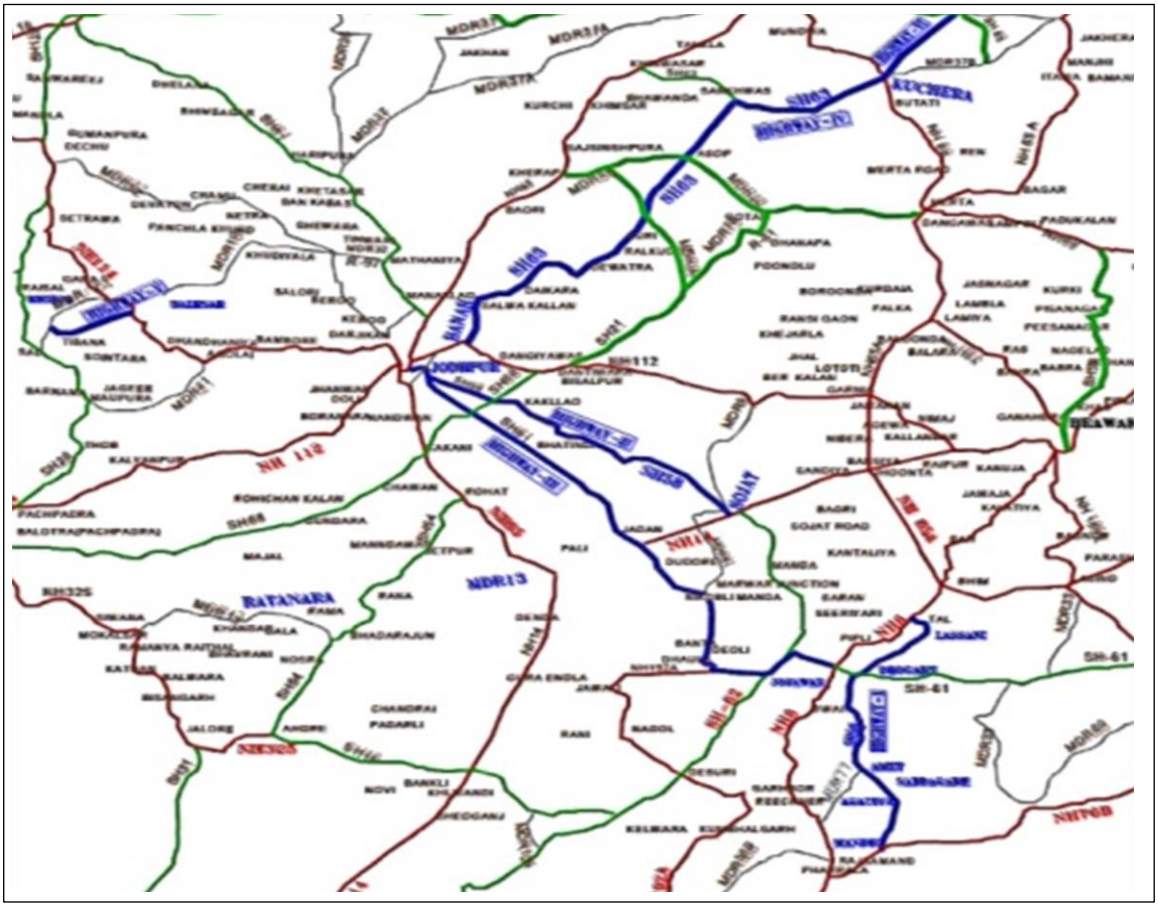
Public Works Department, Government of Rajasthan

Environmental Impact Assessment Report



Banar – Bhopalgarh – Kuchera Road

June 21, 2018 (Revised Draft)

Submitted to

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Executive Summary

The Government of Rajasthan has proposed to upgrade its road network under Rajasthan State Highway Development Program (RSHDP) and as part of this endeavour, the Public Works Department (PWD) of Rajasthan has been mandated to undertake improvement and upgradation of various State Highways and Major District Roads at various locations in the state. As part of this mandate, the PPP Division of the Department has identified roads requiring development that would improve the connectivity to national highways, major towns and industrial belts. The proposed investment program will support up gradation and improvement of the identified roads.

With financial assistance from World Bank, nearly 800 km would be developed under Tranche-1 in five different packages consisting of 11 sub-project roads. Many of these roads are in poor condition with respect to riding quality, geometry, pavement strength, drainage, and safety standards. The project roads are to be constructed under two modalities i) Annuity mode with a length of 293.884 km and ii) EPC mode with a length of 471.160 km. The investment made, to widen and strengthen the highways will improve the efficiency and safety of transport on the state highways.

The **Baner–Bopalgarh-Kuchera section of SH 63** was selected as one of the project road to be widened and upgraded with support of World Bank funding under the EPC mode of funding. The project road starts at the junction of SH 63 and NH 112 near Jodhpur and terminates at the junction of the state highway with NH 89. This 129.5 km long single to intermediate lane existing road is proposed to be upgraded to a two-lane configuration with granular shoulders. The geometric deficiencies, repairs, rehabilitation of bridges, culverts, embankment and providing traffic safety measures in the road would also be included as part of the project. The development of this road would not only ease the traffic between Nagaur and Jodhpur but also benefit the limestone mining traffic plying using the corridor. It would also provide connectivity to several settlements along the highway notably Jhajhirwal Kalan, Thabukada, Daikra, Bucheti, Bopalgarh, Asop, Kankarai, Sankhwas and Khajwana.

The PPP division of the Public Works Department, Government of Rajasthan had engaged M/s Indian Technocrat Ltd for undertaking the feasibility studies as well as carrying out the Environmental Studies.

The proposed improvement for SH 63 (Baner Bopalgarh Kuchera) would include four laning of first 10.5 km stretch up to bypass for NH-65 and two laning with granular shoulder for the remaining stretch. The improvement would also include geometric improvement as per the provisions of IRC: SP:73 2007. The project would also include reconstruction of 3 culverts and development of 2 HP culverts. The remaining 12 existing culverts, which are not to be reconstructed, shall be widened up to the roadway width. Additionally, 120 new culverts shall be constructed equal to roadway width of the Project Highway. Bus-shelters are proposed near 15 village locations on both sides of the project road, earthen drain has been proposed in the rural areas and concrete covered drains /footpath is proposed in the built-up sections. Due to the restriction in the RoW bypasses have been prosed at two locations i.e. Kankarai and Sankhwas.

As per the EIA Notification 2006 and the subsequent amendments, all State Highway with certain exceptions are classified as Category B2 and are exempted from the process of Environmental Clearance. However, the Project, must obtain statutory permits relating to discharges and emission to air and water and also generation of hazardous waste. The Contractor also need to abide by the other statutory provisions applicable such as the Fly Ash Notification, 2016. For abstraction of groundwater for construction the Contractor needs to apply to the Central Groundwater Board for permits.

To understand the baseline environmental condition in addition of primary baselines environmental monitoring, desktop studies were carried out for the project influence areas of 10 km on either side of the corridor through review of secondary literature. The EIA was focused on interactions between the project activities and various resources/receptors and identified significant impacts. The paragraph below gives a description on the impact and mitigations which have been adopted in the project.

The project road primarily passes through and arid region of Jodhpur and Nagaur district. The area lies west of the Aravalli and is part of the arid desert region of Rajasthan and thus faces severe shortage of water. The people along the alignment of the project road are still dependent on rainwater collected in surface water bodies for drinking water. Even though the alignment does not encroach on any of these water bodies at Kankarai Bypass the new alignment would severe the waterbody from its catchment (22 sq km). A culvert has been provided but in the preliminary design it may not be adequate. The detailed design thus needs to look into this carefully so that the road does not impact the flow of water into the pond.

The runoff from the carriageways also should not enter these drinking water ponds. Presently to prevent such intrusion of runoff from the road earthen bunds have been created by Government of Rajasthan or Community along the roadside. The alignment would not disturb these bunds except at two locations where the toe of the embankment of the proposed road would touch the toe of the bund. Protection measures and enhancement has been suggested but the details would be worked out during the Detailed Design. Longitudinal drains have been provided along the entire length of the carriageway in the preliminary design. During the detailed design it has to ensured that longitudinal drains carrying water should not discharge the runoff at locations from where it can enter these ponds.

It is estimated that approximately an average of 150- 175 KLD of water would be required during the peak construction period for construction purpose and 10 KLD for domestic purpose. Usage of surface water for drinking would have a very severe impact on the people and thus has been totally prohibited under this project. The sourcing of water for construction from ground water would also stress on the ground water resource. Being located on the western side of the Aravalli the area receives very less rainfall. The lack of surface water resource has put stress on the Ground water resources as a result most of the blocks in these two districts are declared "overexploited" In fact CGWA has declared Bhopalgarh block in Jodhpur District as a "notified Block" thus restricting use of groundwater. Thus, for sourcing construction water the Contractor has to either undertake rainwater harvesting or abstract saline ground water treat it and use

it for construction. To develop a sustainable source of water resources in the area and also augment the surface water resources in the area rain water harvesting has been planned as part of the Environment Management Plan. The surface water collected in these new/renovated surface water bodies developed by the contractor with permission from the Panchayat can be used for construction purpose and later handed over to the community as an asset.

There are no National Park, Wild Life Sanctuaries within 10 km of the site. There is one small patch of protected forest along the alignment, but the alignment would not encroach on it. However, it is estimated 761 trees need to be felled for this project. Even though there are no Wildlife sanctuaries there is a large population on Chinkaras and Blackbucks in the area. Wildlife collisions have also been reported by the local people. To prevent such collision mitigation measure e.g. traffic calming, wildlife reflectors and signages, have been proposed. Additionally, the veterinary facility of the Forest Department at Jodhpur would be strengthened to cater to any untoward incident.

In absence of any environmentally sensitive areas, the said activity would have predictable impacts which would primarily be limited to the construction stage and can be mitigated with some design interventions and by applying a site specific Environmental Management Plan.

