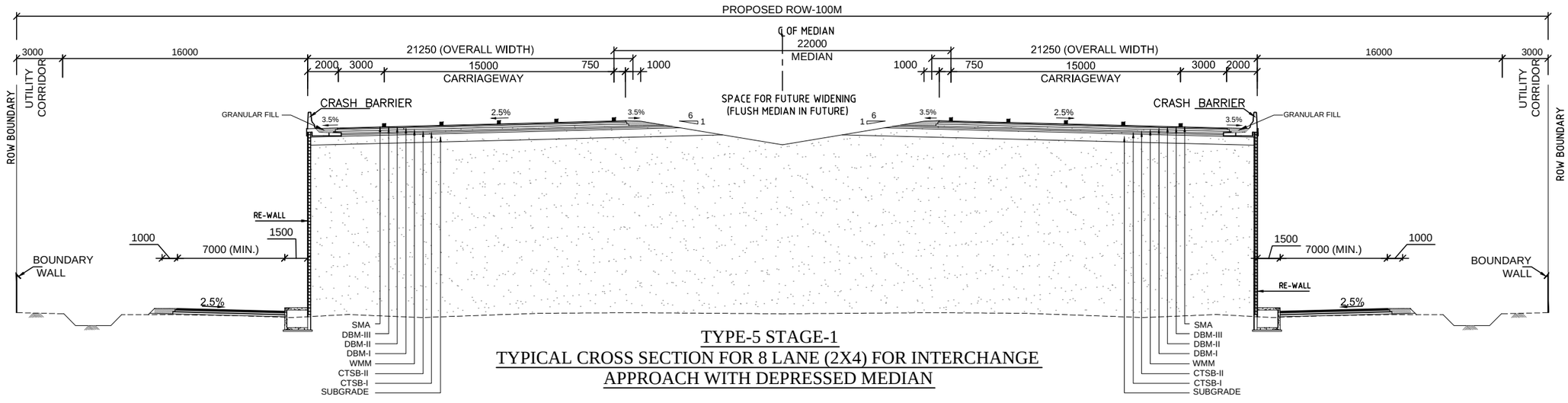
TYPE-3 STAGE-1

TYPICAL CROSS SECTION FOR 8 LANE (2X4) FOR ROB APPROACH / OTHER LOCATIONS WITH HIGH EMBANKMENT WITH DEPRESSED MEDIAN



TYPE-4 STAGE-1

TYPICAL CROSS SECTION FOR 8 LANE (2X4) FOR MJB, MNB WITH DEPRESSED MEDIAN



TYPE-5 STAGE-1

TYPICAL CROSS SECTION FOR 8 LANE (2X4) FOR INTERCHANGE APPROACH WITH DEPRESSED MEDIAN

REV	DATE	DESCRIPTION OF REVISIONS	BY

CLIENT:

NATIONAL HIGHWAYS AUTHORITY OF INDIA
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Government of India
G - 5 & 6, Sector - 10,Dwarka, New Delhi - 110075

CONSULTANT:

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15th Floor, Tower 9B
DLF Cyber City Phase-III,
Gurgaon 122 002

Drawn by:	KA	
Designed by:	KP	
Checked by:	RM	
Approved By:	PR	
Scale:	NTS	
Date:	October- 2018	

STATUS: FEASIBILITY REPORT

PROJECT: Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-4/ Package-4) Development of Delhi-Vadodara Highway NH-148N in Rajasthan State)

TITLE: **TYPICAL CROSS SECTION TYPE-3,4 & 5 (INNER SIDE WIDENING)**

DRG NO.: FIPL/HW/LOT-4/TCS - 02

REV. 0

SHEET:

10/10/2018 – 1:57pm
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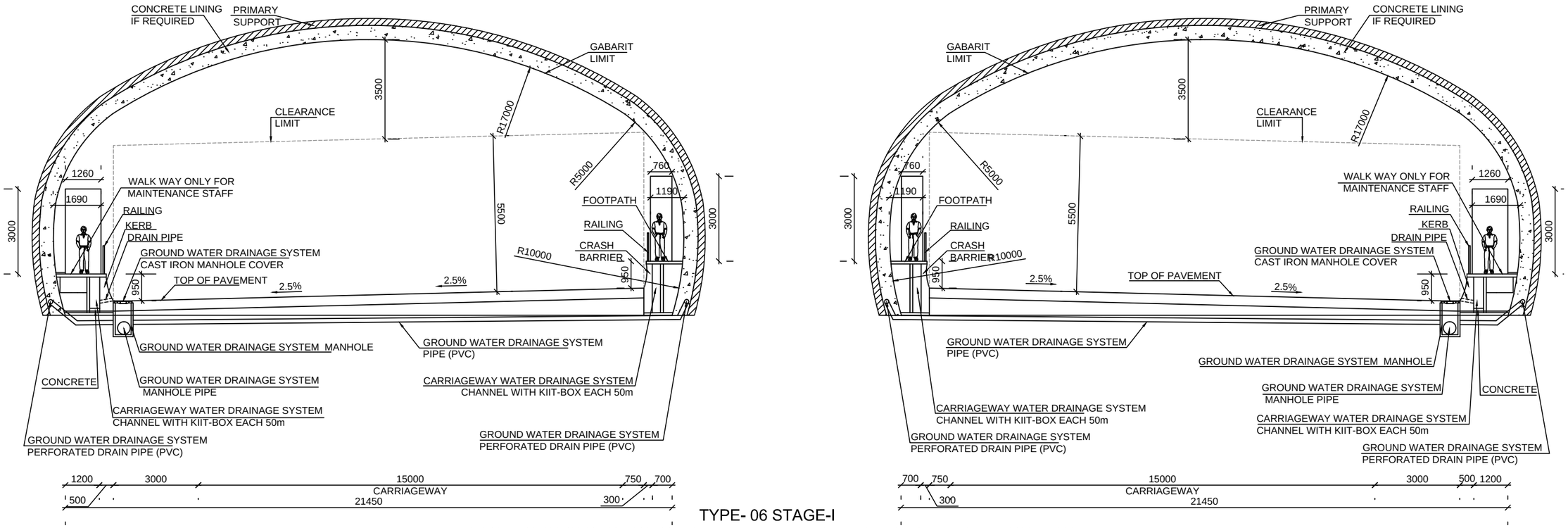

TYPE- 06 STAGE-I

TYPICAL CROSS SECTION OF DUAL 4-LANE (8-LANE DIVIDED) TUNNEL LOCATION

REV	DATE	DESCRIPTION OF REVISIONS	BY

CLIENT:

NATIONAL HIGHWAYS AUTHORITY OF INDIA
(Ministry of Road, Transport & Highways)
Government of India
G - 5 & 6, Sector - 10,Dwarka, New Delhi - 110075

CONSULTANT:

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Gurgaon 122 002

Drawn by:	KA	
Designed by:	KP	
Checked by:	RM	
Approved By:	PR	

Scale: NTS

Date: October- 2018

STATUS:	FEASIBILITY REPORT
PROJECT:	Consultancy Services for preparation of DPR for development of Economic Corridors, Inter Corridors and Feeder Routes to improve the efficiency of freight movement in India under Bharatmala Pariyojana (Lot-4/ Package-4) Development of Delhi-Vadodara Highway NH-148N in Rajasthan State)
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LAND USE / LAND COVER MAP (STUDY AREA - 500 M)

LEGEND

- Chainnage
- Mach Line
- Center Line

LAND USE / LAND COVER

- Crop Land
- Agriculture Plantation
- Fallow Land
- Built Up Area
- Mining
- Road
- Rail
- Canal
- Drain
- Ponds
- River
- Forest
- Scrub land

SCALE 1 : 10,000

0 500 1000 m

CLINT:

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CONSULTANT:

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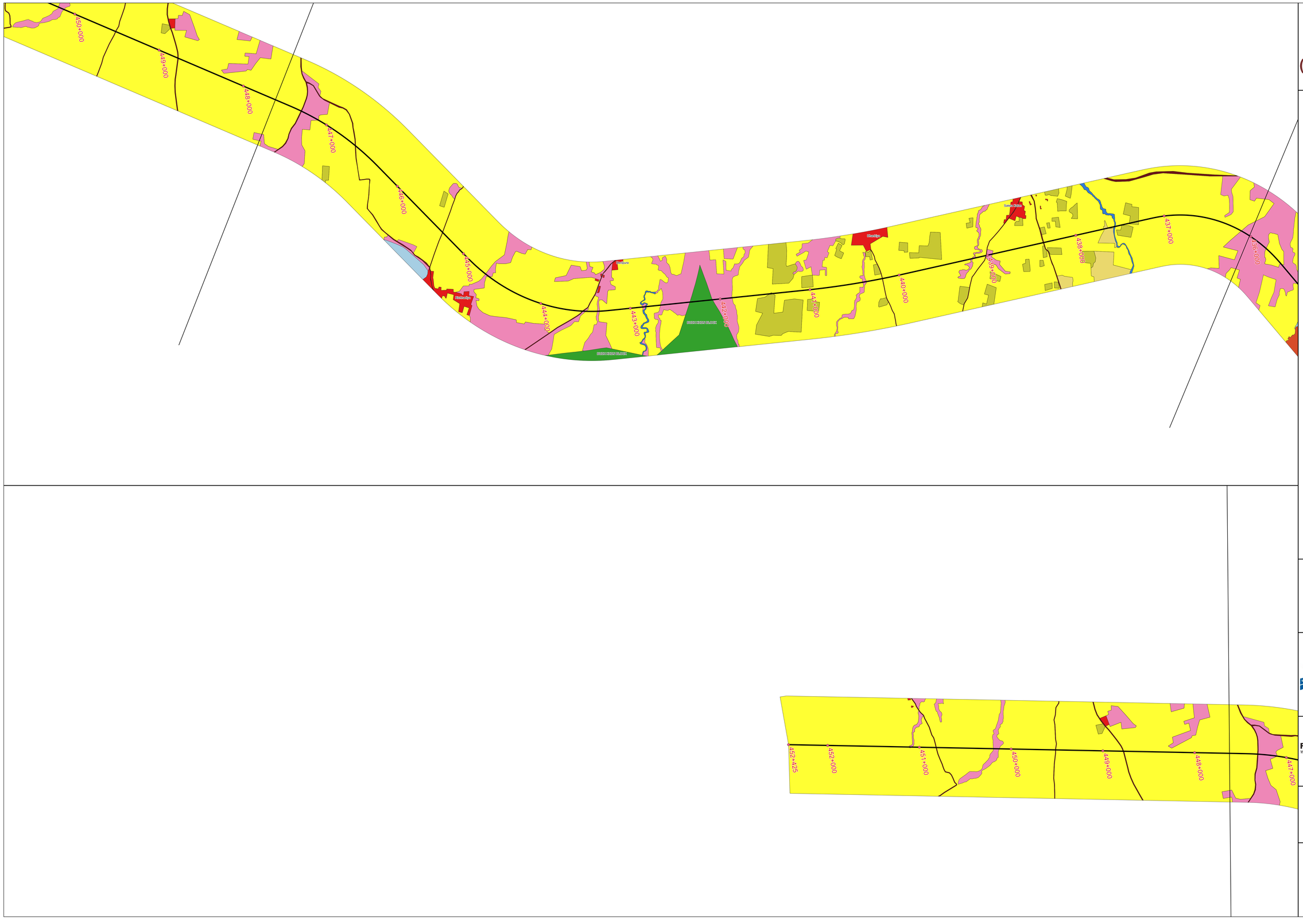
Gurgaon 122 002

Environment Impact Assessment (EIA) Report

Development of 8 lane (Greenfield Highway) from Banda Hera village (Ch. 392.800 Km) to Moondiya village at (Ch. 452.425 Km) Section of NH- 148 N (Total length 59.625 Km), under BHARATMALA PRIYOJANA Lot-4/Pkg-4 in the state of Rajasthan

LAND USE / LAND COVER MAP (STUDY AREA - 500 M)



LEGEND

- Chainnage
- Mach Line
- Center Line

LAND USE / LAND COVER

- Crop Land
- Agriculture Plantation
- Fallow Land
- Built Up Area
- Mining
- Road
- Rail
- Canal
- Drain
- Ponds
- River
- Forest
- Scrub land

SCALE 1 : 10,000

0 500 1000 m

CLINT:

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CONSULTANT:

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Annexure 5.1: Guidelines for Existing Quarry Management

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

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

CONSTRUCTION STAGE

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

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

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

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

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

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

QUARRY OPERATIONS INCLUDING SAFETY

i) Overburden shall be removed and disposed in line with Guidelines for Debris Disposal Site and management given in Annexure-5.4 & 5.5

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

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

iv) The Contractor/Concessionaire shall ensure that all workers related safety measures shall be done as per guidelines for Workers and Safety.

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

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

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

POST CONSTRUCTION STAGE

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

to ensure the implementation of Redevelopment Plan.

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

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

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

REMARKS

Submitted

Signature

Name

Designation

Contractor/Concessionaire

Checked & Approved

Signature

Name

Designation

Monitoring Consultant

Annexure 5.2: Guidelines for New Quarry Management

1. Management Plan for New Quarry

The Contractor/Concessionaire shall prepare a quarry management plan for operation of new quarries and submit it to the Monitoring Consultant for approval and necessary actions. The plan shall consist of the following:

1.1 Selection Details

1.1.1 Location and Layout

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

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

1.1.2 Selection Criteria

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

1.1.3 Agreement with landowners

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

1.1.4 Licenses and permits

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

1.2 Operation

1.2.1 Method of extraction

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

1.2.2 Loading and haulage

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

1.2.3 Crusher Plant

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

1.2.4 Storage of explosives

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

1.2.5 Products

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

1.2.6 Testing and quality assurance

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

1.2.7 Water sourcing

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

1.2.8 Safety

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

1.2.9 Workers Accommodation

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

2. Environmental Management

2.1 Environmental Management during Operation

2.1.1 Removal of trees and plants

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

2.1.2 Overburden

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

2.1.3 Silt management

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

2.1.4 Surface water drainage

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

2.1.5 Soil and water contamination

- Contractor to list sources of possible contaminants to the soil (fuel stores, etc) and what will be done

to control it (minimise spillages, control leaks from plant, etc).

2.1.6 Air pollution

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

2.1.7 Noise

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

2.1.8 Traffic

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

2.1.9 Approach road

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

2.2 Environmental Management at Closure of the site

2.2.1 Dismantling and removal of machinery

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

2.2.2 Slope stabilisation and / or protection

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

2.2.3 Rehabilitation

- Rehabilitation plan of the quarry.
- The Contractor/Concessionaire shall be responsible for the Redevelopment Plan prior to completion. The Consultant and the NHAI shall be responsible for reviewing this case of redevelopment prior to the issuing the defect liability certificate.

2.2.4 Hand-over

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

2.2.5 Removal of debris and solid waste

Confirmation of Contractor/Concessionaire in removal of debris and solid wastes and disposal at a suitable site. For each aggregate-cum-quarry sand source, the plan should be the same. The table below gives the format:

SI. No.	Item	Unit	Details	Remarks by IC, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved	m^2		
5.	Existing land use (verification from land records with revenue department)			

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

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

Submitted

Signature

Name

Designation

Contractor/Concessionaire

Checked & Approved

Signature

Name

Designation

Monitoring Consultant

Annexure 5.3: Plan for Borrow Area Management

SITING

Specific locations of borrow areas to be used (if any) will be identified by Contractor/ Concessionaire. In case the Contractor/ Concessionaire wants to open any new borrow areas and then the selection and recommendations for borrow areas will be based on environmental as well as civil engineering considerations. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF&CC, State Govt. and as specified in IRC:10-1961.

The Contractor/ Concessionaire shall establish a new borrow areas only with the prior consent of the Monitoring Consultant only in cases when:

- Lead from existing borrow area & quarries is uneconomical and
- Alternative material sources are not available.

The Contractor/ Concessionaire shall prepare a Redevelopment Plan for the borrow area and get it approved by the Monitoring Consultant.

Certain precautions have to be taken to restrict unauthorized borrowing by the Contractor/ Concessionaire. No borrow area shall be opened without permission of the Monitoring Consultant. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Monitoring Consultant that there is no suitable uncultivable land in the vicinity for borrowing or private landowners are willing to allow borrowing on their fields.

The construction schedule and operations plans to be submitted to the Consultant prior to commencement of work shall contain a detailed work plan for procuring materials that includes procurement; transportation and storage of borrow earth material. The Contractor/ Concessionaire shall provide the following:

- Selection Criteria for Evaluation of Potential Borrow Areas
- A brief statement as to how the site was chosen
- Alternative sites that were considered to be mentioned
- Record any public consultations involved while choosing and what the public concerns were, if any
- Existing land use (Agricultural / Barren / Scrub / grazing / any other type)
- Vegetation / trees to be removed
- Erosion/degradation potential
- Distance and name of the nearest settlement
- Distance from the nearest surface water body
- Drainage pattern of the area
- Distance of the nearest Reserve Forest (if any) or any other ecologically fragile area

- Distance of the nearest Sacred Tree (if any)
- Distance from the nearest school / hospital / primary health center
- Daily / Occasional use of borrow area by the community
- Any schemes or avenues for generation of income for adjoining community
- Location and Layout
- Sketch plans and photographs to be provided along with adequate details:

A map and sketch plan of the area showing the location of the proposed site with respect to the project road, nearby villages and worker accommodation locations along with indicative distances of the different sites from each other and from the road.

Probable Borrow Areas data (to be filled by Contractor/Concessionaire)

Sample no.	Name of Village	Material type	Site identification			Approximate Quantity (Cum)				Available Land / Terrain	Surrounding Land/ Terrain	Remarks
			Nearest Chainage (Km.)	Left / Right	Offset from nearest Chainage (m)	Length (m)	Breadth (m)	Depth (m)	Total (Cum)			

REMOVAL OF TREES AND PLANTS

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

MITIGATIONS & REHABILITATION OF BORROW AREAS

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

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

For opening new borrow areas other than those identified the consultant shall follow above section. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the

Consultant that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields.

REHABILITATION

The objective of the rehabilitation programme is to return the borrow pit sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing borrow pits sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the borrow pit floor to approximately the access road level.

It is important to plan restoration from the outset and coordinate restoration activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework rehabilitation often leads to the creation of wetlands and or recreation areas.

Special borrow pit rehabilitation plan shall be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., the re-greening and replanting methods..

Other criteria which shall be followed for rehabilitation of quarry/ borrow pits are as given below:

- Borrow pits can be backfilled with rejected construction wastes except bitumen and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Contractor/Concessionaire shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; re-establishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the Contractor/Concessionaire shall restore the environment around the work site to its original splits.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local state forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.
- The borrow pit immediate surroundings shall be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming the open spaces. Walkways around the borrow site may be constructed. Provision for a future drive-in picnic area and car parking area may be developed.

Annexure 5.4: Guidelines for Identification of Debris Disposal Sites & Precautions

Guidelines for identification

The locations of dumping sites have to be selected such that:

- No residential areas are located downwind side of these locations,
- Dumping sites are located at least 1000 m away from forest areas and water bodies
- Dumping sites do not contaminate any water sources, rivers etc.
- Dumping sites have adequate capacity equal to the amount of debris generated.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.

Precautions to be adopted during Dumping of Debris / Waste Material

The Contractor/Concessionaire shall take the following precautions while disposing off the waste material

- During the site clearance and disposal of debris, the Contractor/Concessionaire will take full care to ensure that public or private properties are not damaged / affected and that the traffic is not interrupted.
- The Contractor/Concessionaire will dispose of debris only to the identified places only with prior permission of the Environmental Specialist and the Consultant.
- Contractor can also dispose of the debris for the improvements in public utilities after the proper consent of villagers and approval of Environmental Specialist and the Consultant.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the Contractor/Concessionaire will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Environmental Specialist and the Consultant.
- The Contractor/Concessionaire will at all times ensure that the entire existing stream courses and drains within and adjacent to the site are kept safe and free from any debris.
- The Contractor/Concessionaire will utilise effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Materials having the potential to produce dust will not the loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- During disposal of debris, proper warning signs to be installed to the satisfaction of Environmental Specialist and the Consultant.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of Environmental Specialist and the Consultant.
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the Contractor/Concessionaire will take into account the wind direction and location of settlements to ensure against any dust problems.
- Adequate arrangements will be made to ensure that the debris / waste material is disposed off nearest to the designated dumping site. The report on this activity shall be prepared regularly by Environmental Specialist and the Consultant.

Annexure 5.5: Guideline for Rehabilitation of Dumpsites & Quarries

Dumpsites

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

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

Quarries

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

- The objective of the rehabilitation programme is to return the quarry sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing quarry sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the quarry / quarry floor to approximately the access road level.
- It is important to plan restoration from the outset and coordinate restoration with quarrying activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework quarry rehabilitation often leads to the creation of wetlands and natural reserves or recreation areas.
- Special quarry / quarry rehabilitation plan should be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., and the re-greening and replanting methods.

  Other criteria which should be followed for rehabilitation of quarry sites are as given below:

- Quarries will be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Contactor/Concessionaire shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; reestablishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the Contactor/Concessionaire shall restore the environment around the work site to its original splits.
- To create a safe environment under the terms of The Mines and Quarries Act the faces have to be reduced to a naturally stable slope or be adequately fenced to prevent access to the top and bottom of

the faces. Such a fence must be of a height as prescribed under The Mines Act with a barbed wire top strand designed to exclude the public from the quarry area. Depending on the location of the site presence of a permanent lake is considered to be a satisfactory alternative to a fence.

- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

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

Annexure 5.6: Guidelines for Sediment Control

All materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work.

CONSTRUCTION STAGE

Prior to the start of the relevant construction, the Contractor/Concessionaire shall submit to the Consultant for approval, his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across water courses, pavement courses and shoulders. The Contractor/Concessionaire shall also submit for approval his proposed method of erosion / sedimentation control on service road and quarries and his plan for disposal of waste materials. Work shall not be started until the erosion / sedimentation control schedules and methods of operations for the applicable' construction have been approved by the Consultant.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, quarry and fill operations shall be limited to the extent practicable. The Contractor/Concessionaire may be directed to provide immediate control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties, or cause contamination of nearby streams or other watercourses. Such work may involve the construction of temporary berms, dikes, sediment basins, slope drains and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation.

The Contractor/Concessionaire shall be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time as outlined in his accepted schedule to minimize the need for temporary erosion and sedimentation control measures.

Temporary erosion, sedimentation and pollution control measures will be used to control the phenomenon of erosion, sedimentation and pollution that may develop during normal construction practices, but may neither be foreseen daring design stage nor associated with permanent control features on the Project.

Where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion or sedimentation control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion or sedimentation control measures may be required between successive construction stages. Under no conditions shall a large surface area of credible earth material be exposed at one time by clearing and grubbing or excavation without prior approval of the Environmental Specialist.

The Consultant may limit the area of excavation, quarry and embankment operations in progress, commensurate with the Contractor's/Concessionaire's capability and progress in keeping the finish grading, mulching, seeding and other such permanent erosion, sedimentation and pollution control measures, in accordance with the accepted schedule.

Temporary erosion is sometimes caused due to the Contractor's/Concessionaire's negligence, carelessness or failure to install permanent controls. Sedimentation and pollution control measures then become necessary as a part of the work as scheduled or ordered by the monitoring consultant, and these shall be carried out at the Contractor's/Concessionaire's own expense. Temporary erosion, sedimentation and pollution control work required, which is not attributed to the Contractor's/Concessionaire's negligence, carelessness or failure to install permanent control, will be performed as per the need.

Temporary erosion, sedimentation and pollution control may include construction work outside the right of way where such work is necessary as a result of road construction such as quarry operations, service roads and equipment storage sites.

The temporary erosion, sedimentation and pollution control features installed by the Contractor's/Concessionaire's shall be maintained by him till these are needed, unless otherwise agreed by the Consultant.

Annexure 5.7: Tree Plantation strategy

1. INTRODUCTION

Due to the proposed development, some of the existing trees are to be felled. To offset this impact, compensatory afforestation programme through tree plantation, median plantation, horticulture and landscaping strategy has been prepared, based upon the experiences of successful implementation of a number of ongoing and completed projects.

2. OBJECTIVE

The main objectives are as follows:

- Reducing the impacts of air pollution
- Natural noise barrier
- Arrest of land erosion
- Providing much needed shade during the day time
- Prevention of vehicle glare from vehicles coming from opposite direction
- Enhancement of aesthetic view of the corridors
- Climatic amelioration
- Defining of ROW especially at sharp curves during night

3. SPECIES SELECTION

Grasses, shrubs and trees are the main species that are readily available in India. Where possible, the use of non-native species should be avoided since they can out compete and displace native plants leading to loss of native biodiversity. To maximise the chances of success, one should try to select species whose growing conditions roughly match the environmental conditions of the project site. Care should also be taken to select species with root systems that match the nature of the soil movement at the project site. Homogenous avenues of trees should be selected for long stretches as it provides aesthetic qualities in the landscaping. One should also take into account the economic and other social benefits while selecting the species for plantation. During the selection of species preference should be given towards rapid growing and pest and disease resistant species. Shrub species, which are dwarf and pollution hardy, are to be planted in the median to prevent the glare of traffic moving in opposite direction. Flowering, ornamentals plants and climbers can also be planted in urban areas to provide beauty. For this purpose the species may be decided by interaction with local authority and local populace. Few species has also been recommended in the report under section 7.2.2.

4. TASKS OF THE CONTRACTOR/CONCESSIONAIRE

As part of this project implementation, the contractor/concessionaire shall plant and maintain flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for which cost has been budgeted besides planting and maintenance of ornamental, medicinal & flowering plants and shrubs in the median for which cost has also been budgeted. The specific roles and responsibilities of the Contractor/Concessionaire include:

- Identification of the plantation stretches with NHAI and or Consultant.
- Identification of nursery area and preparation of nurseries
- Planting of saplings in the nurseries during the construction period so that the saplings are a minimum 24 months old

- Replantation of the 2 year old saplings to the plantation stretches and
- Maintenance for three years including watering, removal of weed, litter and debris from the vicinity of the plantation.
- Ensure the protection of the tree guards provided to the saplings from trampling and browsing by the cattle.

5. GUIDELINES FOR HORTICULTURE PLANTATION AND LANDSCAPING

5.1. General

5.1.1. Scope

Contractor/Consultant to furnish all materials, labour and related items necessary to complete the work indicated on drawing and specified herein.

5.1.2. Materials

Plant Materials

- Plant Materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, sun-scaled, windburn, injuries, abrasion or disfigurement.
- All plant materials shall be healthy, sound, vigorous, free from plant diseases, insect's pests, of their eggs, and shall have healthy, well-developed root systems. All plants shall be hardy under climatic conditions similar to those in the locally of the project. Plants supplied shall confirm to the names listed on the plant list given in section 7.2.2. Besides these plant species, the Contractor/Concessionaire shall supply other species as desired by the landscaping specialist and or the environmental specialist of the consultant. Under no circumstances non-native species which might have a negative impact on the ecology of the area shall be permitted. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.
- Any nursery stock shall have been inspected and approved by the Environmental Specialist of the Consultant.
- All plants shall conform to the requirements specified in the plant list. Except that plants larger then specified may be used if approved, but use of such plants shall not increase the contract price if the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of plant. Deliver plants with legible identification labels.

Top Soil (Good Earth)

- Topsoil or good earth shall be a friable loam, typical of cultivated topsoil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth skids, sticks, roots or any other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. It shall have pH value ranging in between 6 to 8.5.

Fertiliser

- Measurement of sludge shall be in stacks, with 8% reduction for payment. It shall be free from extraneous matter, harmful bacteria insects or chemicals (Subjected to safety norms).

Root System

- The root system shall be conducive to successful transplantation. While necessary, the root-ball shall be preserved by support with Hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in such a way that the roots are not damaged.

5.1.3. Condition

Trees and shrubs shall be substantially free from pests and diseases, and shall and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions such as prolonged exposure to drying winds or subjection to water logging between lifting and delivery.

5.1.4. Supply and Substitution

Upon submission of evidence that certain materials excluding the plant Species prescribed are not available at time of contract, the Contractor/Concessionaire shall be permitted to substitute with an equitable adjustment of price. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subjected to the approval of the Environmental Specialist of the Consultant.

5.1.5. Packaging

Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

5.1.6. Marking

Each specimen of tree and shrub, or each bundle, shall be legibly labelled with the following particulars:

- Its name
- The name of the supplier, unless otherwise agreed.
- The date of dispatch from the nursery.