The Environment Management Plan for the Baner–Bopalgarh-Kuchera road has been drawn based on the mitigation measures which has been identified during the impact assessment. It furthers detail out the mitigation measures discussed earlier during the Pre-Construction, Construction and Operation Phases of the project. This will ensure that environmental issues are properly addressed during road upgradation. This Environment Management Plan would be included as part of the Bidding Document and shall be later used by the Contractor for developing the Contractor's EMP. The contractor's management plan would:

- Fill any gaps in the existing EMP with respect the final design to ensure effective implementation of environment protection measures;
- Help comply with all applicable environmental, safety, labour and local legislation;
- Ensure that public opinions and obligations are taken in to account and respected. The project and the design accommodate them to the extent it is technically feasible or provide alternative measures;
- Modify the mitigation measures or implementing additional measures, if required

The environmental health safety management system developed in RHSDP II would be also be used for the monitoring of the Baner-Kuchera Road Project. The system essentially consists of plans and procedures, processes, institutions and responsibilities, Capacity building and Monitoring and Review.

The institutional arrangement for the implementation of the EMP in the project road has been designed in conformity with the institutions considered under the RHSDP II and help the PPP division achieve the desired level of environmental performance during project implementation of various project components as specified by the various conditions of EMP.

RHSDP II is headed by the Chief Engineer of the PPP cell who will be responsible for the successful implementation of the Project. The Chief Engineer would be assisted by an Environmental Officer and Health Safety officer equivalent to the rank of an Executive Engineer. The team at the PMU would be assisted by the Environmental Officer Project Management Consultant (PMC).

At the PIU the Project Director an officer of the rank of Executive Engineer who is the Project Director would also be responsible for the environmental health safety performance of the project road. He would be assisted by an EHS Engineer of the rank of Assistant Engineer who would be responsible for ensure that the provisions of the environmental management plan are implemented. The Authority Engineer associated with the PIU would also have an Environmental Engineer. He would assist the PIU in ensuring that the provisions in the EMP are implemented. The actual responsibility of implementation of the EMP would be with the Contractor. An Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards. The roles and responsibilities of each of these officials have also been detailed out in the EMP

Training and capacity building would be required especially for the PMU and PIU staff associated with the project as the Environmental Safeguards would be a relatively new area which staff are required to handle. The training and capacity building would not only be project specific but would target and developing long term capacities in the PPP Division. The training program would include

- **Sensitisation Training**: primarily aimed at introducing the EHS safeguards to the officers and also make them aware of the responsibilities and benefits of implanting the environmental management measures.
- **Orientation Training:** introducing the Environmental safeguards to the PIU staff and making them aware of the key principles of environmental safeguards
- **Detailed Training**: aimed at the PIU staff and the Authority Engineer to make them aware of the detailed activities which needs to be implemented and enforced during the EMP Implementation
- **Refresher Training:** this would be a need based training organised to rectify the shortcomings identified during the Monitoring and Auditing.

An Environmental Monitoring Program has been drawn up to essentially monitor the day to day activities in order to ensure that the environmental quality is not adversely affected during the implementation. The monitoring programme consists of Performance Indicators and Process Indicators. The performance indicators would identify the components which have to be monitored and reported on a continuous basis during the stage of the implementation. These would help identify the level of environmental performance of the project. In addition, there would be Process Indicators which would help in assessing the effectiveness of the system which has been instituted for the program.

For reporting on environmental performance, a reporting framework has been defined. This includes:

- **Daily Monitoring Report**: by the contractor tot eh Authority Engineer on the environmental actions which has been implemented.

- **Fortnightly Monitoring Report**: by the Authority Engineer to the PIU and PMC
- **Monthly Monitoring** by the PMC and reporting to the PMU
- **Quarterly Auditing** by the PMU to the Management
- **Annual Audit** by an External Agency of the entire process of EMP Implementation and reporting to the PMU for onward reporting to the World Bank

1 INTRODUCTION

1.1 Project Background

The Government of Rajasthan has proposed to upgrade its road network under Rajasthan State Highway Development Program (RSHDP) and as part of this endeavour, the Public Works Department (PWD) of Rajasthan has been mandated to undertake improvement and upgradation of various State Highways and Major District Roads at various locations in the state. As part of this mandate, the PPP Division of the Department has identified roads requiring development that would improve the connectivity to national highways, major towns and industrial belts. The proposed investment program will support up gradation and improvement of the identified roads.

With financial assistance from World Bank, nearly 800 km would be developed under Tranche-1 in five different packages consisting of 11 sub-project roads. Many of these roads are in poor condition with respect to riding quality, geometry, pavement strength, drainage, and safety standards. The project roads are to be constructed under two modalities i) Annuity mode with a length of 293.884 km and ii) EPC mode with a length of 471.160 km. The investment made, to widen and strengthen the highways will improve the efficiency and safety of transport on the state highways.

Baner-Bopalgarh-Kuchera section of SH 63 was selected as one of the Project Road to be widened and upgraded with support of World Bank funding under the EPC mode of funding.

1.2 Brief about the Sub-Project Road

The Baner-Bopalgarh-Kuchera section of SH 63 starts at the junction of SH 63 and NH 112 and terminates at the junction of the state highway with NH 89. This existing 129.5 km long single to intermediate lane road will be upgraded to 2 lane configurations with granular and paved shoulders. The other improvements would include removal of geometric deficiencies, repairs, rehabilitation of bridges, culverts, embankment and providing traffic safety measures. The upgradation to the two-lane carriageway with additional safety features are hereafter referred as “the Project”. The project would get implemented through EPC mode (Public Private Partnership) and funded by the World Bank. The Index map of the project road is presented in Need of the Project Road

At present the town of Jodhpur and Nagaur are connected by the NH 65 and has considerable traffic resulting in congestion and longer travel time. The SH 63 provides an alternate access between these two towns. Bilara-Bopalgarh region of Jodhpur, is a major limestone belt of the district which contains cement, chemical & steel grade of limestone. The proposed project would provide accessibility to this limestone producing areas. Further, the development of this road, would not only ease the traffic between Nagaur and Jodhpur but also benefit the limestone mining activities in the area. At present there are a few industrial units along the corridor notable among them is the Grasim Industries Ltd., White Cement Div.at Bopalgarh. With raw material already being present the industrial activity would also get a fillip.

The development of the SH would also provide connectivity to several settlements along the highways. The notable settlements along the project corridor include Jhajhirwal Kalan, Thabukada, Daikra, Bucheti, Bopalgarh, Asop, Sankhwas and Khajwana

1.3 Benefits of the Project

The project is expected to remove transport bottlenecks in the road corridor and provide all season access; enhance economic opportunities and social services to the habitations. In addition, the improved connectivity would directly benefit the inhabitants in the catchment of the project road, local businesses, as well as road users.

Figure 1-1.

1.4 Need of the Project Road

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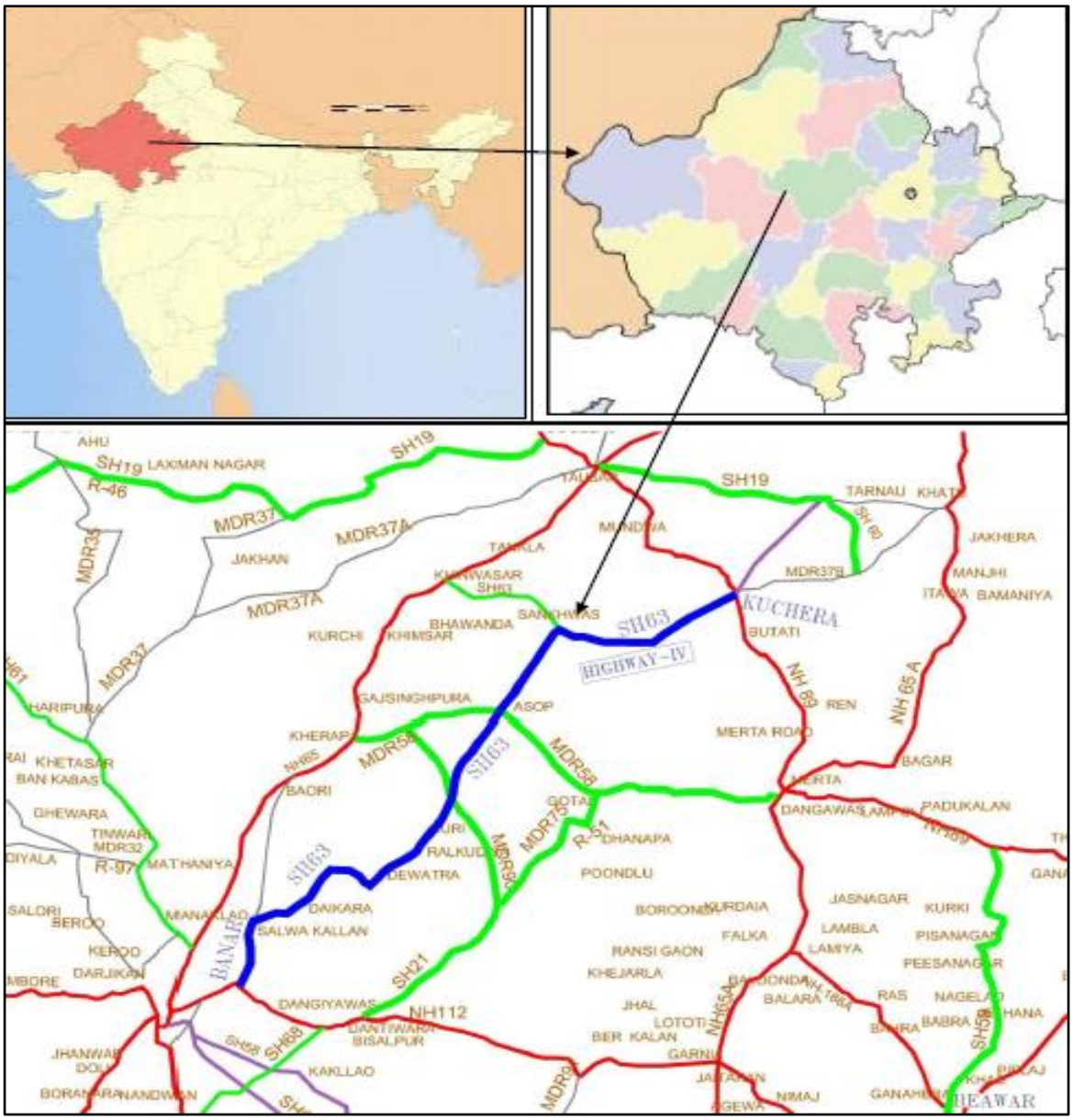
Figure 1-1: Index Map of the Project Road



The major benefit will be improvement in the ride quality, safety, and carrying capacity of road. The improvement in the geometrics of the existing horizontal curves under this project, at critical spots would avoid sharp curves and reduce accident black spots. Further, improved vertical and horizontal alignment designs would reduce travel time for users. Additional cross drainage structures would be provided for improving drainage of the area. Besides, other aspects like lane marking, road signs, junction improvements, road side amenities etc. have all been incorporated in the designs to cater to public needs.