5.2. Plantation Pattern

The type of plantation would be based upon the requirements and the feasibility of the sites along the project corridor. The availability of the space in the RoW is a major guiding factor for landscaping. The plantation pattern to be followed is:

- The first row of plants along the highways will be of small to medium height plants planted at a spacing of 3m c/c and the distance from the second row should be 3m. The second row should be in staggered. The distance from the toe of the embankment should be 1m minimum and the height should be between 1.5m to 2m.
- Flowering shrubs shall be planted in the median in rows as per width availability. Where the width is less than 1.5m grass turfing is to be done. One row of plantation to be done at a spacing of 1.5m c/c.

For special landscaping, embankment slopes and ground cover, herbaceous species to be used. Turfing to be done by grass.

5.3. Tree Planting

5.3.1. Plants and Shrubs

Trees should be supplied with adequate protection as approved. After delivery, if planting is not to be carried out immediately, balled plants should be placed back to back and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in prepared trench and covering them with earth, which should be watered into, avoid air pockets round the roots and shrubs shall be planted with the approval of Environmental Specialist of Consultant.

5.3.2. Digging of Pits

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 120cms in diameter and 120cms deep. While digging the pits, the topsoil up to a depth of 30cms may be kept aside, if found good (depending upon site conditions), and mixed with the rest of the soil.

If the side of the below, it shall be replaced with the soil mixture as specified further herein. If the soil is

normal it shall be mixed with manure; river sand shall be added to the soil if it is heavy. The bottom of the pit shall be forked to break up the subsoil.

5.3.3. Back Filling

The soil back filled watered through end gently pressed down, a day previous to planting, to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all-round for watering.

5.3.4. Planting

No tree pits shall be dug until final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not be buried deeper than in the nursery, or in the pot. Planting should not be carried out in waterlogged soil. Plant trees at the original soil depth; soil marks on the stem is an indication of this and should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damage roots should be cut back to sound growth.

The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid on even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to shift into the root system to ensure close contact with all roots and prevent air pockets Back fill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid damaging the roots. The balance earth shall be filled in a mixture of 1:3 (1 part sludge to 3 part earth by volume) and 50gms potash, (Mop) 50gms of Super Phosphate and 1 Kg. Neem oil cake. Aldrin or equivalent shall be applied every 15 days in a mixture of 5ml in 5 litres of water.

5.3.5. Staking

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

The main methods of staking shall be:

- A single vertical shake, 900mm longer than the clear stem of the tree, driven 600mm to 900mm into the soil.
- Two stakes as above driven firmly on either side of the tree with a cross bar to which the stem is attached. Suitable for bare- rooted or Ball material.
- A single stake driven in at an angle at 45 degrees and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare- rooted or Ball material
- For plant material 3m to 4.5m high with a single stem a three- wire adjustable guy system may be used in exposed situations.

The end of stake should be pointed and the lower 1 m to 1.2m should be coated with a non-injurious wood preservative allowing at least 150mm above ground level.

5.3.6. Tying

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or Hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level: normally two ties should be used for tree. These should be adjusted or replaced to allow for growth.

5.3.7. Watering

The Contractor/Concessionaire through the Landscape Contractor should allow for the adequate watering in of all newly planted trees and shrubs immediately after planting and he shall during the following growing

season, keep the plant material well-watered

5.3.8. Fertilising

Fertilising shall be carried out by application in rotation of the following fertilisers, every 15 days from the beginning of the monsoon till the end of winter:

- Sludge or organic well-rotted dry farm yard manure: 0.05 cum or tussle.
- Urea 25gm.
- Ammonium sulphate 25gm.
- Potassium sulphate 25gm.

All shrubs, which are supplied pot grown, shall be well soaked prior to planting. Watering in and subsequent frequent watering of summer planted container- grown plants is essential.

5.4. Shrub Planting In Planter Beds

All areas to be planted with shrubs shall be excavated, trenched to a depth of 750mm, refilling the excavated earth after breaking clods and mixing with sludge in ratio 8:1 (8 parts of stacked volume of earth after reduction by 20%: 1 part of stacked volume of sludge after reduction by 8%.)

Tall shrubs may need staking, which shall be provided if approved by the Contracting-consulting engineer, depending upon the conditions of individual plant specimen. For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters.

Positions of planters shall be planted should be marked out in accordance with the Design drawings. When shrubs are set out, precautions should be taken to prevent roots drying. Planting holes 40cm diameter and 40cm deep should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level after settlement will be original soil mark on the stem of the shrub. The holes should be back filled to half of its depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

5.5. Grassing

5.5.1. Preparation

During period prior to planting, the ground shall be maintained free from weeds. Grading and preparation of the area shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the area into portions of approximately 5m squares by constructing small bunds to retain water. These 'bunds' shall be levelled just prior to sowing of grass plants; it shall be ensured that the soil has completely settled.

5.5.2. Soil

The soil itself shall be ensured to the satisfaction of Environmental Specialist Consultant to be a good fibrous loam, rich in humus.

5.5.3. Sowing the grass roots

Grass lines will be used to provide a strong surface cover and will be planted over a well prepared surface. Slope treatments using grasses will be allowed to establish properly such that the slopes are not subject to undue stress from erosion and mass movement in its initial stages. The sowing of grasses will create a strengthened surface that will reduce the vulnerability to erosion. Median with a width of 1.5 m will have only grasses to strengthen the surface. The Contractor/Concessionaire will ensure that the condition of the site is good enough for the successful establishment of grasses.

Grass roots shall be obtained from a grass patch, seen and approved beforehand. The grass roots stock

received at site shall be manually cleared of all weeds and water sprayed over the same after keeping the stock in place protected from sun and dry winds. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

5.5.4. Execution

Small roots shall be dibbled about 5cms apart into the prepared grounds. Grass will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed. The Contractor/Concessionaire through the landscape contractor shall supervise all field operations like preparation of surface, sowing of grasses and quality of grasses seeds used.

- Carry out grassing such that a cover of 25 gm of grass seed per sqm of surface is achieved.
- Carry out seed sowing before the onset of monsoon [May & June] so as to achieve the desired results. The watering of the surface will be by tankers till the onset of the monsoon.
- Ensure that a mulch of prepared and dried out herbs is laid over the whole seeded area after sowing, in a thin layer, so that the grass is not affected by direct sunlight and transpiration loss.

5.5.5. Maintenance

As soon as the grass is approximately a 3cm high it shall be rolled with a light wooden roller - in fine, dry weather - and when it has grown to 5 to 8cms, above to ground weeds must be removed and regular cutting with the scythe and rolling must be begun. A top-dressing of an ounce of guano to the square yard or well decomposed well broken sludge manure shall be applied when the grass is sufficiently secure in the ground to bear the mowing machine, the blades must be raised an inch above the normal level for the first two or three cuttings. That is to say, the grass should be cut so that it is from 4 to 5cms in length, instead of the 3cm necessary for mature grass.

In the absence of rain, in the monsoon, the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 20cms. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the Landscaping Contractor. Any shrinkage below the specified levels during the contract or defect liability period shall be rectified at the Landscaping Contractor's expense. The Landscaping Contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

5.5.6. Rolling

A light roller shall be used periodically, taking care that the area is not too wet and sodden.

5.5.7. Edging

These shall be kept neat and must be cut regularly with the edging shears.

5.5.8. Fertilising

The area shall be fed once in a month with liquid manure prepared by dissolving 45gms of ammonium sulphate in 5 litres of water.

5.5.9. Watering

Water shall be applied at least once in three days during dry weather. Watering whenever done should be thorough and should wet the soil at least up to a depth of 20cms.

5.5.10. Weeding

Prior to regular mowing the Landscaping Contractor shall carefully remove rank and unsightly weeds.

5.6. Maintenance of Plants

5.6.1. Cultivating

The Contractor/Concessionaire through the Landscaping Contractor shall maintain all planted areas within contract boundaries for one year until the area is handed over in whole or in phases. Maintenance shall include replacement of dead plants, watering, weeding, cultivating, control of insects, fungus and other diseases by means of spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for proper growth of the plants and for keeping the sub-contract area neat in appearance

5.6.2. Pruning and Repairs

Upon completion of planting work of the sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the result of the transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of trees.

5.6.3. Tree Guards and Protective Fencing

According to local environment, shrubs shall be protected adequately from vandalism until established. Where the tree guards are necessary, care should be taken to ensure that they do not impede natural movement or restrict growth. The specifications of the tree guard proposed are given below:

- The tree guards shall normally be brick in urban and bamboo guards in rural and semi urban areas. The specifications of the cement guards should be as per the relevant IS specification. In certain cases, if required by the Consultant, Circular Iron Tree Guard with Bars shall be provided. The specifications of such tree guard shall be as per relevant IS specification. The Consultant shall spell out in details about the cases where such exception shall be. In absence of any proper specification the decision of the Consultant and or NHAI shall be binding.

5.7. Nursery Stack

Planting should be carried out as soon as possible after reaching the site. Where planting must be a necessity and / or be delayed, care should be taken to protect the plants from pilfering or damage from people / animals. Plants with bare-roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting is to be delayed for more than a week, packaged plants should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

5.8. Completion

On completion, the ground shall be formed over and left tidy.

6. SPECIAL CONDITIONS AND PARTICULAR SPECIFICATIONS.

- Wherever applicable, work shall be done according to specifications in vogue, at the time of invitation of tender.
- The Plantation area should avoid the stretches within the settlement area and the Ecological Sensitive area.
- The stretches identified should be free from encumbrances and should not lead to impact on any private or community asset. No fresh land acquisition shall be made under the project for the purpose of plantation.
- Contractor/Concessionaire through the Landscaping Contractor shall make his own arrangement for drawing water from there.
- The work included in the schedule of Quantities includes grassing as well as planting of trees and shrubs. The quoted rates shall include execution of these works at different levels and nothing extra shall be paid

for any item, for working at these levels

- The Landscaping Contractor shall not be entitled to any compensation for any losses suffered by him and/or revision in the rates originally quoted by him.
    - On account unforeseen delay in commencing the work, whatever the cause of such delays is.
    - On account of reduction in the scope of work.
    - On account of suspension of work, or abandon after award of work.
- The Contractor/Concessionaire shall provide all facilities to Environmental Specialist / Project Engineer and / or his authorized representatives to make frequent inspection of their Nursery and ascertain the process / quality of various categories of trees / plants etc., grown by them.
- The quote rate shall include the cost of transportation of tools and plants to and from the site, including GST. It shall be clearly understood that no claim for any extra payment on account of GST shall be entertained after the opening of the tender.
- The safe custody and up-keep of various categories of plants brought to site is the sole responsibility of the Contractor/Concessionaire and he shall employ sufficient supervisory personnel to ensure the safety of these items.
- The site of work may be handed over to the Contractor/Concessionaire in phases, as soon as the same are available and the Contractor/Concessionaire in turn shall work in these areas forthwith. Nothing extra shall be payable for such phased execution of work.
- While excavating / executing the work the Contractor/Concessionaire shall ensure that the existing cables / pipe lines / structures / fittings are not damaged and if due to his negligence, these are damaged, the same shall be set right with no extra cost to the clients.
- The Contractor/Concessionaire shall co-ordinate his work with other agencies employed by the Clients and ensure that the works of other agencies are not hampered in any way during the duration of contract.
- The Contractor/Concessionaire shall keep the site of works neat and clean during the execution of the work. Any debris found at or near the site of work shall be moved immediately as and when so required by the Environmental Specialist / Project Engineer.
- On completion of the work, the site of work shall be thoroughly cleaned and all debris removed before the work is handed over satisfactorily.
- The Contractor/Concessionaire shall, without any additional charge to the clients, renew or replace any dead or defective plants/grass for a period of 12 months after the certified date of completion.
- "General condition of contract and standard contract Forms of shall also form part of the contract.
- All Tree saplings should be two years (2) years old before they are planted. The numbers of the plants shall be as specified in the schedule of quantities and shall be straight and symmetrical with a crown and having a persistent main stem. The size of crown shall be in good overall proportion to the height of the tree.
- Small trees and shrubs shall be well formed with the crown typical of the species or variety.

General requirements of plants

- Plants shall be typical of their species and variety, well-developed branches, and well foliated with fibrous root system. Plants shall be free from defects and injuries. Plants shall not be pruned before planting.

- Plants shall be free from defects and injuries.
- Plants shall not be freshly dug and nursery grown.
- Nursery grown plants shall have been at least once transplanted
- Bark shall be free from abrasion.
- All trees, soon after planting, shall be properly supported with bamboo stocks to ensure their safety against winds or any other factor, which may affect it adversely.

Protection of "tree to be preserved"

- The Contractor/Concessionaire through the Landscaping Contractor shall be responsible for the protection of tops, trunks and roots of existing trees on site. Existing trees subject to the construction damage shall be boxed, fenced or otherwise protected before any work is started.

General Requirements of Earth Manure and Fertilisers

- EARTH: Good earth shall be agricultural soil of loamy texture, free from kankar, morrum, shingles, rocks, stones, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 50mm in any direction. It shall have pH ranging in between 6.5 to 7.5.
- MANURE: Manure shall be of well-decayed organic matter obtained in dry state from the Municipal dump or other similar source approved by the Environmental Engineer/ Project Engineer. The manure shall be free from earth, stone or other extraneous matter. Manure shall be supplied, at site well screened.
- FERTILISER: If the soil tests indicate pH value not as per the above specification namely in between 6.5 to 7.5, following measures need to be taken.
- If pH exceeds 7.5, aluminium sulphate or equivalent fertilizer should be added at the rate of 1 kg per cubic metre to lower the pH by one full point.
- If pH is below 6.5, add ground limestone or equivalent fertilizer at the rate of 1 kg per cubic metre to raise pH by one full point.

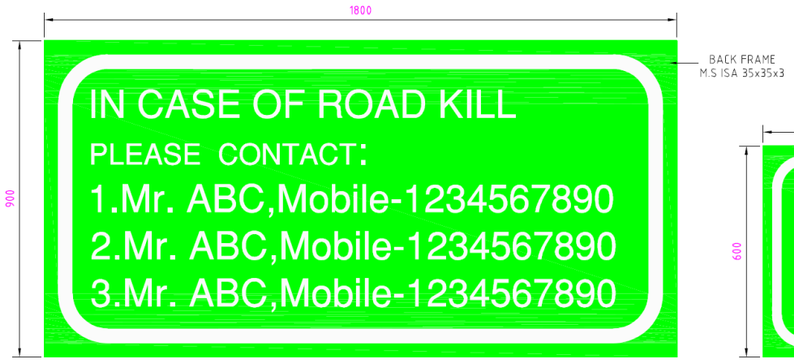
7. TEAM FOR THE ASSIGNMENT

The Contractor/Concessionaire is free to recommend a team commensurate with the requirements of the project.

8. DATA TO BE PROVIDED BY THE CLIENT

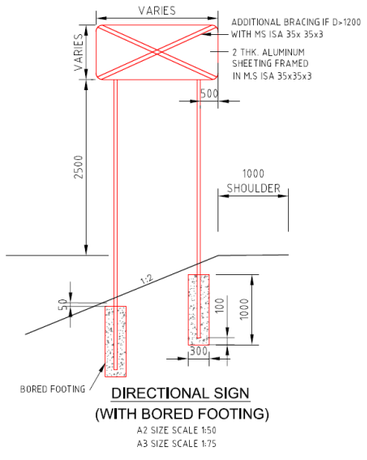
Client will provide to the Contractor/Concessionaire the map showing settlements and the forest areas

Annexure 5.8: Conceptual Drawing for Roadside Signage - Wildlife

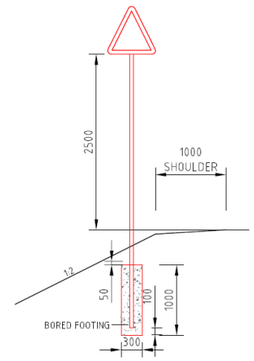


PLACE IDENTIFICATION SIGN
01

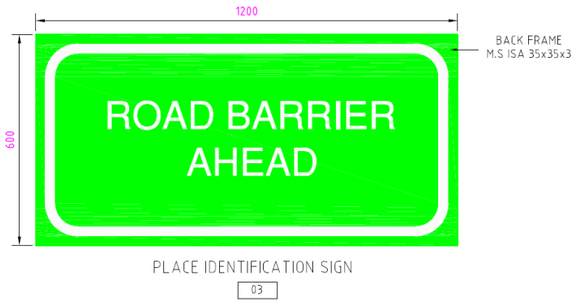
PLACE IDENTIFICATION SIGN
02



DIRECTIONAL SIGN
(WITH BORED FOOTING)
A2 SIZE SCALE 1:50
A3 SIZE SCALE 1:75



SINGLE LEAF SIGN
A2 SIZE SCALE 1:50
A3 SIZE SCALE 1:75



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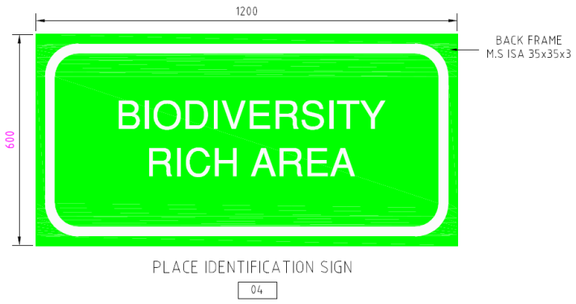

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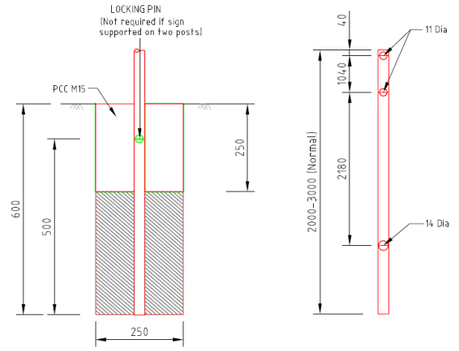
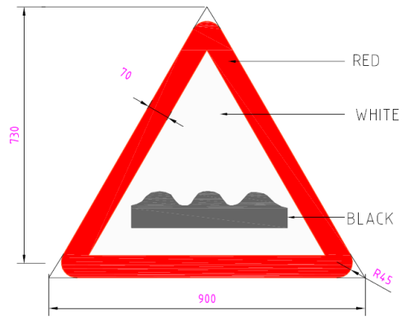
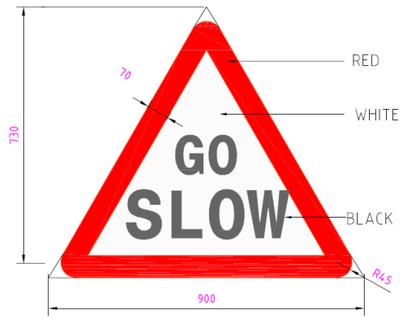


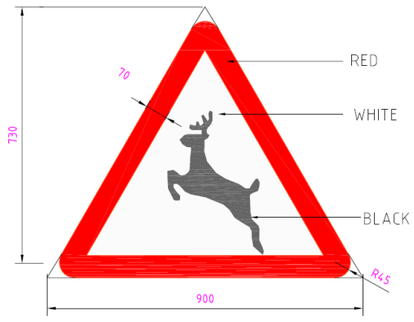
FOOTING DETAILS FOR SINGLE SIGN SUPPORT
A2 SIZE SCALE 1:10
A3 SIZE SCALE 1:15



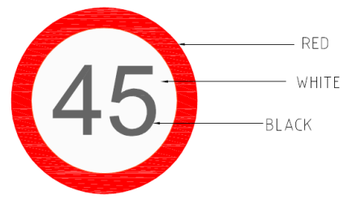
RUMBLE STRIP



GO SLOW



WILD ANIMAL



MAXIMUM SPEED LIMIT

Notes :
1. ALL THE DIMENSIONS ARE IN MILLIMETER UNLESS SPECIFIED
2. RETROREFLECTORISED SHEETING SHALL BE CONFORMING TO ASTM D-4957-2001/ (TYPE VIII AND TYPE IX).
3. SIGN SHALL BE AS PER IRC:67-2001 & IRC:30-1968

Annexure 5.9: Traffic Control and Safety during Construction

A. TRAFFIC MANAGEMENT PRACTICES

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

(i) Make traffic safety an integral and high priority element of every project
(ii) Avoid inhibiting traffic as much as possible
(iii) Guide drivers in a clear and positive way
(iv) Perform routine inspection of traffic control elements and traffic operations
(v) Give care and attention to roadside safety

B. TRAFFIC CONTROL DEVICES

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

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

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

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

C. SIGNS

The road construction and maintenance signs fall into the same three major categories as do other traffic signs, that is Regulatory Signs, Warning Signs and Direction (or Guidance) Signs. The IRC: 67 (Code of Practice for Road Signs) provides a list of traffic signs. Where possible, the size, colours and placement of sign shall conform to IRC: 67. This also covers signs that are not included in IRC: 67 but are considered desirable to aid drivers' comprehension of the route through the road works. Each sign should be well

located so that its message is seen and is clear, which will be assisted if the surroundings are devoid of "unnecessary" signs and other clutter. These signs should be of retroreflective sheets of high intensity grade or engineering grade depending upon the importance of the road as directed by the Engineer.

Annexure 5.10: Guidelines for Sitting and Layout of Construction Camp

SITING

The Contractor/Concessionaire based on the following guidelines shall identify the location of the construction site. The construction site shall be located:

- The construction camps will be located at least 500 m away from habitations at identified sites. The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the Environmental Specialist of Consultant.
- On non-agricultural lands, as far as possible
- Not within 1000m of either side of locations of Forest areas.
- All sites used for camps must be adequately drained. They must not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures.
- The camps must be located such that the drainage from and through the camps will not endanger any domestic or public water supply.
- All sites must be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance.

(B) LAYOUT

A conceptual layout of a typical construction site has been presented in Figure A. The Contractor/Concessionaire during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the engineer. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided, and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.

***Sanitation Facilities*:** Construction camps shall be provided sanitary latrines and urinals. Sewerage drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner

***Shelter at Workplace*:** At every workplace, there shall be provided free of cost, four suitable shelters, two for meals and two others for rest, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5m^2 per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The Contractor/Concessionaire shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

***First aid facilities*:** At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided.

***Health Care Facilities*:** Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staff, medicines and minimum medical facilities to tackle first-aid

requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

The health centre should have MCW (Mother and Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

***Day Crèche Facilities*:** At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the Contractor/Concessionaire shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

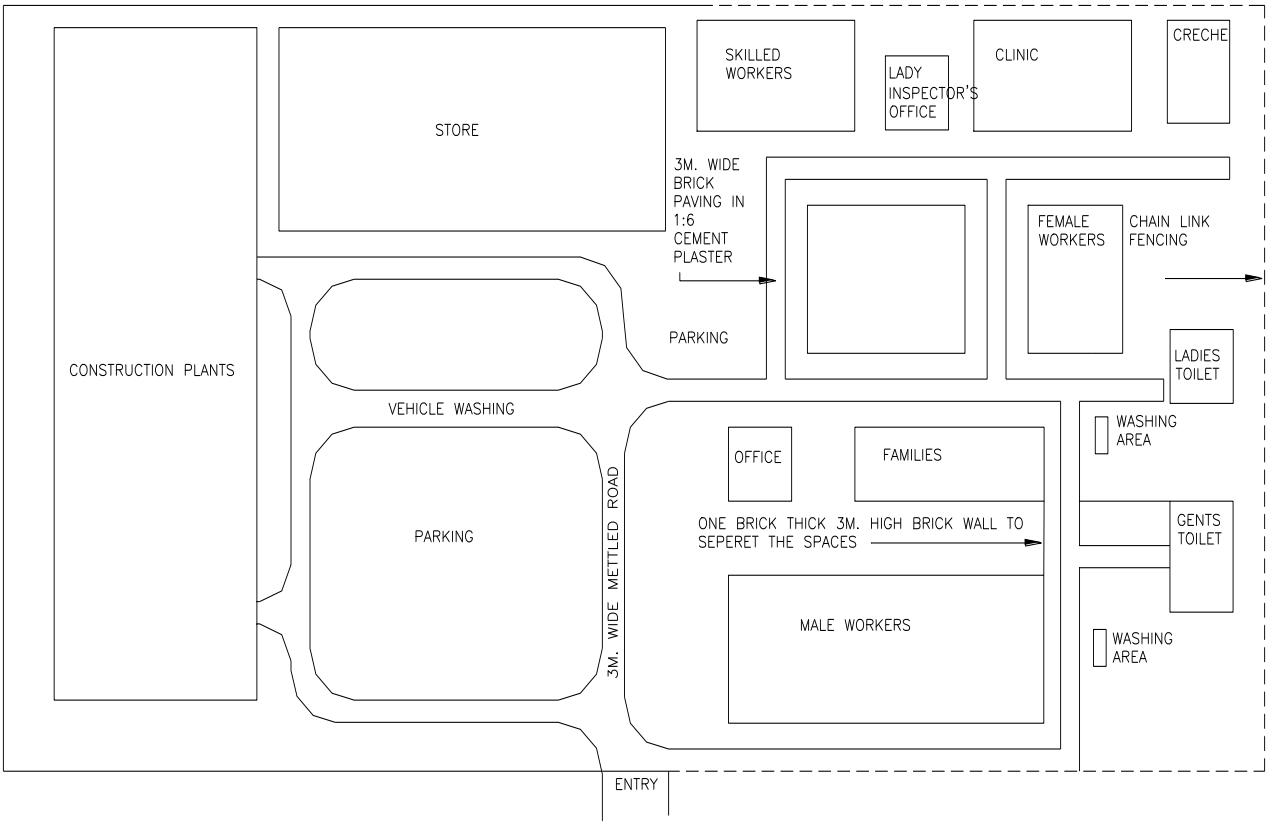


FIGURE A: TYPICAL LAYOUT OF CONSTRUCTION CAMP

Annexure 8.1: Format for Reporting of Road Kill

Date				**Time**	
Chainage (Km)-		**Village-**		**Distance from Road (m)**	
Local/ Common Name of Species		**Scientific Name (if known)**		**Sighting / Kill**	
Photographs of Road Kill					
Top View		**View from LHS**		**View from RHS**	
Signature (Contractor)		**Signature (Concessionaire)**		**Signature (AE/MC)**	

Annexure 9.1: Environmental Management Plan

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
A. Pre-construction and Design Stage									
1. Alignment									
1.1 Pavement damage and inadequate drainage provisions in habitation areas	• Pavement Construction in habitation areas considering alignment level and drainage • Raise road level above the nearby areas with provision of adequate side drains to evacuate the rain water and domestic discharges (drained by inhabitants occasionally) to prevent damage to road and rain water entry to habitation area as per IRC SP:42-1994 and 50-1999. • Existing Culverts / causeways are to be widened / upgraded / reconstructed as per the need. • Unlined drains are proposed along the road in either side Line drains are proposed at some of the locations.	Design requirement	All habitation areas, throughout the alignment	Design of both cross & side drains	Design of both side drain in urban area should be incorporated in design	Review of detail design documents & drawings	Included in construction cost	Design Consultant	NH div / AE
1.2 Safety along the proposed alignment	• Provision of Road signage and pavement marking as per IRC:67-2012. • Provision of speed regulator in habitat / sensitive areas to regulate vehicle speed • Provision of signage and other safety measure for pedestrian crossing near habitat areas, school, hospital, religious places • Provision of footpath cum drain in habitation areas • Compliance with norms specified in IRC codes for major district road for curvature	Design requirement	Accident prone areas, habitat areas and bridge area, Wild Life Movement area	No. of accident & Vehicle collision, Accidental Kill of Wild life	Provision of cautionary sign board, Speed regulator and signage in habitat and sensitive areas	Field observation, interview of locals	Included in construction cost	Design Consultant	NH div / AE
2. Natural Hazards									
2.1 Protection for damage	• Design considering relevant IRC specifications No 6-2010 for earthquakes in		Throughout the stretch	Incorporation of IRC	Incorporation of IRC	Review of bridge design	Project preparation	Design Consultant	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
from Earthquake	bridges			guidelines for earthquake in bridge design	guidelines		Cost		
2.2 Protection of Road embankment in Flood prone / water logged areas	• Improvement in existing culverts to maintain or increase their carrying capacity. • Provision of adequate drainage and cross drainage structures	IRC:34 Recommend ations for road construction in waterlogged area and IRC: 75 and MORT&H guidelines for Design of High Embankment s	All the existing culverts / bridges	Design of both cross & side drains	Design after consideration of flood hazard	Review of design	Included in construction cost	Design Consultant	NH div / AE
3. Shifting of utility structures									
3.1 Disruption of utility services to local community	• Electric poles, transformers, Hand Pump, HT Line and OFC poles are likely to be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies to allow quick shifting and restoration of utility services • Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services if any	Project requirement	Throughout the corridor	Utility shifting plan Complaints from local people Status of local utility services	Necessary approval from regulatory body with proper safety provisions	Interaction with concerned utility authorities and local public	Included in construction .	Concession aire/Contra ctor	NH div / AEAE
B. Construction Stage									
1. Air Quality									
1.1 Dust Generation due	• Transport of construction materials in covered	MORT&H Specification	Throughout project	Particulate matter	Zero complaint	Standards	Included in	Concession aire/Contra	NH div /