Wherever the roads pass through heavily built up towns bypass options have been considered in consultation with PWD department and the local public. Two bypasses have been considered in the project for Kankarai and Sankhwas to avoid congested habitations and ensure smooth flow of traffic

1.6 Need of Environment Impact Assessment Study

The Rajasthan State Highway Development Program II (RHSDP II) is partly being funded with assistance from the World Bank. As per the operational policy 4.01 of the World Bank, projects are classified into Category A, B & C depending on the scale of the associated environmental and social impacts of the project. Projects falling in Category A & B are required to carry out the EIA study whereas project falling in Category C are likely to have minimal or no adverse environmental impacts.

Even though an EIA is required to be carried out for the Baner- Bopalgarh – Kuchera Road as per OP 4.01, no such studies are required as per the Indian statutory requirement. In India, environmental assessment is governed by the EIA Notification 2006 and the subsequent amendments. The Schedule I of the notification defines threshold of activities which require to undertake an environmental assessment and obtain an environmental clearance from statutory bodies. All State Highway with exceptions[1] are classified[2] as Category B2 and are exempted from the process of Environmental Clearance.

In absence of any environmentally sensitive areas in the vicinity of the road stretches covered under RHSDP II, the impacts are likely to be predictable, local in nature and limited to the Construction Stage of the project. These impacts can thus be mitigated with the Site-Specific Environment Management Plan (EMP). Hence the RHSDP II has been classified as Category "B". Consequently, a rapid/short term EIA study was carried out for each of the road stretches prior to implementation. The PPP division of the Public Works Department, Government of Rajasthan had engaged M/s Indian Technocrat Ltd for undertaking the feasibility studies for determining the technical feasibility and financial viability of the Baner-Bopalgarh- Kuchera Road. The scope of work also included carrying out of the EIA study for the proposed development.

1.7 Scope of the EIA Study

The EIA study has been developed in accordance to the requirement of OP 4.01 and the Terms of Reference developed by MoEF&CC for highway projects. The EIA study accordingly covers the following key elements:

- Collecting primary and secondary environmental baseline data within the project boundary and surrounding areas;

[1] However New highway alignment (greenfield Projects) and expansion of existing state highway in hilly terrain above 1000 m above mean sea level and or ecologically sensitive areas would require prior environmental clearance from the State Level Environmental Impact Assessment Authority (SEIAA) . However, in case projects fall within (i) Protected Areas notified under the Wild Life (Protection) Act, 1972; (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time; (iii) Notified Eco-sensitive areas; and (iv) 5 kilometres from interstate boundaries and international boundaries would be treated as a Category A project and would require prior Environmental Clearance from the Expert Appraisal Committee of MoEF&CC

[2] The notification specifies that prior Environmental Clearance is required for the projects listed in the schedule of the notification. The Schedule of the notification lists eight broad categories of projects that require prior environmental clearance. These are sub categorised into to Category 'A' and category 'B' based on the magnitude and environmental impacts of the project. A category Projects require Clearance to be obtained from the Ministry of Environment, Forests while Category 'B' projects, require clearance from the State Environment Impact Assessment Authority (SEIAA). . Category 'B' projects will be further classified in to category 'B1' and category 'B2'

- Assessing potential adverse environmental impacts that might arise during operation of the Project after reviewing Project information and using the environmental baseline study conducted during the feasibility study;
- Suggesting appropriate mitigation measures to effectively manage potential adverse impacts; and
- Analyse the alternatives in terms of alternative alignment, technology, design and operation, including the "without project" situation. A detailed analysis for each of the alternatives, were carried out to analyse the feasibility in terms of capital and recurrent costs; their suitability under local conditions and quantify the environmental impacts to the extent possible, and attach economic values where feasible and explain the rationale behind the preferred/chosen option
- Consultation with the Public/Stakeholders and incorporate their concerns into the project design;
- Developing an Environmental Management Plan (EMP) to implement suggested mitigation measures and management plans to minimise adverse impacts through effective management systems including formulation of monitoring and reporting requirements;
- Conducting additional studies for the enhancement of the benefit to the local community and the road users;

1.8 Approach and Methodology of the EIA Study

The methodology for the EIA study employs a traditional approach of identifying the environmental sensitivities along the project corridor and analysing the environmental issues identified. The EIA process simultaneously informs the design of the project road about these issues so that necessary modification can be carried to minimise these environmental concerns. Thereafter the impact assessment that is carried out would identify the impacts which are still likely and identify mitigation measures which need to be adopted during the construction and operation of the state highway. The methodology adopted is presented in

Figure 1-2.

1.8.1 Screening of Project Road

As a part of the project feasibility study, Environmental Screening is undertaken in parallel with the Preliminary Economic and Engineering studies to determine any significant social or environmental issues which could require further analysis (including the analysis of alternative alignments, improvement of junctions etc.) to resolve such issues.

The environmental screening typically identifies the natural habitats (e.g. national parks, wildlife reserves, sanctuaries, sacred groves, protected areas, forests, water bodies etc.), major rivers and waterways, notified cultural heritage sites and any other potentially sensitive areas. The information available from secondary sources along with the inputs from the site visits and consultation with local people are used to identify these issues and

sensitive receptors which might be located along the corridor. The results of this analysis are communicated to the design team to resolve them (including recommendation for exclusion, analysis of alternative alignment and/or mitigation) as a precursor to preliminary engineering design and undertaking the required for environmental assessment studies. The outcomes of the Screening Study of Baner-Bopalgarh- Kuchera road is presented in **Error! Reference source not found.**.

Box 1-1: Outcome of the Screening Study

A separate screening study was conducted for all the project roads in RHSDP II to identify the environmental sensitivities along the project road. This study helped not only in categorisations of the project but also helped in identifying the key issues which should be studies in details during the EIA studies for the respective project roads.

In case of Baner-Bopalgarh -Kuchera road there are no protected areas e.g. National Parks, Sanctuaries within the project corridor. There is also no protected forest along the corridor. Being an arid area there are no major river or stream crossing and the area is faced with severe water crisis.

1.8.2 Delineation of Project Impact Zone

For carrying out further environmental studies and subsequently the assessment, it was required to delineate the project influence zone. Depending on the severity of impact the Project influence zone has been classified as:

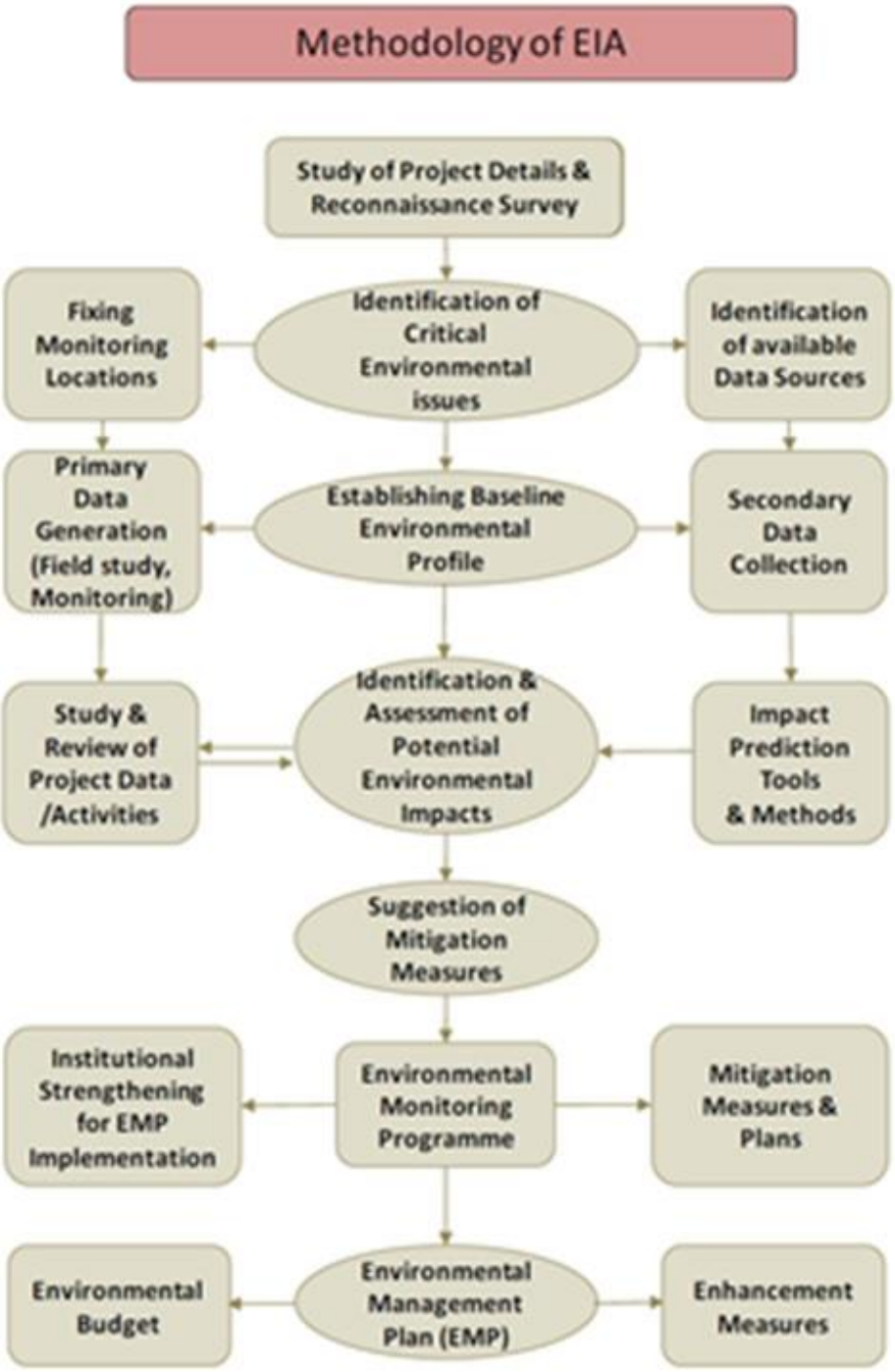
Corridor of Impact (CoI)

The area of 500 m on either side of the proposed road centreline is considered as the corridor of impact. The proposed RoW i.e. 30 m is thus included within the CoI. This area is more vulnerable to the project's direct impacts.