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
to construction activities and transport, storage and handling of construction materials	vehicles. • Storage areas to be located downwind of the habitation area • Water spraying on earthworks, unpaved haulage roads and other dust prone area. • Provision of PPEs to workers.	s for Road and Bridge works (Clause No 111) Air Act, 1981 and Central Motor and Vehicle Act, 1988	corridor	concentration measurements, Dust pollution or complaint of locals	from locals Level of pollution should not exceed the NAAQ standards	CPCB methods Observations Public consultation	project cost	ctor	AE
1.2 Emission of air pollutants (SO_2, NO_X, CO etc.) from vehicles due to traffic congestion and use of equipment and machinery	• Regular maintenance of machinery and equipment. • Batching plant, Asphalt mixing plants and crushers at downwind (1 km) direction from the nearest settlement. • Only crushers licensed by the PCB shall be used • Use of low Sulphur diesel as fuel in DG sets. • Ambient air quality monitoring • Use of PUC certified vehicles	The Air Act, 1981 and Rules 1982	Asphalt mixing plants, crushers, DG sets locations	Monitoring of ambient air quality & checking PUC certificates	Zero complaint from locals Level of pollution should not exceed the NAAQ standards	Standards CPCB methods	Included in project cost	Concession aire/Contra ctor	NH div / AE
2. Noise									
2.1 Noise from construction vehicle, equipment and machinery.	• All equipment to be timely serviced and properly maintained. • Construction equipment and machinery to be-fitted with silencers and maintained properly. • Only IS approved equipment shall be used for construction activities. • Timing of noisy construction activities shall be done during night time and weekends near schools and selected suitable times near temples when there are no visitors, • Time regulation near residential, built up and construction shall be restricted to daylight	Noise Pollution (Regulation and Control) Rules, 2000	Throughout project section especially at construction sites, residential and identified sensitive locations	Noise levels Measurement s Complaints from local people	Zero Complaints from locals Leq should not exceed as per prescribed limit	As per Noise rule, 2000 Consultation with local people	Included in Project Cost	Concession aire/Contra ctor	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	hours. • Initiation of multi layered plantation in open areas (if any) • Honking restrictions near sensitive areas • PPEs to workers • Noise monitoring as per EMP • Provision of Noise Barrier at sensitive receptors likely to experience high noise.								
3. Land and Soil									
3.1 Land use Change and Loss of productive / top soil	• Non-agricultural areas to be used as borrow areas to the extent possible (if required).	Project requirement	Throughout the project section and borrow areas	Borrow pit locations Top soil storage area	Productive land should be avoided for borrowing / construction purpose	Review borrow area plan, site visits	Included in construction cost	Concessionaire/Contractor	NH div / AE
3.2 Slope failure and Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	• Care should be taken that the slope gradient shall not be greater than 2:1. • The earth stockpiles to be provided with gentle slopes to prevent soil erosion.	IRC:56 - 1974 recommended practice for treatment of embankment slopes for erosion control	Throughout the entire project road	Occurrence of slope failure or erosion issues	Necessary provisions as per column 2 should be implemented	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/ Concessionaire	NH div / AE
3.3 Borrow area management	• Non-productive, barren lands, upland shall be used for borrowing earth with the necessary permissions/consents. • Depths of borrow pits to be regulated and sides not steeper than 25%. • Topsoil to be stockpiled and protected for use at the rehabilitation stage. • Transportation of earth materials through covered vehicles.	IRC specifications No 10-1961 on borrow areas (Environmental Protection Act and Rules, 1986;	Borrow sites location	Existence of borrow areas in inappropriate unauthorized locations. Poor borrow area management	Productive land should be avoided for borrowing purpose Borrow area should be selected as per MoRTH	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	• Borrow areas shall be leveled with salvaged material or other filling materials which do not pose contamination of soil. Else, it shall be converted into fishpond in consultation with fishery department. • Garland drain all along the Borrow area • Detailed borrow area management plan is given as Annexure 7.3.	Water Act, Air Act)		practices. Incidents of accidents. Complaints from local people.	and IRC-10, 1961 specifications				
3.4 Quarry Operations	• Aggregates will be sourced from existing licensed quarries • In case Contractor/Concessionaire decides in opening new stone quarries he shall follow the stipulated GoI norms	Clause No. 111.3 MORT&H Specifications for Road and Bridge works Guidelines	Quarry area locations	Existence of licenses for all quarry areas from which materials are being sourced	Only licensed quarry should be used	Review of design documents, contractor documents and site observation	Included in Construction cost	Contractor/ Concessionaire	NH div / AE
3.5 Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	• Construction vehicles, machinery, and equipment to be stationed in the designated RoW to avoid compaction. • Approach roads / haulage roads shall be designed along barren and hard soil area to reduce the compaction. • Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear and tear to the village/minor roads. • Land taken for construction camp and other temporary facility shall be restored to its original conditions.	Design requirement	Parking areas, Haulage roads and construction yards.	Location of approach and haulage roads Presence of destroyed / compacted agricultural land or land which has not be restored to its original condition	Ensure 3times water sprinkling on all haul roads	Site observation	Included in construction cost	Contractor/ Concessionaire	PIU NHAI / AE
3.6 Contamination of soil due to leakage /	• Construction vehicles and equipment will be maintained and refueled in such a fashion that oil / diesel spillage does not contaminate the soil. • Fuel storage and refueling sites to be kept away	Design requirement	Fueling station, construction sites, and	Quality of soil near storage area Presence of	Should ensure proper storage to achieve zero	Site observation	Included in construction cost.	Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
spillage of oil, bituminous and non - bituminous debris generated from demolition and road construction	from drainage channels. • All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. • To avoid soil contamination 3nos of Oil-Interceptors shall be provided at wash down and refueling areas. • Waste oil and oil soaked cotton/ cloth shall be stored in containers labeled 'Waste Oil' and 'Hazardous' sold off to MoEF/SPCB authorized vendors only • Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations as directed by AE, with approval of the concerned authority. • The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed		construction camps and disposal location.	spilled oil or bitumen in project area	contamination				
4. Water Resources									
4.1 Sourcing of water during Construction	• Requisite permission shall be obtained for abstraction of groundwater from Central Groundwater Authority and Surface Water from Irrigation Department and/or CWC or other concerned authorities. Extraction of Groundwater should be avoided since the project area is located in water scarce zone • Arrangements shall be made by contractor/concessionaire that the water availability and supply to nearby communities remain unaffected.	-	Throughout the project construction	Approval from competent authority Complaints from local people on water availability	No complaints from downstream users	Checking of documentatio n Discussion with local people	Included in construction cost	Contractor/ Concession aire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
4.2 Disposal of waste water	• Waste water will be disposed at suitable location. • No-runoff water will be discharged to existing pond being used for domestic and recreational purposes.	Environment Protection Act, 1986 and Water Act, 1974	Throughout the Project construction	Existence of proper drainage system for disposal of waste water	Reutilization for water sprinkling and horticulture purpose	Standards methods Site observation and review of documents	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.3 Alteration in surface water hydrology due to embankment	• Existing drainage system to be maintained and further enhanced.	Design requirement, Clause No 501.8.6. MORT&H Specifications	Near all drainage channels, river, cross drainages structures, etc.	Design of road side drains	No alteration	Review of design documents Site observation	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.4 Siltation in water bodies due to construction activities / earthwork	• Provision of 540m of Silt fencing shall be made for 6 water bodies • Earthworks and stone works to be prevented from impeding natural flow of streams and water canals or existing drainage system. • Periodic monitoring of water quality as per Environmental Monitoring Plan.	MoRT&H Specifications for Road and Bridge works and worldwide best practices	Near all water bodies, river embankment slopes.	Siltation of rivers, streams, ponds and other water bodies in project area	Ensure provision of silt fencing near water bodies to ensure zero siltation due to construction activities	Field observation	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.5 Deterioration in Surface water quality due to leakage from vehicles and equipment and waste from construction camps.	• No vehicles or equipment should be parked or refueled near water-bodies, so as to avoid contamination from fuel and lubricants. • 5 Nos of Oil-Interceptors shall be provided at wash down and refueling areas. • All chemicals and oil shall be stored away from water and concreted platform with catchment pit for spills collection. • Construction camp to be sited away from water bodies. • Wastes must be collected, stored and taken to	The Water Act, 1974 and amendments thereof.	Water bodies, refueling stations, construction camps.	Water quality of ponds, streams, rivers and other water bodies in project Presence of oil floating in water bodies	Construction camp should be 500 m away from nearest water body Zero Contamination	Conduction of water quality tests as per the monitoring plan Field observation	Included in project cost	Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	approve disposal site only. • Water quality shall be monitored periodically			in project area					
4.6 Sewage discharge from the construction camp	• Septic tank with soak pit will be provided in construction camp	The Water Act, 1974 and amendments thereof.	Construction Camp	Discharge practice of sewage	Provision of septic tank with soak pit in construction camp	Visual observation	Construction Cost	Contractor/ Concessionaire	NH div / AE
5. Flora and Fauna									
5.1 Vegetation loss due to site preparation and construction activities	• Minimize tree cutting to the extent possible. • Approx. 6922 roadside trees to be removed with prior approval of competent authority. • Compensatory plantation of 69220 at 1:10 basis as per the legal requirement • Additional avenue plantation & maintenance of 449856 trees • Regular maintenance of all trees planted. • Provision of LPG in construction camp as fuel source to avoid tree cutting, wherever possible. • Plantation of trees on both sides of the road to the extent possible. • Speed control & provision of signage for wildlife movement areas must be taken • Accidental road kill record must be documented and maintained as per the format of Annexure – 8.1 • Ponds (Ch km 87.180) slightly affected. Bridge/Flyover proposed at this location. • In the event of design changes during the construction stages additional assessments including the possibility to save trees shall be made by the Environment Expert of AE. • Road side Plantation Strategy as per IRC SP21:2009 specifications including manuring	Forest Conservation Act, 1980	Throughout project corridor	ROW width Number of trees for felling Compensatory plantation plan- Number of trees replanted	Proposer permission and compensatory afforestation as per legislation	Review of relevant documents, tree cutting permit, compensatory plantation plan Field observations	Road side & Compensatory plantation cost is included in project costs.	Contractor/ Concessionaire, Relevant agency specialized in afforestation	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
6. Construction Camps									
6.1 Impact associated with location	• All camps should maintain minimum distance from following: ➢ 500m from habitation ➢ 500m from water bodies where possible ➢ 500m from through traffic route where possible • The average distance between two camps should be 50 km	Design Requirement	All construction camps	Location of campsites and distance from habitation, forest areas, water bodies, through traffic route and other construction camps	Guidelines as mentioned in column 2 should be followed	On site observation	Included in construction cost	Contractor/ Concessionaire and AE	PIU NHAI/ AE
6.2 Worker's Health in construction camp	• The location, layout and basic facility provision of each labor camp will be submitted to CSC prior to their construction. • The contractor, no later than 30 days after the issuance of the Notice to proceed will prepare and submit a Health and Safety Plan to the Engineer (AE) for review and approval. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as approved by AE. • Adequate water and sanitary latrines with septic tanks attached to soak pits shall be provided. • Preventive medical care to be provided to workers including a First-Aid kit that must be available in the camp. • Waste disposal facilities such as dust bins must be provided in the camps and regular disposal of waste must be carried out. • No alcoholic liquor or prohibited drugs will be imported to, sell, give and barter to the workers	The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof	All construction camps	Camp health records Existence of proper first aid kit in camp site Complaints from local people	One qualified doctor supported by one compounder in each camp	Camp records Site observation	Part of the Contractors costs	Contractor/ Concessionaire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	of host community. • Awareness raising to immigrant workers / local community on communicable and sexually transmitted diseases.								
7. Management of Construction Waste / Debris									
7.1 Selection of Dumping Sites	• Unproductive / waste lands shall be selected for dumping sites. • Away from residential areas and water bodies • Public perception and consent / approval from the village Panchayats and other concerned authorities has to be obtained before finalizing the location.	Design Requirement and MORT&H guidelines	At all Dumping Sites	Location of dumping sites Public complaints	No dumping without permission from Gram Sabha / Municipal Corporation	Field survey and interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
7.2 Reuse and Disposal of construction and dismantled waste	• The existing bitumen surface shall be utilized for paving of access roads and paving works in construction sites and camps temporary traffic diversions, and haulage routes. • Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations, with approval of the concerned authority. • The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed	MORT&H guidelines	Throughout the project corridor	Percentage of reuse of existing surface material Method and location of disposal site of construction debris	Ensure Zero contamination to land, soil and water bodies	Contractor records Field observation Interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
8. Traffic Management and Safety									
8.1 Management of existing traffic and safety	• Temporary traffic diversion shall be planned by the contractor and approved by the AE. • The traffic control plans shall contain details of diversions; traffic safety arrangements during construction; safety measures for night time traffic and precautions for transportation of hazardous materials. Traffic control plans shall	Design requirement and IRC SP:55, 2001	Throughout the project corridor especially at intersections.	Traffic management plan Safety signs on site	Approved Traffic Management Plan should be in place before start of construction	Review traffic management plan Field observation of traffic management and safety	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	be prepared in line with requirements of IRC's SP 55 document'. • The Contractor/Concessionaire will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. • On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. • Restriction of construction activity to only one side of the existing road. • The contractor/concessionaire shall inform local community of changes to traffic routes, and pedestrian access arrangements with assistance from AE • Use of adequate signages to ensure traffic management and safety. Conduct of regular safety audit on safety measures.			Number of traffic accidents	activities Zero complaints from locals	system Interaction with people in vehicles usingthe road			
8.2 Pedestrians, Cattle movement	• Access to the schools, temples and other public places will be maintained when construction takes place in nearby locations.	Design requirement and IRC: SP: 27-1984 IRC:SP: 32 - 1988 Road Safety for Children (5-12 Years Old) IRC:SP:44-1994 Highway Safety Code	Near habitation on both sides of schools, temples, hospitals, graveyards, construction sites, haulage roads, diversion sites.	Road signage as per IRC guideline Complaints from local people	Ensure Road signage is in place as per IRC guideline	Field observation Interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
8.3 Safety of Workers and	• The contractor/concessionaire, no later than 30 days after the issuance of the Notice to proceed	Child Labour Act, 1986	Construction	Availability of Safety	Ensures Zero accident due	Site	Included in construction	Obligation of	PIU NHAI/