Project Influence Area (PIA)

In accordance with MoEF&CC' S EIA Guideline Manual for Highways and as per guidelines of EIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arial distance) from boundary of road for collection of secondary data, including impacts due to ancillary sites like borrow areas, quarry, material storage, disposal areas, etc

Figure 1-2: Methodology for the EIA Studies



1.8.3 Preliminary Engineering Surveys

With the information available from the screening the design team took the preliminary surveys of the project site to assess the engineering aspects of the road including the likely environmental issues associated with the project. The survey carried out as part of the detailed design data collection also provided valuable information regarding area adjacent to the proposed project corridor.

1.8.4 Collection of Secondary Environmental Data

Secondary data was collected from various verifiable sources about different components e.g. Climate, Physiography, Soil type, Ecology, etc. The sources from which information is gathered is presented in **Error! Reference source not found.**

Table 1-1:Secondary collected for the EIA Study

Environmental Aspects	Parameters	Source/s of Information
Climatic Conditions in the Project Influence Area	Climate, Temperature, Rainfall	Indian Metrological Department
Soil & Geology	Soil type and its stability, Fertility of the Soil potentiality for soil erosion	Geological Survey of India, State Mining Department
Slopes	Direction of slope, Percentage of slope	Contour Survey, satellite image and Survey of India topographic sheets
Drainage/ Flooding	Existing drainage map and flooding level including its extent of water spread. Identification of drainage channel and its catchments area around the Project stretch	Satellite Imagery/ Topo sheet /Hydrology study/State Water Resource Department.
Water Bodies and Water Quality	Identification of water bodies/canal/drainage channels where the run off surface water will flow/due to erosion and also due to spillage oil and other hazardous materials. Status of surface water and ground water quality	Topography sheets/field study. Hydrological data from the CGWB Reports
Air Quality	Air quality status of the project area.	Monitoring of the ambient air quality carried out by the Rajasthan State Pollution Control Board.
Ambient Noise levels	Existing noise level in the project area	Monitoring of the ambient noise level carried out by the Rajasthan State Pollution Control Board.
Forest Within Proposed ROW Legal Status – Protected Areas, Endangered Plant and Animal, Ecological Sensitive Area, Migratory Corridor/Route,	Status of the forests, Conservation of forest area, & endangered plant and animal and any other species	Department of Forest, Govt. of Rajasthan, DFOs, Discussion with local community and local DFO officers
Trees and Vegetation Cover	Identification of existing tree species and the project influence area	Forest Department, Research Institution, Field Survey.

Settlements within the PROW	Settlements & its population along the corridor. Its location & numbers	Population/ District Census report 2011; Topographic survey.
Cultural / Heritage and Ancient Structures.	Conservation areas if any, Protected structures, monuments and heritage structures.	Archaeological Survey of India, State Archaeological Department

1.8.1 Collection of Primary Baseline Information

For gathering the baseline environmental condition along the project corridor baselines studies were conducted. These baseline studies carried out included:

- Baseline environmental surveys for assessing the ambient air, water and noise quality;
- Enumeration of trees to identify the Location, number, types spread, girth etc. Local name, value of the trees within the proposed RoW;
- Ecological surveys to identify the habitats and the flora and fauna;
- Structure enumeration to identify the one likely to be impacted;
- Socio-economic surveys to identify the condition of the impacted persons.

In addition to the above survey interactions are carried out with the populations along the project corridor to gather local level information on the following:

- Local practices and traditions with respect to conservation and use of natural resources;
- Farming practices and Cropping pattern;
- Perception of the people about the project
- Traffic surveys were used to estimate the present and future traffic
- Preliminary engineering surveys to identify the topographical features

This information was used to develop the baseline environmental condition in the project area and identify the environmental sensitivities which might still get affected by the proposed alignment

1.8.2 Public consultation

At the beginning of the EIA process, a preliminary identification of probable stakeholders was carried out. An inventory of actual / potential stakeholders, including local groups and individuals, local institutions like the panchayats which may be directly or indirectly affected by the project or with interest in the development activities in the region was made at a preliminary stage. This inventory was arrived through discussions with local PWD official and also in consultation with members of the local community.

Consultations with the community is a continual process that was carried out during the EIA study and would also be continued during the construction and operation phases of the project. Issues like disturbance during the construction, severance and increased

congestion, noise and air pollution, employment opportunities, need for development of basic infrastructure, safe drinking water, sanitation facilities in the villages adjoining to the corridor were discussed during the consultations so that they can be adequately addressed through the environment management plans. The consultations with community and local institution like panchayat also helped in developing preliminary understanding of the requirement of people in the area and identification of the enhancement proposals.

1.8.3 Impact Identification and Evaluation

The principal impact assessment (IA) steps comprise of the following:

- **Impact prediction**: to determine what could potentially happen to resources/ receptors as a consequence of the project and its associated activities.
- **Impact evaluation**: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/ receptor.
- **Mitigation and enhancement**: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- **Residual impact evaluation**: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

1.8.4 Environmental Management and Monitoring

The final stage in the EIA Process is definition of the management and monitoring measures that are needed to ensure : a) impacts and their associated Project components remain in conformance with applicable regulations and standards; and b) mitigation measures are effectively implemented to reduce the effects to the extent predicted.

An Environmental Management Plan, which is a summary of all actions which the Project has committed to execute with respect to environmental/social/health performance for the Project, is also included as part of the Bidding Documents. The Environmental Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities

1.9 Limitation of EIA Study

This report is based on the preliminary design which were prepared for the road. The final design would be developed by the Contractor before the initiation of construction. Even though no major changes are expected in the design the EIA report needs to be verified against the final engineering design. Further, the report has been developed on certain information available at this point of time, scientific principles and professional judgement to certain facts with resultant subjective interpretation. Professional judgement expressed herein is based on the available data and information.

The Report only deals with the environment health and safety aspects (both community safety and occupational health and safety) associated with the project during the construction and operations. The social impact and the resettlement and rehabilitation requirement of private and community property have been detailed in the Social Impact Assessment and Resettlement and Rehabilitation Plan. In case of common property

structures the report only considers those structures where relocation is required and only enhancement is required either for the aesthetics or safety purpose.

1.10 Layout of the EIA Report

The EIA report contains the following chapters:

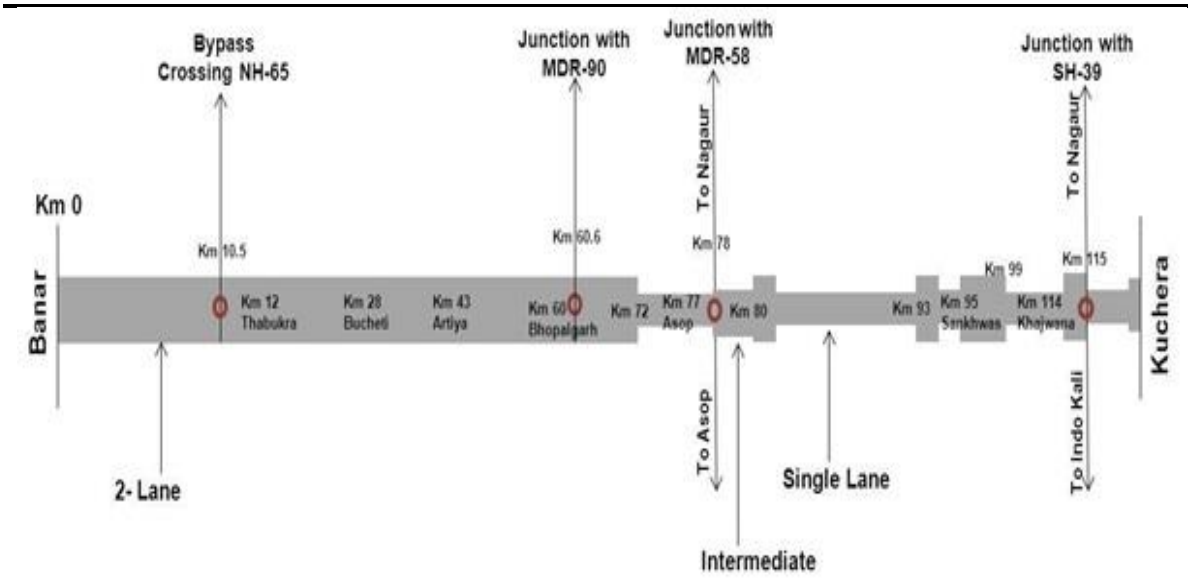
- **Chapter 2: Project Description**: This chapter presents all the technical information related to the project roads and also presents information on the existing and proposed RoW, cross drainage structures, junctions etc. It also summarises the resource requirement for the project road
- **Chapter 3: Policy Legal and Administrative Framework**: This section presents the Environmental policy, laws and rules which would be applied to the project. It also presents the regulatory agencies and the permits and compliance requirements of the project.
- **Chapter 4: Environmental Baseline Status**: It delineates the project influence area and defines the baseline environmental condition within it. The environmental sensitivities along the project corridor is also presented in the document.
- **Chapter 5: Analysis of Alternatives**: The chapter analyses various design alternatives which were considered especially in case of the bypasses. In addition, alternative material which can be used for construction has also been described in the document.
- **Chapter 6: Impact Assessment and Mitigation**: The chapter identifies the various impacts likely due to the construction and operations of the project road. The assessment considered the various sensitivities which have been identified during the baseline studies and suggest mitigation measures
- **Chapter 7: Public Consultation and Discussion:** The consultation and discussion which were carried out during the preparation of the EIA study have been documented in the chapter
- **Chapter 8: Environment Management Plan;** The chapter discusses the Environmental Management Plan which has been proposed for minimising the impacts. The EMP would be implemented by the contractor and would be part of the Contract Document
- **Chapter 9: Conclusion and Recommendation:** The document summaries the environmental sensitivities in the project. The environmental safeguards, monitoring etc which need to be implemented is also summarised in the Chapter.

2 Project Description

2.1 Project Profile

The project road starts from the junction of SH-63 with NH-112 and ends at junction of SH-63 with NH-89 after traversing a length of about 129 km. The existing road passes through habitation areas like Jhajhirwal, Kalan, Thabukada, Daikra, Bucheti, Bopalgarh, Asop, Sankhwas and Khajwana. At present most of the length of project road is a 2-lane undivided carriageway. However, there are some stretches which are single lane or intermediate lane. The alignment is schematically presented in Figure 2-1

Figure 2-1: Schematic representation of the carriageway width along the existing alignment



The project road is having fair pavement condition in general, with few stretches having poor pavement condition. The proposed road length of Baner- Bopalgarh-Kuchera project road is about 126.033 km and proposed ROW is 30m.

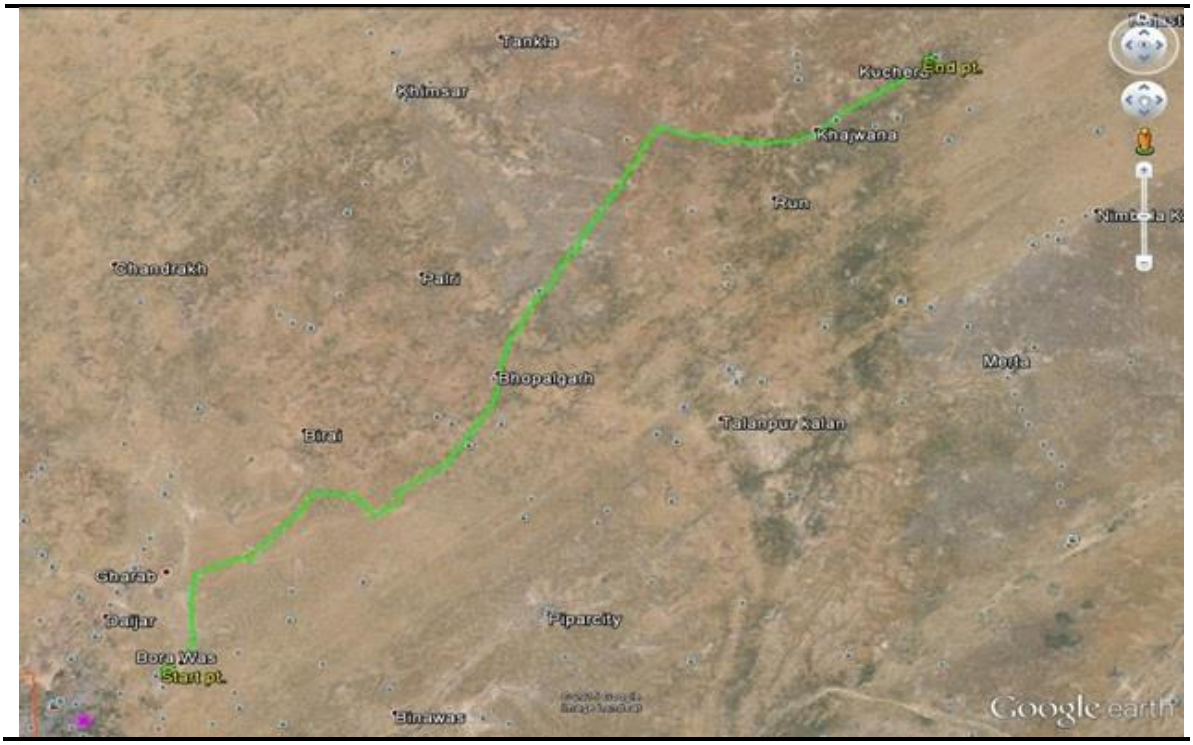
2.2 Project Location & Accessibility

The proposed project road passes through two districts namely Jodhpur and Nagaur. Major portion of the road runs through Jodhpur district. (78 km is in Jodhpur district while only 50 km is in Nagaur District). It runs North-easterly direction between Latitudes of 26°20’18.25” N & 26°59’28.24” N and Longitudes of 73°8’ 47.12” E & 73°58’7.85” E. The existing alignment on the Google Imagery is presented in Figure 2-2 and the start and end point is presented in Figure 2-2.

Figure 2-2: Start and End point of the Project Road

Start Point at junction with NH-112 | End Point at junction with NH-89

Figure 2-3: Present alignment marked on Satellite Imagery



2.3 Project Features

The features of the exiting road and the proposed road is presented in the following sections

2.3.1 Right of Way

The existing Right of Way along the project corridors varies from 18 m to 44 m. Encroachments are observed along the existing carriageway with shops and residences especially in the town areas. Details of existing & proposed RoW in the project stretch are given in Table 2-1

Table 2-1:Exisiting and proposed Right of Way

Sl. No.	Chainage (km)		Length (km)	Existing RoW (m)	Proposed RoW (m)
	From	To			
1.	0+000	12+550	12.500	18-30	30
2.	12+550	17+765	5.215	18-30	30
3.	17+765	19+270	1.505	18-33	30
4.	19+270	26+000	6.730	30-44	30
5.	26+000	57+850	31.850	20-30	30
6.	57+850	61+034	3.184	25-30	30
7.	61+034	86+809	25.775	25-30	30
8.	86+809	88+204	1.395	25-30	30
9.	88+204	94+134	5.930	25-35	30
10.	94+134	96+534	2.400	18-30	30
11.	96+534	101+464	4.930	17-40	30
12.	101+464	102+894	1.430	25-30	30
13.	102+894	117+034	14.140	25-30	30
14.	117+034	126+033	9.000	21-35	30

Source: Feasibility Report

2.3.2 Existing Traffic

The project road is divided into five homogenous sections for better assessment of traffic in each section. The homogenous sections are as follow:

- Homogenous Section (HS)-1: Km 0 (Baner) – Km 12.500 (Thabukada)
- Homogenous Section (HS)-2: Km 12.500 (Thabukada) – Km 60.000 (Bhopalgarh)
- Homogenous Section (HS)-3: Km 60.000 (Bhopalgarh) – Km 79.000 (Asop)
- Homogenous Section (HS)-4: Km 79.000 (Asop) – Km 114.000 (Khajwana)
- Homogenous Section (HS)-5: Km 114.000 (Khajwana) – Km 129.500 (Kuchera)

A 7-days classified traffic volume count survey has been conducted in at approved mid-block location of each homogeneous section. The Annual Average Daily traffic calculated out of the seven days' classified traffic count survey, at each of these locations were 6721, 1868, 1419, 1614 and 1788 respectively. The projected traffic (AADT) for Baner – Bopalgarh –

Kuchera in the year 2040-2041 was estimated at 23897, 6643, 5044 , 5740 and 6600 in each of these homogeneous sections respectively. Thus, keeping in view, the guideline[3] and the present / projected traffic, the flexible pavement has been designed.

Existing Road

Carriageway

The present carriageway of the Project Highway varies from 2- Lane to Single Lane as presented in Figure 2-1. The existing pavement includes both flexible and rigid, in different stretches and the details are given in Annexure 2.1.

Pavement Conditions

The existing pavement of project road is of bituminous surface with earthen shoulders of width 0.80 m to 3.5 m which exist predominantly on both sides throughout the project stretch. It was observed from the above road and pavement condition surveys that the road quality is 30% fair, 33% good and 37% poor.

Figure 2-4: Condition of Pavement along the Project Road

Poor Pavement Condition Near Chainage 10+000

Fair Pavement Condition Near Chainage 70+000

2.3.3 Existing Cross Drainage Structures

There is no major bridge in the present alignment. However, there are three minor bridges at km 46+315, km 48+709 and km 50+185. In addition, there are 3 pipe culverts and 13 slab culverts. At 5 locations causeways are provided. Details of the Cross-Drainage structure are provided in Annexure 2.2.

[3] vide clause 1.14 and 2.16 of IRC: SP: 73-2007

2.3.4 Railway Level Crossings

The Jodhpur- Jaipur railway line of the North -Western Railways intersects the alignment at two locations. There are two level crossings in the alignment:

- at km 0+940 at Baner village neat the starting Point and;
- another at km 116+260 near Khajwana Village near the end-point of the corridor.

2.3.5 Junctions and Intersections

The Existing alignment has 9 Major Junctions at prominent habitations and 61 Minor Junctions. Details are given in Annexure 2.3. Of the 9 major junctions only 4 junctions are intersections:

- Chainage 59+650 at Bopalgarh intersection with MDR 90
- Chainage 96+100 at Sankhwas intersection with MDR 37B
- Chainage 114+360 at Khajwana intersection with SH 39
- Chainage 129+450 at Kuchera Intersection with NH89

The remaining intersections are either Y junctions or T Junctions

2.3.6 Trees Cutting

The approximate number of trees to be affected in the proposed RoW for the said up-gradation are summarised in Table 2-2 and is also presented spatially in the Plan and Profile drawing submitted for the Project. The detailed enumeration of trees would however be conducted once the designs are finalised and the application for permission of tree felling is submitted by the Contractor

Table 2-2:Trees likely to be impacted

Sl. No.	Girth Size (mm)	No of Trees
1	300-500	205
2	500-800	16
3	800-1200	7
4	Above 1200	533
Total Trees likely to be Impacted		761

Source: Environmental Surveys

2.3.7 Utility Shifting

Different types of existing utility services like Optical Fibre Cables (OFC), Electric poles, Transformers, Telephone poles are existing which shall be affected during implementation stage and may require shifting for construction of proposed carriageway. The summary of existing utilities is in Table 2-2

Table 2-3:Summary of Existing utilities along the existing alignment

Sl. No	Description	Unit	Quantity
1.	Shifting of Hand pump	Nos.	-
2.	Shifting of Transformer	Nos.	39
3.	Shifting of Telephone Pole	Nos.	18
4.	Shifting of Electric Pole	Nos.	458
5.	Optical Fibre Cable	Running meters	17125.0

Source: Engineering Surveys

2.4 Proposed Improvement Plan

2.4.1 Proposed Carriageway Width

As part of the road improvement for SH 63 (Baner Bopalgarh Kuchera) the following has been proposed:

- Four laning has been proposed for first 10.5 km stretch up to bypass for NH-65
- Two laning with granular shoulder for the remaining stretch.