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
accident risk from construction activities	will prepare and submit a Health and Safety Plan to the Engineer (AE) for review and approval. • Contractor/Concessionaire to adopt and maintain safe working practices. • Usage of fluorescent and retro-reflectors signage, in local language at the construction sites • Training to workers on safety procedures and precautions. • Mandatory appointment of safety officer. • All regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means shall be complied with. • Provision of PPEs to workers. • Provision of a readily available first aid unit including an adequate supply of dressing materials. • The contractor will not employ any person below the age of 18 years for any work • Use of hazardous material should be minimized and/or restricted. . If used, hazardous material shall be handled as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 • Emergency plan (to be approved by engineer) shall be prepared to respond to any accidents or emergencies.	Indian Labour Laws	sites	PPEs to workers Safety signage Training records on safety Number of safety related accidents	to construction activities	observation Review records on safety training and accidents Interact with construction workers	cost	Contractor/ Concession aire	AE
8.4 Accident risk to local community	• Restrict access to construction sites to authorized personnel. • Physical separation must be provided for movement of vehicular and human traffic. • Adequate signage must be provided for safe		Construction sites	Safety signs and their location Incidents of accidents	Ensures Zero accident due to construction activities	Site inspection Consultation with local people	Included in construction cost	Contractor/ Concession aire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	traffic movement			Complaints from local people					
9. Site restoration and rehabilitation									
9.1 Clean-up Operations, Restoration and Rehabilitation	• Contractor/Concessionaire will prepare site restoration plans, which will be approved by the AE • The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. • All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used / affected by the project will be left clean and tidy, at the contractor's expense, to the satisfaction of the Environmental officer of AE. • All the opened borrow areas will be rehabilitated and CSC will certify in this regard.	Project requirement	Throughout the project corridor, construction camp sites and borrow areas	Clean and restored camp sites Presence / absence of construction material / debris after completion of construction works on construction site	NOC from respective authority / land owners	Site observation Interaction with locals Issue of completion certificate after restoration of all sites	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
C. Operation stage									
1. Air quality									
1.1 Air pollution due to vehicular movement	• Roadside tree plantations shall be maintained. • Regular maintenance of the road will be done to ensure good surface condition • Vehicular air pollution will be monitored on regular basis. • Ambient air quality monitoring as per Environmental Monitoring Plan. If monitored parameters are above the prescribed limit, suitable control measures must be taken. • Road signs shall be provided reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment.	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Throughout the Corridor	Ambient air quality (PM 2.5, PM10, CO, NOx, SO2) Survival rate of trees planted	No traffic congestion	As per CPCB requirements Site inspection	Included in Operation / Maintenance cost	PIU NHAIthrough monitoring agency	PIU NHAI /AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
2. Noise									
2.1 Noise due to movement of traffic	• Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch and speed limitation and honking restrictions may be enforced near sensitive locations. • The effectiveness of the multilayered plantation should be monitored and if needed, solid noise barrier shall be placed. • Create awareness amongst the residents about likely noise levels from road operation at different distances, the safe ambient noise limits and easy to implement noise reduction measures while constructing a building close to the road • Noise monitoring as per as per Environmental Monitoring plan • Provision of Noise Barrier at sensitive receptors likely to experience high noise	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	Sensitive receptors	Noise levels	No horn key zone near sensitive receptor	Noise monitoring as per noise rules, 2000 Discussion with people in sensitive receptor sites	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI / AE
3. Land and Soil									
3.1 Soil erosion at embankment during heavy rain fall.	• Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching near water bodies, slope management, etc. • Necessary measures to be followed wherever there are failures	Project requirement	At slopes and other probable soil erosion areas.	Existence of soil erosion sites Number of soil erosion sites	No soil erosion	On site observation	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI
4. Water resources/Flooding and Inundation									
4.1 Siltation	• Regular checks shall be made for soil erosion and turfing conditions of river • Provision of side drain on both side of the road • Regular water quality monitoring	Project requirement	Near surface Water bodies	Water quality	No siltation	Site observation	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI
4.2 Water logging due to	• Regular visual checks and cleaning of drains shall be done along the alignment to ensure that	Project requirement	Near surface	Areas with water	No water logging or	Site observation	Included in Operation /	PIU NHAI through	PIU NHAI

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
blockage of drains, culverts or streams	flow of water is maintained through cross drains and other channels / streams • Monitoring of water borne diseases due to stagnant water bodies		Water bodies	stagnation	blockage of side drains / CD structures		Maintenance cost	monitoring agency	
5. Flora									
5.1 Vegetation	• Planted trees, shrubs and grasses to be properly maintained • The tree survival audit to be conducted at least once in a year to assess the effectiveness	Forest Conservation Act, 1980	Project tree plantation sites	Minimum of 70% of tree survival	70% survival	Records and fields observations	Operation and Maintenance Cost	NHAI through monitoring agency	PIU NHAI
6. Fauna									
6.1 Wildlife	• Speed control & Condition of signage for wildlife movement areas must be monitored , checked and maintained properly • Accidental road kill record must be documented and maintained as per the format of Annexure – 8.1 • Ponds slightly affected. Flyover proposed at these locations.	Wildlife Conservation Act, 1972	Throughout project corridor & Specific stretches	Number of accidental road Kill of wildlife	Zero (0) accidental road kill of any Schedule I species	Audit/Review of efficacy of EMP, Condition of mitigation measures taken	Considered in EMP	Contractor/ Concessionaire ,	PIU NHAI/ AE
7. Maintenance of Right of Way and Safety									
6.1 Accident Risk due to uncontrolled growth of vegetation	• Efforts shall be made to make shoulder completely clear of vegetation • Regular maintenance of plantation along the roadside	Project requirement	Throughout the project route	Presence of and extent of vegetation growth on either side of road Accident data	Necessary pruning	Visual inspection Accident records	Included in operation / Maintenance cost	PIU NHAI	PIU NHAI
6.2 Accident risks associated with traffic movement.	• Traffic control measures, including speed limits, will be enforced strictly. • Further encroachment of squatters within the ROW will be prevented. • Monitor/ensure that all safety provisions included in design and construction phase are properly maintained	IRC:SP:55	Throughout the Project route	Police records on accident Condition and existence of safety signs,	Zero Accident	Review accident records Site observations	Included in Operation / Maintenance cost	PIU NHAI	PIU NHAI

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	• Tow-away facility for the break down vehicles if possible			rumble strips etc. on the road					

Annexure 9.1: Environmental Management Plan

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
A. Pre-construction and Design Stage									
1. Alignment									
1.1 Pavement damage and inadequate drainage provisions in habitation areas	• Pavement Construction in habitation areas considering alignment level and drainage • Raise road level above the nearby areas with provision of adequate side drains to evacuate the rain water and domestic discharges (drained by inhabitants occasionally) to prevent damage to road and rain water entry to habitation area as per IRC SP:42-1994 and 50-1999. • Existing Culverts / causeways are to be widened / upgraded / reconstructed as per the need. • Unlined drains are proposed along the road in either side Line drains are proposed at some of the locations.	Design requirement	All habitation areas, throughout the alignment	Design of both cross & side drains	Design of both side drain in urban area should be incorporated in design	Review of detail design documents & drawings	Included in construction cost	Design Consultant	NH div / AE
1.2 Safety along the proposed alignment	• Provision of Road signage and pavement marking as per IRC:67-2012. • Provision of speed regulator in habitat / sensitive areas to regulate vehicle speed • Provision of signage and other safety measure for pedestrian crossing near habitat areas, school, hospital, religious places • Provision of footpath cum drain in habitation areas • Compliance with norms specified in IRC codes for major district road for curvature	Design requirement	Accident prone areas, habitat areas and bridge area, Wild Life Movement area	No. of accident & Vehicle collision, Accidental Kill of Wild life	Provision of cautionary sign board, Speed regulator and signage in habitat and sensitive areas	Field observation, interview of locals	Included in construction cost	Design Consultant	NH div / AE
2. Natural Hazards									
2.1 Protection for damage	• Design considering relevant IRC specifications No 6-2010 for earthquakes in		Throughout the stretch	Incorporation of IRC	Incorporation of IRC	Review of bridge design	Project preparation	Design Consultant	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
from Earthquake	bridges			guidelines for earthquake in bridge design	guidelines		Cost		
2.2 Protection of Road embankment in Flood prone / water logged areas	• Improvement in existing culverts to maintain or increase their carrying capacity. • Provision of adequate drainage and cross drainage structures	IRC:34 Recommend ations for road construction in waterlogged area and IRC: 75 and MORT&H guidelines for Design of High Embankment s	All the existing culverts / bridges	Design of both cross & side drains	Design after consideration of flood hazard	Review of design	Included in construction cost	Design Consultant	NH div / AE
3. Shifting of utility structures									
3.1 Disruption of utility services to local community	• Electric poles, transformers, Hand Pump, HT Line and OFC poles are likely to be shifted before start of construction. Necessary permission and payments should be made to relevant utility service agencies to allow quick shifting and restoration of utility services • Local people must be informed through appropriate means about the time of shifting of utility structures and potential disruption of services if any	Project requirement	Throughout the corridor	Utility shifting plan Complaints from local people Status of local utility services	Necessary approval from regulatory body with proper safety provisions	Interaction with concerned utility authorities and local public	Included in construction .	Concession aire/Contra ctor	NH div / AEAE
B. Construction Stage									
1. Air Quality									
1.1 Dust Generation due	• Transport of construction materials in covered	MORT&H Specification	Throughout project	Particulate matter	Zero complaint	Standards	Included in	Concession aire/Contra	NH div /