2.4.2 Geometric Design

The draft design standards proposed for this project are based on IRC: SP:73 2007," Manual of Standards & Specifications for Two Laning of State Highways on BOT basis" for two laning improvement option and IRC: SP:84:2014," Manual of Standards & Specifications for Four Laning of Highways Through Public Private Partnership". The design standards are presented in

Box 2-1: Design Standards for the Baner – Bopalgarh and Kuchera Road

- Design Speed
  - Plain (ruling-Minimum): 100-80 kmph
  - Rolling (ruling-Minimum): 80-65 kmph
- Lane width: 3.5 m
- Carriage way width
- Two Lane: 7.0 m
- Four Lane): 2X 7.5 m
- Width of Shoulder
- Two lane (unpaved): 2.5m
- Four lane (paved): 1.5 m

- Four lane (earthen): 2.0 m
- Camber
- Bituminous Carriageway: 2.5%
- Concrete Carriageway: 2.0%
- Unpaved Shoulder: 3.0%
- Maximum Super Elevation 7.0%
- Minimum radius of horizontal Curves:
- 100 kmph: 360m
- 80 Kmph: 230 m
- 65 kmph: 155 m
- Longitudinal Gradient
- Ruling maximum 3.3 %
- Absolute Maximum 5.0%

Source: Feasibility Report

As per traffic demand 4-lane proposed for first 10.2 km length of project stretch would be developed as a 4- lane carriageway. The 2- lane is proposed with granular shoulders having carriageway width of 7m for the remaining stretch. The proposed RoW of 45 meter is considered for the bypass and 4-lane stretch. For the remaining alignment a minimum 16m ROW width is proposed.

With a view to utilise existing pavement of fair and good condition, it is proposed to adopt concentric widening system to the maximum extent possible. For selection of bypass alignment, environmental considerations e.g. presence of forest land, natural habitats community land, water bodies etc were give due consideration along with social issues related to land acquisition, resettlement and rehabilitation, and engineering design parameters e.g. good geometry etc. A ruling design speed of 80-100km/h has been maintained almost all along the project road. Flexible pavement has been proposed with a service life of 15 years. Overlay has been designed on project road to withstand a service life of 15 years. Rigid pavement is proposed at existing rigid pavement locations and at the toll plaza location only. The pavement has been designed for traffic of 50 MSA between Chainage 0+000 to 12+500 and 10 MSA between 12+500 to 58+500

2.4.3 Typical Cross-sections

The proposed improvement of project highway of Baner-Bopalgarh-Kuchera Road comprises of concentric widening, eccentric widening and geometric improvement at necessary locations. Keeping in view the future development and current land requirement scenario concentric widening is followed for the project highway development. As per traffic demand four laning has been proposed for first 10.5 km stretch up to bypass for NH-65 and remaining stretch will be two laning only. Re-alignment is done at number of sharp and reverse curve locations.

The following Typical Cross Section's (TCS) have been developed based on IRC: SP: 73-2007 and the cross-sectional elements are presented as under:

- TCS Type-1: Strengthening of Existing 2-Lane Carriageway (Figure 2-5)
- TCS Type-2: Concentric Widening to Two Lane Carriageway (Flexible Pavement) (Figure 2-6)
- TCS Type-3: Reconstruction of Existing Road to Two Lane Carriageway (Figure 2-7)
- TCS Type-4: Widening to 4-Lane Carriageway in Built up Area (Flexible Pavement) (
- Figure 2-8)
- TCS Type-5: Two Lane Carriageway in Bypass/ Re-alignment (Figure 2-9)
- TCS Type-6: Widening to 4-Lane Carriageway in Built up Area (Rigid) (Figure 2-10)
- TCS Type-7: Widening to 2-Lane Carriageway in Built-up Area (Figure 2-11)
- TCS Type-8: Reconstruction of Existing Road to 4 Lane Carriageway in Built up Area (Figure 2-12)
- TCS Type-9: Widening to 2 Lane Carriageway (Rigid Pavement) (Figure 2-13)
- TCS Type-10: Widening to 4 Lane Carriageway in Rural Area (Flexible) (Figure 2-14)

The typical cross sections are also presented in figures as indicated above

Figure 2-5: Typical Cross Section (Type 1)

Strengthening of Existing 2-Lane Carriageway

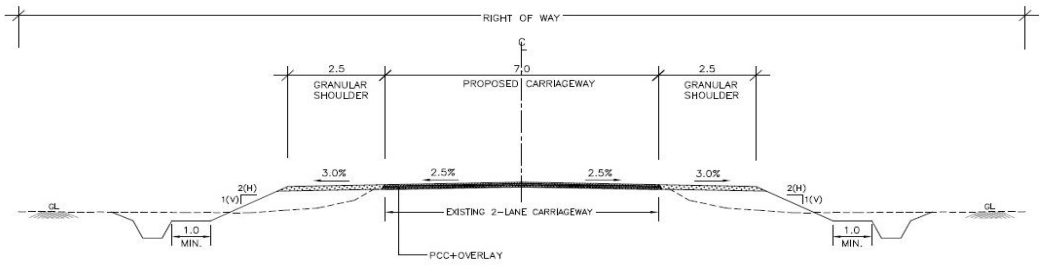


Fig.6.1-TYPICAL CROSS SECTION : TYPE -1
Strengthening of Existing 2- Lane Carriageway

NOTE: –
1. ALL DIMENSIONS ARE IN METERS.

S.No.	Design Chainage		Length (Km)
	From	To	
1	21.000	28.480	7.480
2	28.690	30.960	2.280
3	33.450	33.660	0.210
4	33.900	35.660	1.780
5	37.050	38.720	1.670
6	39.050	40.200	1.150
7	40.600	42.000	1.400
8	66.000	56.340	0.340
9	56.650	57.720	1.070
10	61.200	62.034	0.834
11	71.034	72.034	1.000
12	99.034	101.034	2.000
13	105.034	105.200	0.166
14	107.200	108.034	0.834
15	108.034	111.084	3.050
16	114.034	115.034	1.000
17	116.034	118.034	2.000
		Total	28.224

Figure 2-6: Typical Cross Section (Type-2)
Concentric Widening to Two Lane Carriageway (Flexible Pavement)

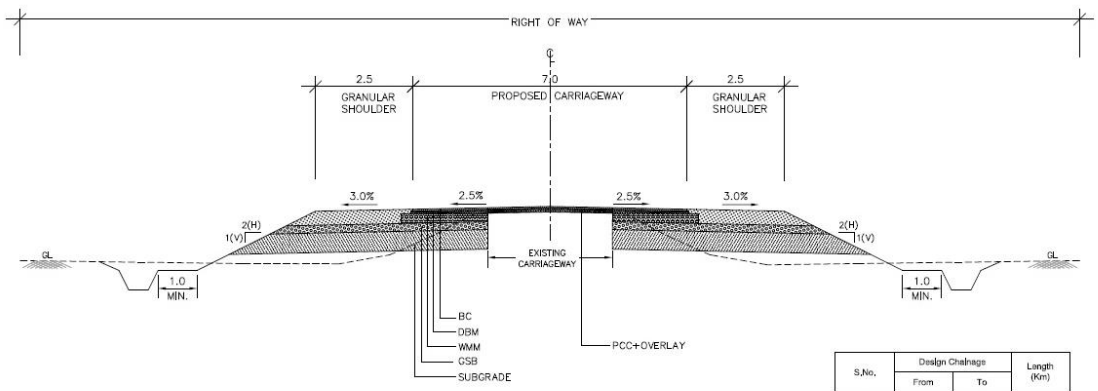


Fig 6.2 TYPICAL CROSS SECTION : TYPE - 2

Concentric Widening To 2 -Lane Carriageway (Flexible)

NOTE: –
1. ALL DIMENSIONS ARE IN METERS.

S.No.	Design Chainage		Length (Km)
	From	To	
1	73.034	75.034	2.000
2	85.434	86.034	0.600
3	101.034	101.464	0.430
4	102.894	105.034	2.140
5	113.484	114.034	0.550
6	115.034	116.034	1.000
7	118.034	120.034	2.000
		Total	8.720

Figure 2-7: Typical Cross Section (Type-3)
Reconstruction of Existing Road to Two Lane Carriageway

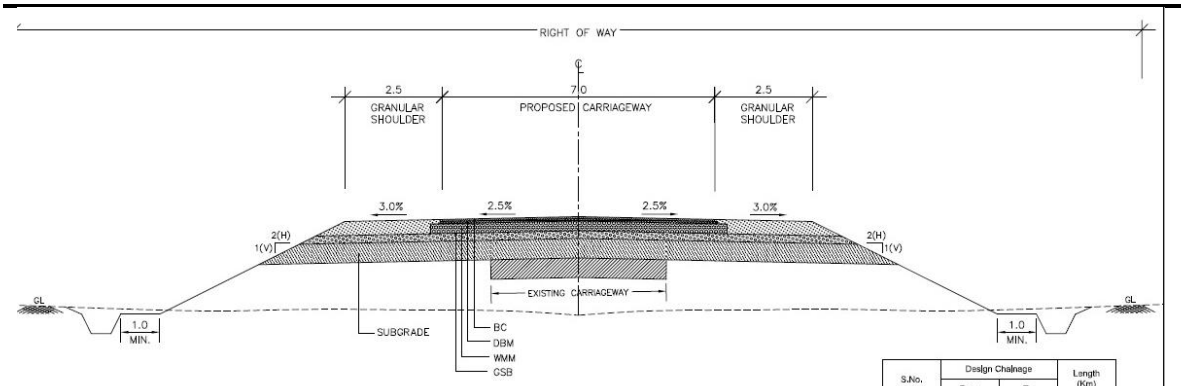


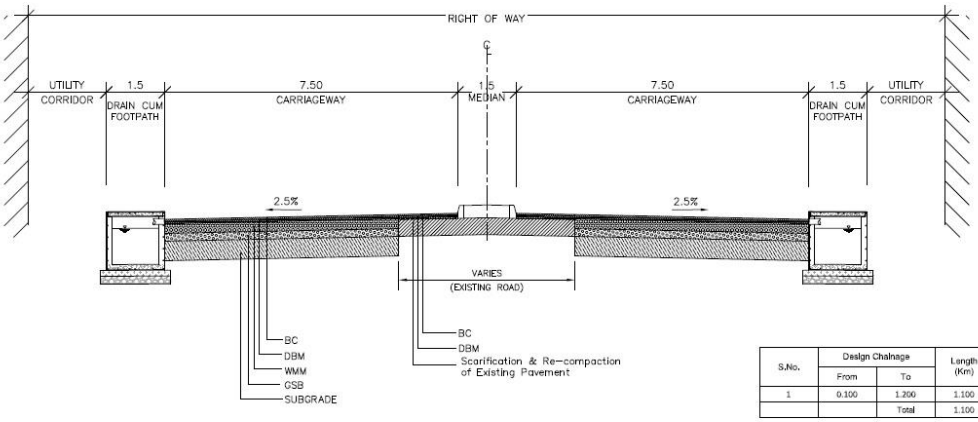
Fig. 6.3 TYPICAL CROSS SECTION : TYPE - 3

Reconstruction of Existing Road To 2 Lane Carriageway

NOTE: –
1. ALL DIMENSIONS ARE IN METERS.