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
to construction activities and transport, storage and handling of construction materials	vehicles. • Storage areas to be located downwind of the habitation area • Water spraying on earthworks, unpaved haulage roads and other dust prone area. • Provision of PPEs to workers.	s for Road and Bridge works (Clause No 111) Air Act, 1981 and Central Motor and Vehicle Act, 1988	corridor	concentration measurements, Dust pollution or complaint of locals	from locals Level of pollution should not exceed the NAAQ standards	CPCB methods Observations Public consultation	project cost	ctor	AE
1.2 Emission of air pollutants (SO_2, NO_X, CO etc.) from vehicles due to traffic congestion and use of equipment and machinery	• Regular maintenance of machinery and equipment. • Batching plant, Asphalt mixing plants and crushers at downwind (1 km) direction from the nearest settlement. • Only crushers licensed by the PCB shall be used • Use of low Sulphur diesel as fuel in DG sets. • Ambient air quality monitoring • Use of PUC certified vehicles	The Air Act, 1981 and Rules 1982	Asphalt mixing plants, crushers, DG sets locations	Monitoring of ambient air quality & checking PUC certificates	Zero complaint from locals Level of pollution should not exceed the NAAQ standards	Standards CPCB methods	Included in project cost	Concession aire/Contra ctor	NH div / AE
2. Noise									
2.1 Noise from construction vehicle, equipment and machinery.	• All equipment to be timely serviced and properly maintained. • Construction equipment and machinery to be-fitted with silencers and maintained properly. • Only IS approved equipment shall be used for construction activities. • Timing of noisy construction activities shall be done during night time and weekends near schools and selected suitable times near temples when there are no visitors, • Time regulation near residential, built up and construction shall be restricted to daylight	Noise Pollution (Regulation and Control) Rules, 2000	Throughout project section especially at construction sites, residential and identified sensitive locations	Noise levels Measurement s Complaints from local people	Zero Complaints from locals Leq should not exceed as per prescribed limit	As per Noise rule, 2000 Consultation with local people	Included in Project Cost	Concession aire/Contra ctor	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	hours. • Initiation of multi layered plantation in open areas (if any) • Honking restrictions near sensitive areas • PPEs to workers • Noise monitoring as per EMP • Provision of Noise Barrier at sensitive receptors likely to experience high noise.								
3. Land and Soil									
3.1 Land use Change and Loss of productive / top soil	• Non-agricultural areas to be used as borrow areas to the extent possible (if required).	Project requirement	Throughout the project section and borrow areas	Borrow pit locations Top soil storage area	Productive land should be avoided for borrowing / construction purpose	Review borrow area plan, site visits	Included in construction cost	Concessionaire/Contractor	NH div / AE
3.2 Slope failure and Soil erosion due to Construction activities, earthwork, and cut and fill, stockpiles etc.	• Care should be taken that the slope gradient shall not be greater than 2:1. • The earth stockpiles to be provided with gentle slopes to prevent soil erosion.	IRC:56 - 1974 recommended practice for treatment of embankment slopes for erosion control	Throughout the entire project road	Occurrence of slope failure or erosion issues	Necessary provisions as per column 2 should be implemented	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/ Concessionaire	NH div / AE
3.3 Borrow area management	• Non-productive, barren lands, upland shall be used for borrowing earth with the necessary permissions/consents. • Depths of borrow pits to be regulated and sides not steeper than 25%. • Topsoil to be stockpiled and protected for use at the rehabilitation stage. • Transportation of earth materials through covered vehicles.	IRC specifications No 10-1961 on borrow areas (Environmental Protection Act and Rules, 1986;	Borrow sites location	Existence of borrow areas in inappropriate unauthorized locations. Poor borrow area management	Productive land should be avoided for borrowing purpose Borrow area should be selected as per MoRTH	Review of design documents and site observation	Included in Construction cost	Design consultant and Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	• Borrow areas shall be leveled with salvaged material or other filling materials which do not pose contamination of soil. Else, it shall be converted into fishpond in consultation with fishery department. • Garland drain all along the Borrow area • Detailed borrow area management plan is given as Annexure 7.3.	Water Act, Air Act)		practices. Incidents of accidents. Complaints from local people.	and IRC-10, 1961 specifications				
3.4 Quarry Operations	• Aggregates will be sourced from existing licensed quarries • In case Contractor/Concessionaire decides in opening new stone quarries he shall follow the stipulated GoI norms	Clause No. 111.3 MORT&H Specifications for Road and Bridge works Guidelines	Quarry area locations	Existence of licenses for all quarry areas from which materials are being sourced	Only licensed quarry should be used	Review of design documents, contractor documents and site observation	Included in Construction cost	Contractor/ Concessionaire	NH div / AE
3.5 Compaction of soil and impact on quarry haul roads due to movement of vehicles and equipment	• Construction vehicles, machinery, and equipment to be stationed in the designated RoW to avoid compaction. • Approach roads / haulage roads shall be designed along barren and hard soil area to reduce the compaction. • Transportation of quarry material to the dumping site through heavy vehicles shall be done through existing major roads to the extent possible to restrict wear and tear to the village/minor roads. • Land taken for construction camp and other temporary facility shall be restored to its original conditions.	Design requirement	Parking areas, Haulage roads and construction yards.	Location of approach and haulage roads Presence of destroyed / compacted agricultural land or land which has not be restored to its original condition	Ensure 3times water sprinkling on all haul roads	Site observation	Included in construction cost	Contractor/ Concessionaire	PIU NHAI / AE
3.6 Contamination of soil due to leakage /	• Construction vehicles and equipment will be maintained and refueled in such a fashion that oil / diesel spillage does not contaminate the soil. • Fuel storage and refueling sites to be kept away	Design requirement	Fueling station, construction sites, and	Quality of soil near storage area Presence of	Should ensure proper storage to achieve zero	Site observation	Included in construction cost.	Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
spillage of oil, bituminous and non - bituminous debris generated from demolition and road construction	from drainage channels. • All excavated materials from roadway, shoulders, verges, drains, cross drainage will be used for backfilling embankments, filling pits, and landscaping. • To avoid soil contamination 3nos of Oil-Interceptors shall be provided at wash down and refueling areas. • Waste oil and oil soaked cotton/ cloth shall be stored in containers labeled 'Waste Oil' and 'Hazardous' sold off to MoEF/SPCB authorized vendors only • Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations as directed by AE, with approval of the concerned authority. • The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed		construction camps and disposal location.	spilled oil or bitumen in project area	contamination				
4. Water Resources									
4.1 Sourcing of water during Construction	• Requisite permission shall be obtained for abstraction of groundwater from Central Groundwater Authority and Surface Water from Irrigation Department and/or CWC or other concerned authorities. Extraction of Groundwater should be avoided since the project area is located in water scarce zone • Arrangements shall be made by contractor/concessionaire that the water availability and supply to nearby communities remain unaffected.	-	Throughout the project construction	Approval from competent authority Complaints from local people on water availability	No complaints from downstream users	Checking of documentatio n Discussion with local people	Included in construction cost	Contractor/ Concession aire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
4.2 Disposal of waste water	• Waste water will be disposed at suitable location. • No-runoff water will be discharged to existing pond being used for domestic and recreational purposes.	Environment Protection Act, 1986 and Water Act, 1974	Throughout the Project construction	Existence of proper drainage system for disposal of waste water	Reutilization for water sprinkling and horticulture purpose	Standards methods Site observation and review of documents	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.3 Alteration in surface water hydrology due to embankment	• Existing drainage system to be maintained and further enhanced.	Design requirement, Clause No 501.8.6. MORT&H Specifications	Near all drainage channels, river, cross drainages structures, etc.	Design of road side drains	No alteration	Review of design documents Site observation	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.4 Siltation in water bodies due to construction activities / earthwork	• Provision of 540m of Silt fencing shall be made for 6 water bodies • Earthworks and stone works to be prevented from impeding natural flow of streams and water canals or existing drainage system. • Periodic monitoring of water quality as per Environmental Monitoring Plan.	MoRT&H Specifications for Road and Bridge works and worldwide best practices	Near all water bodies, river embankment slopes.	Siltation of rivers, streams, ponds and other water bodies in project area	Ensure provision of silt fencing near water bodies to ensure zero siltation due to construction activities	Field observation	Included in construction cost	Contractor/ Concessionaire	NH div / AE
4.5 Deterioration in Surface water quality due to leakage from vehicles and equipment and waste from construction camps.	• No vehicles or equipment should be parked or refueled near water-bodies, so as to avoid contamination from fuel and lubricants. • 5 Nos of Oil-Interceptors shall be provided at wash down and refueling areas. • All chemicals and oil shall be stored away from water and concreted platform with catchment pit for spills collection. • Construction camp to be sited away from water bodies. • Wastes must be collected, stored and taken to	The Water Act, 1974 and amendments thereof.	Water bodies, refueling stations, construction camps.	Water quality of ponds, streams, rivers and other water bodies in project Presence of oil floating in water bodies	Construction camp should be 500 m away from nearest water body Zero Contamination	Conduction of water quality tests as per the monitoring plan Field observation	Included in project cost	Contractor/ Concessionaire	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	approve disposal site only. • Water quality shall be monitored periodically			in project area					
4.6 Sewage discharge from the construction camp	• Septic tank with soak pit will be provided in construction camp	The Water Act, 1974 and amendments thereof.	Construction Camp	Discharge practice of sewage	Provision of septic tank with soak pit in construction camp	Visual observation	Construction Cost	Contractor/ Concessionaire	NH div / AE
5. Flora and Fauna									
5.1 Vegetation loss due to site preparation and construction activities	• Minimize tree cutting to the extent possible. • Approx. 6922 roadside trees to be removed with prior approval of competent authority. • Compensatory plantation of 69220 at 1:10 basis as per the legal requirement • Additional avenue plantation & maintenance of 449856 trees • Regular maintenance of all trees planted. • Provision of LPG in construction camp as fuel source to avoid tree cutting, wherever possible. • Plantation of trees on both sides of the road to the extent possible. • Speed control & provision of signage for wildlife movement areas must be taken • Accidental road kill record must be documented and maintained as per the format of Annexure – 8.1 • Ponds (Ch km 87.180) slightly affected. Bridge/Flyover proposed at this location. • In the event of design changes during the construction stages additional assessments including the possibility to save trees shall be made by the Environment Expert of AE. • Road side Plantation Strategy as per IRC SP21:2009 specifications including manuring	Forest Conservation Act, 1980	Throughout project corridor	ROW width Number of trees for felling Compensatory plantation plan- Number of trees replanted	Proposer permission and compensatory afforestation as per legislation	Review of relevant documents, tree cutting permit, compensatory plantation plan Field observations	Road side & Compensatory plantation cost is included in project costs.	Contractor/ Concessionaire, Relevant agency specialized in afforestation	NH div / AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
6. Construction Camps									
6.1 Impact associated with location	• All camps should maintain minimum distance from following: ➢ 500m from habitation ➢ 500m from water bodies where possible ➢ 500m from through traffic route where possible • The average distance between two camps should be 50 km	Design Requirement	All construction camps	Location of campsites and distance from habitation, forest areas, water bodies, through traffic route and other construction camps	Guidelines as mentioned in column 2 should be followed	On site observation	Included in construction cost	Contractor/ Concessionaire and AE	PIU NHAI/ AE
6.2 Worker's Health in construction camp	• The location, layout and basic facility provision of each labor camp will be submitted to CSC prior to their construction. • The contractor, no later than 30 days after the issuance of the Notice to proceed will prepare and submit a Health and Safety Plan to the Engineer (AE) for review and approval. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner as approved by AE. • Adequate water and sanitary latrines with septic tanks attached to soak pits shall be provided. • Preventive medical care to be provided to workers including a First-Aid kit that must be available in the camp. • Waste disposal facilities such as dust bins must be provided in the camps and regular disposal of waste must be carried out. • No alcoholic liquor or prohibited drugs will be imported to, sell, give and barter to the workers	The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and The Water (Prevention and Control of Pollution) Act, 1974 and amendments thereof	All construction camps	Camp health records Existence of proper first aid kit in camp site Complaints from local people	One qualified doctor supported by one compounder in each camp	Camp records Site observation	Part of the Contractors costs	Contractor/ Concessionaire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	of host community. • Awareness raising to immigrant workers / local community on communicable and sexually transmitted diseases.								
7. Management of Construction Waste / Debris									
7.1 Selection of Dumping Sites	• Unproductive / waste lands shall be selected for dumping sites. • Away from residential areas and water bodies • Public perception and consent / approval from the village Panchayats and other concerned authorities has to be obtained before finalizing the location.	Design Requirement and MORT&H guidelines	At all Dumping Sites	Location of dumping sites Public complaints	No dumping without permission from Gram Sabha / Municipal Corporation	Field survey and interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
7.2 Reuse and Disposal of construction and dismantled waste	• The existing bitumen surface shall be utilized for paving of access roads and paving works in construction sites and camps temporary traffic diversions, and haulage routes. • Unusable and non-bituminous debris materials should be suitably disposed of in an environmentally acceptable manner at pre-designated disposal locations, with approval of the concerned authority. • The bituminous wastes shall be disposed in secure landfill sites only in environmentally accepted manner. For removal of debris, wastes and its disposal MoRTH guidelines should be followed	MORT&H guidelines	Throughout the project corridor	Percentage of reuse of existing surface material Method and location of disposal site of construction debris	Ensure Zero contamination to land, soil and water bodies	Contractor records Field observation Interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
8. Traffic Management and Safety									
8.1 Management of existing traffic and safety	• Temporary traffic diversion shall be planned by the contractor and approved by the AE. • The traffic control plans shall contain details of diversions; traffic safety arrangements during construction; safety measures for night time traffic and precautions for transportation of hazardous materials. Traffic control plans shall	Design requirement and IRC SP:55, 2001	Throughout the project corridor especially at intersections.	Traffic management plan Safety signs on site	Approved Traffic Management Plan should be in place before start of construction	Review traffic management plan Field observation of traffic management and safety	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
	be prepared in line with requirements of IRC's SP 55 document'. • The Contractor/Concessionaire will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. • On stretches where it is not possible to pass the traffic on the part width of existing carriageway, temporary paved diversions will be constructed. • Restriction of construction activity to only one side of the existing road. • The contractor/concessionaire shall inform local community of changes to traffic routes, and pedestrian access arrangements with assistance from AE • Use of adequate signages to ensure traffic management and safety. Conduct of regular safety audit on safety measures.			Number of traffic accidents	activities Zero complaints from locals	system Interaction with people in vehicles usingthe road			
8.2 Pedestrians, Cattle movement	• Access to the schools, temples and other public places will be maintained when construction takes place in nearby locations.	Design requirement and IRC: SP: 27-1984 IRC:SP: 32 - 1988 Road Safety for Children (5-12 Years Old) IRC:SP:44-1994 Highway Safety Code	Near habitation on both sides of schools, temples, hospitals, graveyards, construction sites, haulage roads, diversion sites.	Road signage as per IRC guideline Complaints from local people	Ensure Road signage is in place as per IRC guideline	Field observation Interaction with local people	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
8.3 Safety of Workers and	• The contractor/concessionaire, no later than 30 days after the issuance of the Notice to proceed	Child Labour Act, 1986	Construction	Availability of Safety	Ensures Zero accident due	Site	Included in construction	Obligation of	PIU NHAI/

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
accident risk from construction activities	will prepare and submit a Health and Safety Plan to the Engineer (AE) for review and approval. • Contractor/Concessionaire to adopt and maintain safe working practices. • Usage of fluorescent and retro-reflectors signage, in local language at the construction sites • Training to workers on safety procedures and precautions. • Mandatory appointment of safety officer. • All regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means shall be complied with. • Provision of PPEs to workers. • Provision of a readily available first aid unit including an adequate supply of dressing materials. • The contractor will not employ any person below the age of 18 years for any work • Use of hazardous material should be minimized and/or restricted. . If used, hazardous material shall be handled as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 • Emergency plan (to be approved by engineer) shall be prepared to respond to any accidents or emergencies.	Indian Labour Laws	sites	PPEs to workers Safety signage Training records on safety Number of safety related accidents	to construction activities	observation Review records on safety training and accidents Interact with construction workers	cost	Contractor/ Concession aire	AE
8.4 Accident risk to local community	• Restrict access to construction sites to authorized personnel. • Physical separation must be provided for movement of vehicular and human traffic. • Adequate signage must be provided for safe		Construction sites	Safety signs and their location Incidents of accidents	Ensures Zero accident due to construction activities	Site inspection Consultation with local people	Included in construction cost	Contractor/ Concession aire	PIU NHAI/ AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	traffic movement			Complaints from local people					
9. Site restoration and rehabilitation									
9.1 Clean-up Operations, Restoration and Rehabilitation	• Contractor/Concessionaire will prepare site restoration plans, which will be approved by the AE • The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. • All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used / affected by the project will be left clean and tidy, at the contractor's expense, to the satisfaction of the Environmental officer of AE. • All the opened borrow areas will be rehabilitated and CSC will certify in this regard.	Project requirement	Throughout the project corridor, construction camp sites and borrow areas	Clean and restored camp sites Presence / absence of construction material / debris after completion of construction works on construction site	NOC from respective authority / land owners	Site observation Interaction with locals Issue of completion certificate after restoration of all sites	Included in construction cost.	Contractor/ Concessionaire	PIU NHAI/ AE
C. Operation stage									
1. Air quality									
1.1 Air pollution due to vehicular movement	• Roadside tree plantations shall be maintained. • Regular maintenance of the road will be done to ensure good surface condition • Vehicular air pollution will be monitored on regular basis. • Ambient air quality monitoring as per Environmental Monitoring Plan. If monitored parameters are above the prescribed limit, suitable control measures must be taken. • Road signs shall be provided reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment.	Environmental Protection Act, 1986; The Air (Prevention and Control of Pollution) Act, 1981	Throughout the Corridor	Ambient air quality (PM 2.5, PM10, CO, NOx, SO2) Survival rate of trees planted	No traffic congestion	As per CPCB requirements Site inspection	Included in Operation / Maintenance cost	PIU NHAIthrough monitoring agency	PIU NHAI /AE