S.No.	Design Chainage		Length (Km)
	From	To	
1	10.200	17.765	7.565
2	19.270	21.000	1.730
3	30.950	32.220	1.270
4	32.370	32.980	0.610
5	42.000	43.150	1.150
6	44.100	56.000	11.900
7	59.500	61.200	1.700
8	62.024	71.024	9.000
9	72.034	73.034	1.000
10	75.024	76.624	1.600
11	78.784	79.034	0.250
12	80.034	80.434	0.400
13	80.634	85.434	4.800
14	86.034	86.809	0.775
15	88.204	94.134	5.930
16	96.534	97.034	0.500
17	98.034	99.034	1.000
18	105.200	107.200	2.000
19	120.024	126.034	6.000
		Total	59.180

Figure 2-8:Typical Cross Section (Type-4)
Widening to 4-Lane Carriageway in Built up Area (Flexible Pavement)

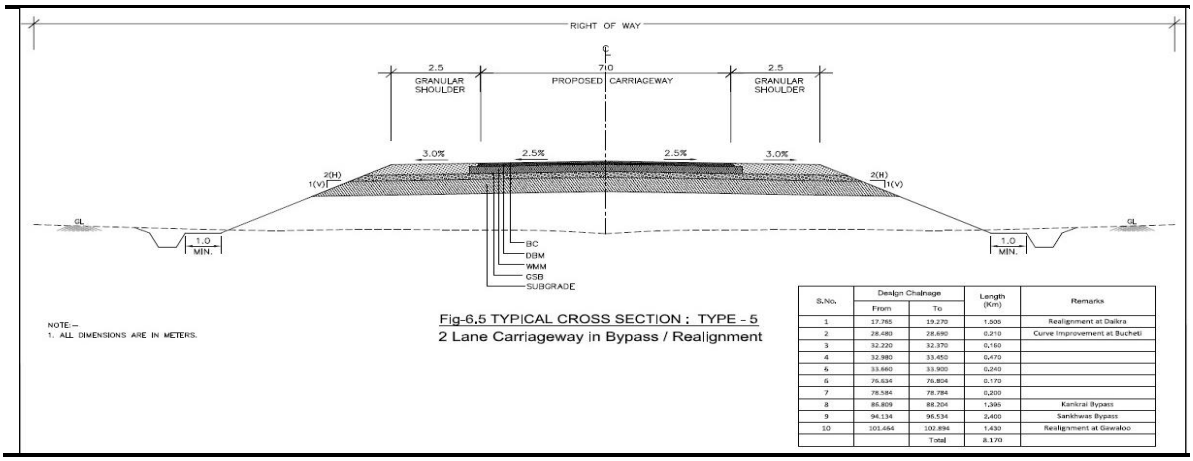


S.No.	Design Chainage		Length (Km)	Remarks
	From	To		
1	0.100	1.200	1.100	Banar
		Total	1.100	

Fig-6.4 TYPICAL CROSS SECTION : TYPE - 4
Widening To 4 Lane Carriageway in Builtup Area (Flexible Pavement)

NOTE:-
1. ALL DIMENSIONS ARE IN METERS.

Figure 2-9: Typical Cross section (Type-5)
Two Lane Carriageway in Bypass/ Re-alignment



NOTE:-
1. ALL DIMENSIONS ARE IN METERS.

Fig-6.5 TYPICAL CROSS SECTION : TYPE - 5
2 Lane Carriageway in Bypass / Realignment

S.No.	Design Chainage		Length (Km)	Remarks
	From	To		
1	17.765	19.270	1.506	Realignment at Dalkra
2	28.480	28.690	0.210	Curve Improvement at Buchet
3	32.220	32.370	0.150	
4	32.980	33.450	0.470	
5	33.660	33.900	0.240	
6	76.634	76.804	0.170	
7	78.584	78.784	0.200	
8	86.809	88.204	1.395	Kankrai Bypass
9	94.134	96.534	2.400	Sankhwas Bypass
10	101.464	102.894	1.430	Realignment at Gewaloo
		Total	8.170	

Figure 2-10: typical Cross section (Type-6)
Widening to 4-Lane Carriageway in Built up Area (Rigid)

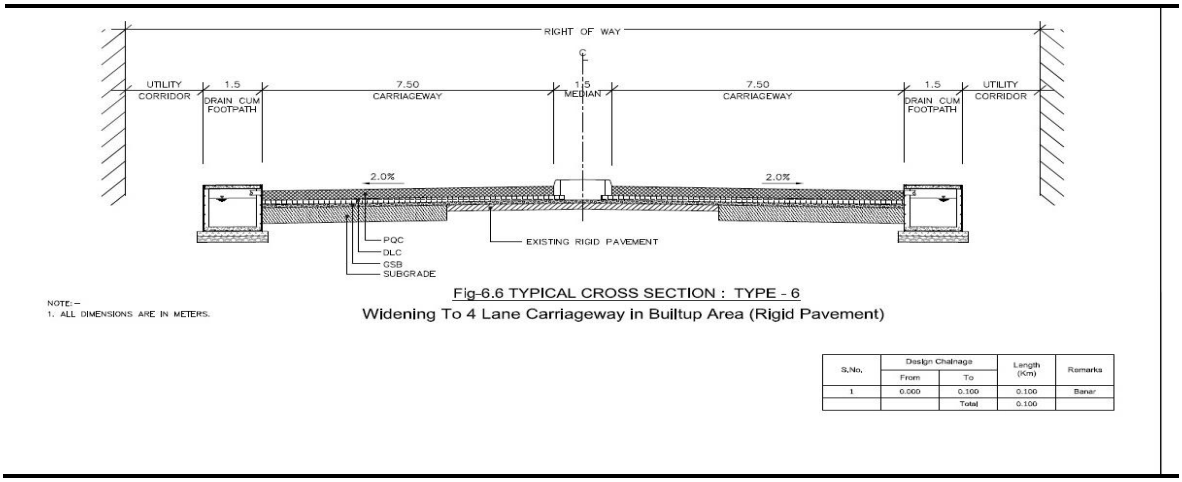


Figure 2-11: Typical Cross Section (Type-7) Widening to 2-Lane Carriageway in Built-up Area

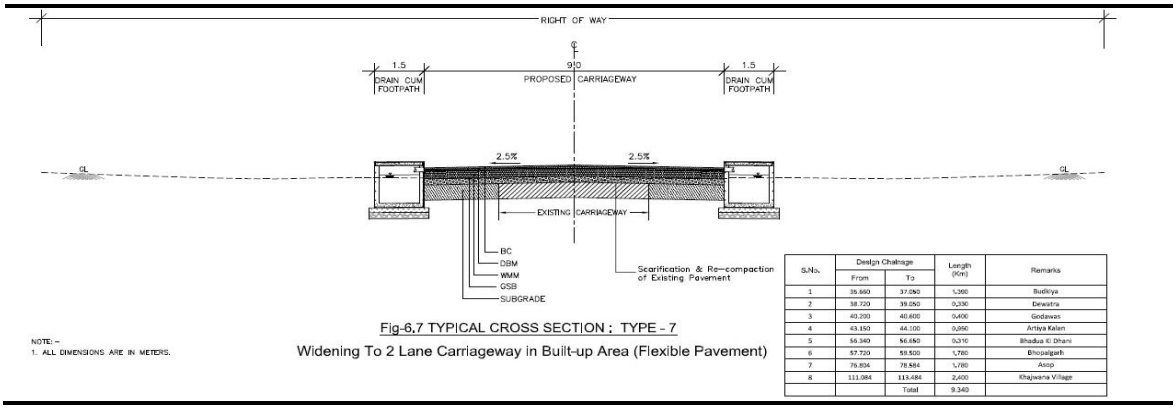


Figure 2-12: typical Cross Section (Type-8) Reconstruction of Existing Road to 4 Lane Carriageway in Built up Area

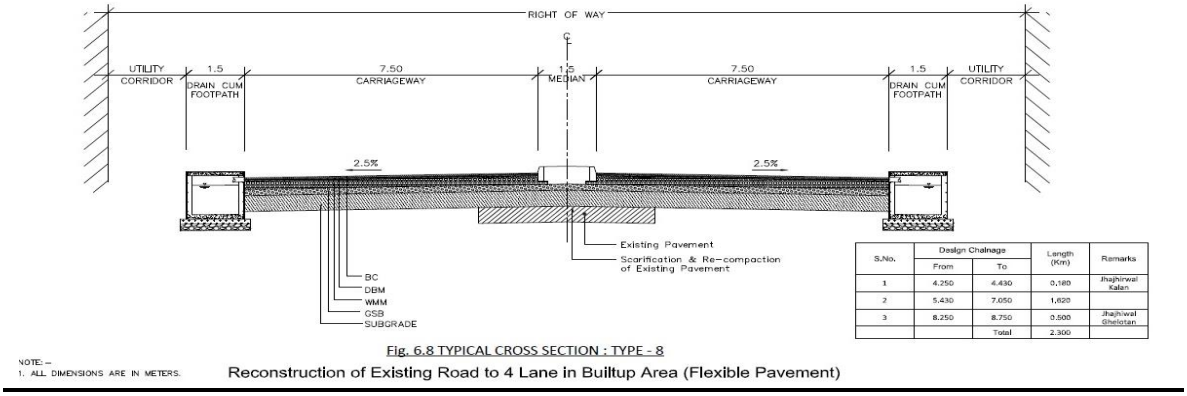
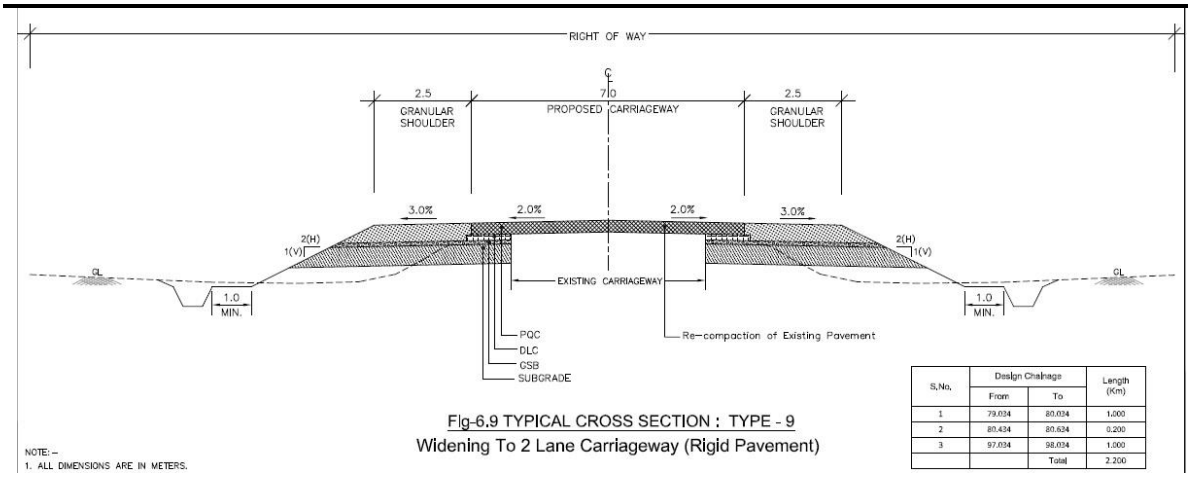