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
2. Noise									
2.1 Noise due to movement of traffic	• Effective traffic management and good riding conditions shall be maintained to reduce the noise level throughout the stretch and speed limitation and honking restrictions may be enforced near sensitive locations. • The effectiveness of the multilayered plantation should be monitored and if needed, solid noise barrier shall be placed. • Create awareness amongst the residents about likely noise levels from road operation at different distances, the safe ambient noise limits and easy to implement noise reduction measures while constructing a building close to the road • Noise monitoring as per as per Environmental Monitoring plan • Provision of Noise Barrier at sensitive receptors likely to experience high noise	Noise Pollution (Regulation and Control) Rules, 2000 and amendments thereof	Sensitive receptors	Noise levels	No horn key zone near sensitive receptor	Noise monitoring as per noise rules, 2000 Discussion with people in sensitive receptor sites	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI / AE
3. Land and Soil									
3.1 Soil erosion at embankment during heavy rain fall.	• Periodic checking to be carried to assess the effectiveness of the stabilization measures viz. turfing, stone pitching near water bodies, slope management, etc. • Necessary measures to be followed wherever there are failures	Project requirement	At slopes and other probable soil erosion areas.	Existence of soil erosion sites Number of soil erosion sites	No soil erosion	On site observation	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI
4. Water resources/Flooding and Inundation									
4.1 Siltation	• Regular checks shall be made for soil erosion and turfing conditions of river • Provision of side drain on both side of the road • Regular water quality monitoring	Project requirement	Near surface Water bodies	Water quality	No siltation	Site observation	Included in Operation / Maintenance cost	PIU NHAI through monitoring agency	PIU NHAI
4.2 Water logging due to	• Regular visual checks and cleaning of drains shall be done along the alignment to ensure that	Project requirement	Near surface	Areas with water	No water logging or	Site observation	Included in Operation /	PIU NHAI through	PIU NHAI

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement-ation	Supervi-sion
blockage of drains, culverts or streams	flow of water is maintained through cross drains and other channels / streams • Monitoring of water borne diseases due to stagnant water bodies		Water bodies	stagnation	blockage of side drains / CD structures		Maintenance cost	monitoring agency	
5. Flora									
5.1 Vegetation	• Planted trees, shrubs and grasses to be properly maintained • The tree survival audit to be conducted at least once in a year to assess the effectiveness	Forest Conservation Act, 1980	Project tree plantation sites	Minimum of 70% of tree survival	70% survival	Records and fields observations	Operation and Maintenance Cost	NHAI through monitoring agency	PIU NHAI
6. Fauna									
6.1 Wildlife	• Speed control & Condition of signage for wildlife movement areas must be monitored , checked and maintained properly • Accidental road kill record must be documented and maintained as per the format of Annexure – 8.1 • Ponds slightly affected. Flyover proposed at these locations.	Wildlife Conservation Act, 1972	Throughout project corridor & Specific stretches	Number of accidental road Kill of wildlife	Zero (0) accidental road kill of any Schedule I species	Audit/Review of efficacy of EMP, Condition of mitigation measures taken	Considered in EMP	Contractor/ Concessionaire ,	PIU NHAI/ AE
7. Maintenance of Right of Way and Safety									
6.1 Accident Risk due to uncontrolled growth of vegetation	• Efforts shall be made to make shoulder completely clear of vegetation • Regular maintenance of plantation along the roadside	Project requirement	Throughout the project route	Presence of and extent of vegetation growth on either side of road Accident data	Necessary pruning	Visual inspection Accident records	Included in operation / Maintenance cost	PIU NHAI	PIU NHAI
6.2 Accident risks associated with traffic movement.	• Traffic control measures, including speed limits, will be enforced strictly. • Further encroachment of squatters within the ROW will be prevented. • Monitor/ensure that all safety provisions included in design and construction phase are properly maintained	IRC:SP:55	Throughout the Project route	Police records on accident Condition and existence of safety signs,	Zero Accident	Review accident records Site observations	Included in Operation / Maintenance cost	PIU NHAI	PIU NHAI

Environmental Issue / Component	Remedial Measure	Reference to laws / guidelines	Location	Monitoring indicators	Target	Monitoring Methods	Mitigation Costs	Institutional Responsibility	
								Implement -ation	Supervi -sion
	• Tow-away facility for the break down vehicles if possible			rumble strips etc. on the road					

Annexure 9.2: Environmental Standards & Environmental Monitoring Plan

Monitoring Parameters and Standards

The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:

1.1 Ambient Air Quality Monitoring (AAQM)

The air quality parameters as per CPCB standard procedure and further recommendation of the World Bank as per direction of Environment Specialist of IE shall be regularly monitored at identified locations from the initiation of the project just after award of job to concessionaire. Ambient air quality shall be monitored in accordance with the National Ambient Air Quality Standards as given in Table 1.

The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 1: National Ambient Air Quality Standards

Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
1	Sulphur Dioxide (SO_2) µg/m^3	Annual*	50	20	- Improved West & Gaeke - Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO_2) µg/m^3	Annual*	40	30	- Modified Jacob and Hochheiser (Na-Arsenite) - Chemilumiscence
		24 hours**	80	80	
3	Particulate Matter (size less than 10 µm) or PM_{10} µg/m^3	Annual*	60	60	- Gravimetric - TOEM - Beta attenuation
		24 hours**	100	100	
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual*	40	40	- Gravimetric - TOEM - Beta attenuation
		24 hours**	60	60	
5	Ozone (O_3)µg/m^3	8 hours**	100	100	- UV photometric - Chemilumiscence - Chemical Method
		1 hours**	180	180	
6	Lead (Pb) µg/m^3	Annual*	0.50	0.50	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) (mg/m^3)	8 hours**	02	02	- Non Dispersive Infra-Red (NDIR) spectroscopy
		1 hours**	04	04	
8	Ammonia (NH_3) µg/m^3	Annual*	100	100	- Chemilumiscence - Indophenol Blue Method
		24 hours**	400	400	
9	Benzene ($C_6H_{6)}$ µg/m^3	Annual*	05	05	- Gas chromatography based continuous analyser - Adsorption and Desorption followed by GC analysis
10	Benzo(a) Pyrene Particulate Phase only ng/m^3	Annual*	01	01	- Solvent Extraction followed by HPLC/GC analysis
11	As ng/m^3	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Ni ng/m^3	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

** Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.*

*** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.*

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or monitoring and further investigation.

Source: MoEF Notification dated 16th November, 2009

1.2 Noise Quality Monitoring

The noise levels shall be monitored at already designated locations in accordance with the Ambient Noise Quality standards given in Table 2 below. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table 5.

Table 2: National Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Note: (1) Day time shall mean from 6.00 a.m. to 10.00 p.m. (2) Night time shall mean from 10.00 p.m. to 6.00 a.m. (3) Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority (4) Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

1.3 Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, coliform count, total suspended solids, total dissolved solids, Iron, Fluorides etc. shall be monitored at all identified locations from initiation of the project just after award of job to concessionaire as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications IS 10500:2012, presented in Table 3 & 4 respectively. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan.

Table 3: Primary Water Quality Standards

S. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	Total Coliform MPN/100 ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 2 mg/l or less
2	Outdoor bathing (organised)	B	Total Coliform MPN/100 ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/1 or less
3	Drinking Water source (without conventional treatment)	C	Total Coliform MPN/100 ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg / l or more Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/1 or less
4	Propagation of Wildlife	D	pH between 6.5 to 8.5 for fisheries Dissolved Oxygen 4 mg / l or more Free Ammonia (as N) 1.2 mg/l or less
5	Irrigation, Industrial Cooling, Controlled Waste	E	pH between 6.0 to 8.5 Electrical Conductivity at 25°C µmhos/cm Max. 2250 Sodium absorption rations Max. 26 Boron, Max.2 mg/l

Ref: CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

Table 4: Indian Standard Drinking Water Specifications: IS 10500:2012

S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	15	IS 3025 (Part 4)	Extended to 15 only if toxic substances, in absence of alternate sources.
2	Odour	Agreeable	-	Agreeable	IS 3025 (Part 5)	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	Agreeable	IS 3025 (Part 7 & 8)	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	1	Above 5, consumer acceptance decreases	5	3025 (Part 10): 1984	
5	PH value	6.5 to 8.5	Beyond this range the water will not affect the mucous membrane and /or water supply system	No relaxation	IS 3025 (Part 11)	
6	Total hardness (as $CaCO_3$) mg/1, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	IS 3025 (Part 21)	
7	Iron (as Fe) mg /l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	No relaxation	IS 3025 (Part 53)	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
8	Chlorides (as Cl) mg/1 Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	IS 3025 (Part 32)	
9	Residual, free chloride, mg/1 Min.	0.2		1	IS 3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min. 0.5 mg/1
Desirable characteristics						
1	Dissolved solids mg/1 Max.	500	Beyond the palatability decreases and may cause gastro intestinal irritation	2000	IS 3025 (Part 16)	
2	Calcium (as Ca) mg/1 Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	IS 3025 (Part 40)	
3	Magnesium (as Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	100	IS 3025 (Part 46)	

S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
4	Copper (as Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	1.5	IS 3025 (Part 42)	
5	Manganese (as Mn) mg/1, Max.	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	IS 3025 (Part 59)	
6	Sulphate (as 200 So2), mg/1, Max.	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	IS 3025 (Part 24)	May be extended up to 400 provided (as Mg) does not exceed 30
7	Nitrate (as No2) mg/l, Max.	45	Beyond this methaemoglobinemia take place	No relaxation	IS 3025 (Part 34)	To be tested when pollution is suspected
8	Fluoride (as F) mg/1, Max.	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	IS 3025 (Part 60)	To be tested when pollution is suspected
9	Phenolic compounds (as C6H5OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	IS 3025 (Part 43)	To be tested when pollution is suspected
10	Mercury (as Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 48)	To be tested when pollution is suspected
11	Cadmium (as cd), mg/1, Max.	0.003	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 41)	To be tested when pollution is suspected
12	Selenium, (as Se). mg/l, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 56)	To be tested when pollution is suspected
13	Arsenic (As) mg/1, Max.	0.01	Beyond this the water becomes toxic	0.05	IS 3025 (Part 37)	To be tested when pollution is suspected
14	Cyanide (as CN) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 27)	To be tested when pollution is suspected
15	Lead (as Pb), mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	IS 3025 (Part 47)	To be tested when pollution is suspected
16	Zinc (as Zn) mg/1, Max.	5	Beyond this limit it can cause astringent taste and an opalescence taste and an opalescence in water	15	IS 3025 (Part 49)	To be tested when pollution is suspected
17	Anionic detergents (as MBAS) mg/1, Max.	0.2	Beyond this it can cause a light froth in water	1	Annex K of IS 13428	To be tested when pollution is suspected
18	Chromium (as Cr6+) mg/1, Max.	0.05	May be carcinogenic above this limit	No relaxation	IS 3025 (Part 52)	To be tested when pollution is suspected
19	Poly nuclear aromatic hydra carbons (as PAH) mg/1, Max.	0.0001	May be carcinogenic above this limit	No relaxation	APHA 6440	-
20	Mineral oil mg/1, Max.	0.5	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	IS 3025 (Part 39)	-
21	Pesticides mg/1, Max.	-	Toxic	-	-	-

S. No.	Substance / Characteristics	Requirement (acceptable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
22	Radioactive material	-	-	-	IS 14194	-
23	Alpha emitters bq/1, Max.	0.1	-	No Relaxation	-	-
24	Beta emitter pci/1, Max.	1.0	-	No Relaxation	-	-
25	Total alkalinity (as $CaCO_3$), mg/l, max	200	Beyond this limit taste becomes unpleasant	600	IS 3025 (Part 23)	-
26	Aluminium (as Al) mg/1, Max.	0.03	Cumulate effect is reported to cause dementia	0.2	IS 3025 (Part 55)	-
27	Boron mg/1, Max.	0.5	-	1.0	IS 3025 (Part 57)	-

Source: Indian Standard Drinking Water Specification – IS 10500:2012

Environmental Monitoring Plan

The environmental monitoring plan is given below in table 5.

Table 1: Environmental Monitoring Plan

Environmental Components	Monitoring			Location	Frequency	InstitutionalResponsibility	
	Parameters	SpecialGuidance	Standards			Implementation	Supervision
Air	PM2.5, PM10, SO_2, NO_X, CO	As per CPCB guidelines	The Air (Prevention and Control of Pollution) Rules, CPCB,1982	At hot mix plant, batching plant, sensitive areas and chainage as directed by Environment Specialist of Monitoring / Supervision Consultant	3 Locations twice in month for three seasons in a year for 3 years for construction period and 3 locations once in a season for three seasons in one year x for 10 years during operation period	Contractor / Concessionaire through NABL / MOEF&CC approved monitoring agency	NHAI, MC
Water	pH, BOD, COD, TDS, TSS, DO, Total coliform, Conductivity, Oil & Grease other Baseline Parameters	Grab sample collected from source and analyze as per standard methods for examination of water and wastewater	Water quality standards by CPCB	River tributaries, roadside ponds and ground water at construction campsites and chainages as directed by Environment Specialist of Monitoring Consultant	3 Locations once in a season for 2 seasons (pre & Post Monsoon) in a year for 3 years for construction period and 3 Locations once in a year for 2 season (pre & Post Monsoon) in every alternate year for 10 years for operation period	Contractor / Concessionaire through NABL / MOEF&CC approved monitoring agency	NHAI, MC
Noise Levels	Noise level for day and night on dB(A)scale	In free field at1m distance from the equipment to be monitored	Noise standard by CPCB	At equipment yards, camp and villages along the alignment and chainages as directed by Environment Specialist of Monitoring Consultant	3 Locations two times in a year for 3 years for construction period and 3 Locations twice in year for 10 years	Contractor / Concessionaire through NABL / MOEF&CC approved monitoring agency	NHAI, MC
Soil quality	Monitoring of NPK &heavy metals, grease and other Baseline Parameters		ICAR Criteria of Soil Quality	Sensitive Landuse and chainages as directed by Environment Specialist of Monitoring Consultant	3 Locations twice in a year for 3 years for construction period and 3 Locations once in every year for 10 years for operation period	Contractor / Concessionaire through NABL / MOEF&CC approved monitoring agency	NHAI, MC
Road side plantation	Monitoring of felling of trees	It should be ensured That the marked trees are felled only	As given in the EIA report	All along the corridor	During the felling of trees	Forest department	NHAI, MC
	Survival rate of trees, success of re- vegetation	The number of trees surviving during each visit should be compared with the number of saplings planted	The survival rate should be at- least 75% below which re-plantation should be done	At locations of compensatory afforestation	For 3 years after completion of construction period	NHAI	NHAI

Environmental Components	Monitoring			Location	Frequency	InstitutionalResponsibility	
	Parameters	SpecialGuidance	Standards			Implementation	Supervision
Wildlife	Accidental Road Kill	Format attached as Annexure 8.1	Zero accidental kill of Schedule – I species	Entire Project Stretch	As and when required	Contractor/Concessionaire	NHAI, MC
	Condition of Roadside Signage	Visual observation	as per IRC code	Roadside Signage Locations	At least twice in ayear		
	Plying Vehicular speed	Random Speed checking	-	Speed Limit Sections	At least twice in ayear		