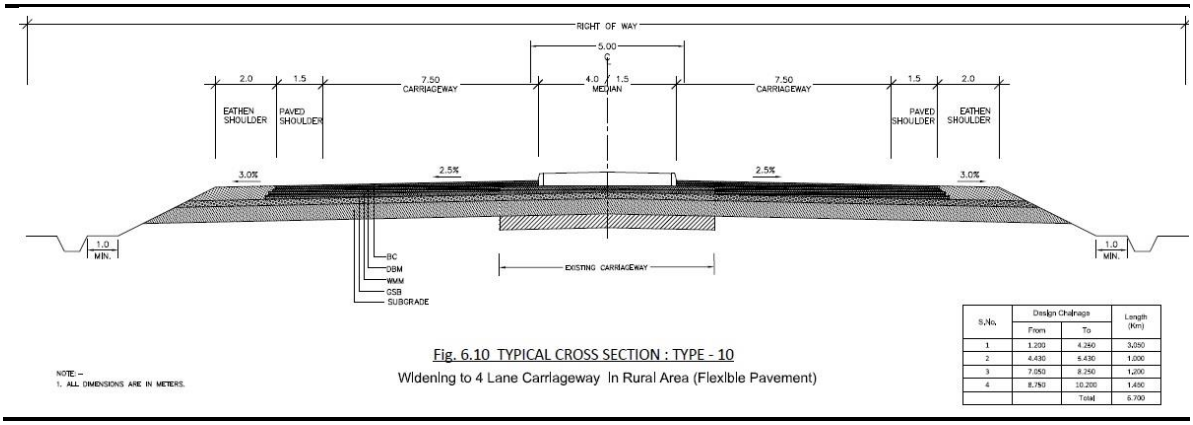
Figure 2-13: Typical Cross SectionType-9: Widening to 2 Lane Carriageway (Rigid Pavement)



S.No.	Design Chainage		Length (Km)
	From	To	
1	79.034	80.034	1.000
2	80.434	80.634	0.200
3	97.034	98.034	1.000
		Total	2.200

Fig-6.9 TYPICAL CROSS SECTION : TYPE - 9
Widening To 2 Lane Carriageway (Rigid Pavement)

Figure 2-14: Typical Cross Section (Type-10) Widening to 4 Lane Carriageway in Rural Area



S.No.	Design Chainage		Length (Km)
	From	To	
1	1.200	4.250	3.050
2	4.430	5.430	1.000
3	7.050	8.250	1.200
4	8.750	10.200	1.450
		Total	6.700

Fig. 6.10 TYPICAL CROSS SECTION : TYPE - 10
Widening to 4 Lane Carriageway In Rural Area (Flexible Pavement)

2.4.4 Realignment and Bypass

Two bypasses have been considered in the project to avoid congested habitations and ensure smooth flow of traffic. The location of the bypass are as follows:

- Kankrai Bypass between Chainage km 86+976 and Chainage km 88+017and
- Sankhwas Bypass: between Chainage 94+344 and Chainage 96 +298

The rationale for having of these two bypasses and the other details would be discussed in Section **Error! Reference source not found.**.

2.4.5 Proposed widening and pavement

Widening Schedule

At the settlement areas Typical Cross section 7 has been provided except for Baner where TCS -6 and TCS 4 has been proposed as 4- laning is proposed in this part. At Jhajhirwal and Thabukada villages TCS 8 widening has been proposed. All the realignment i.e. Kankarai Bypass, Sankhwas Bypass and Gawaloo Realignment the typical cross section 5 has been

proposed. The proposed widening schedule for project highway is presented in Annexure 2.4.

Pavement Design

Pavement for the new carriageway has been designed as per IRC: 37: 2102. The rigid pavement shall be provided at Toll Plaza Location and existing rigid pavement locations.

2.4.6 Bridge & Cross Drainage Structures

The existing culverts at Chainage12+636 and 59+946 would be reconstructed and new 2x1.2 dia a 1x1.2 dia new HP culverts developed. The remaining 12 existing culverts, which are not to be reconstructed, shall be widened up to the roadway width of the carriageway & as per the typical cross section of the particular section. Additionally, 120 new culverts shall be constructed equal to roadway width of the Project Highway

2.4.7 Toll Plaza

Toll plazas of 3 nos. are proposed near Jajiwal Gehlotan at km 7+700, 49+100 and near Gawaloo Village at km 104+834.

2.4.8 Bus-Shelters

Bus-shelters are proposed near 15 village locations on both sides of the project road as an improvement option. The locations of these are presented in Table 2-4.

Table 2-4:Location of Bus shelters

Sl. No	Design Chainage	Side of the carriageway	Village Name
1.	0+310	Both LHS & RHS (same chainage)	Baner
2.	8+100	Both LHS & RHS (same chainage)	Jajiwal Gehlotan
3.	17+625	Both LHS & RHS (same chainage)	Daikra
4.	28+950	Both LHS & RHS (same chainage)	Bucheti
5.	32+750	Both LHS & RHS (same chainage)	Nandiya Prabhawa
6.	36+550	Both LHS & RHS (same chainage)	Budkiya
7.	44+400	Both LHS & RHS (same chainage)	Artiya
8.	57+600	Both LHS & RHS (same chainage)	Bopalgarh
9.	63+250	Both LHS & RHS (same chainage)	Basani Sandwa
10.	69+484	Both LHS & RHS (same chainage)	Khumara
11.	77+154	Both LHS & RHS (same chainage)	Asop

12.	86+634	Both LHS & RHS (same chainage)	Kankarai
13.	94+734	Both LHS & RHS (same chainage)	Sankhwas
14.	101+934	Both LHS & RHS (same chainage)	Gawaloo
15.	111+634	Both LHS & RHS (same chainage)	Khajwana

Source: Feasibility Study

2.4.9 Drains

Earthen drain is proposed in the rural areas and concrete covered drains /footpath is proposed in the built-up sections. The details of the longitudinal drains are presented in Table 2-5

Table 2-5:Details of proposed Longitudinal drain

Sl. No	Location		Length	Side	Type of Drain
	From	To			
1.	0+000	1+200	1.200	Both	Concrete
2.	1+200	4+250	3.500	Both	Earthen Unlined
3.	4+250	4+430	0.180	Both	Concrete
4.	4+430	5+430	1.000	Both	Earthen Unlined
5.	5+430	7+050	1.620	Both	Concrete
6.	7+050	8+250	1.200	Both	Earthen Unlined
7.	8+250	8+750	0.500	Both	Concrete
8.	8+750	12+150	3.400	Both	Earthen Unlined
9.	12+150	12+570	0.420	Both	Concrete
10.	12+570	35+660	23.090	Both	Earthen Unlined
11.	35+660	37+050	1.390	Both	Concrete
12.	37+050	38+720	1.670	Both	Earthen Unlined
13.	38+720	39+050	0.330	Both	Concrete
14.	39+050	40+200	1.150	Both	Earthen Unlined
15.	40+200	40+600	0.400	Both	Concrete
16.	40+600	43+150	2.550	Both	Earthen Unlined
17.	43+150	44+100	0.950	Both	Concrete
18.	44+100	56+340	12.240	Both	Earthen Unlined

Sl. No	Location		Length	Side	Type of Drain
	From	To			
19.	56+340	56+650	0.310	Both	Concrete
20.	56+650	57+720	1.070	Both	Earthen Unlined
21.	57+720	59+500	1.780	Both	Concrete
22.	59+500	76+804	17.304	Both	Earthen Unlined
23.	76+804	78+584	1.780	Both	Concrete
24.	78+584	111+084	32.500	Both	Earthen Unlined
25.	111+084	113+484	2.400	Both	Concrete
26.	113+484	126+033	12.550	Both	Earthen Unlined

Source: Feasibility Study

2.4.10 Junction improvement

The investment proposal would also has provision for improvement of the 11 junctions along the alignment. These include the ones in habitation areas as well at the intersection of SH and NH. The junction improvement would help in reducing accidents and also enhance traffic safety along the corridor

Figure 2-15: Location of the Junction Improvement

Sr. No.	Location	Type of Junction	Cross Road	Remarks
1	0+000	Y	NH-112	Banar
2	12+584	Y	Bypass for NH-65	Thabukra
3	17+900	Y	Cross Road	Daikra
4	58+940	X	MDR-90	Bhopalgarh
5	77+364	T	MDR-58	Asop
6	86+979	Y	Start of kankrai bypass	Kankrai
7	88+017	Y	End of Kankrai Bypass	Kankrai
8	94+344	Y	Start of Sankhwas	Sankhwas
9	96+289	Y	End of Sankhwas bypass	Sankhwas
10	112+974	X	SH-39	Khajwana
11	126+033	X	Kuchera Bypass	Kuchera

LOCATION OF THE PROPSOED JUNCTION IMPROVEMENT

Baner-Bopalgarh—Kuchera Road

SH 63

Source Feasibility Study

2.5 Project Environmental Setting

The proposed road start at the junctions of NH 119 and SH 63 approximately 14 km north east of Jodhpur town. It traverses in a north -easterly direction and terminates at Kuchera at the junction of SH 63 and NH 89 approximately 40 Km South-east of Nagaur

- En-route the project traverses through the Jodhpur and Bopalgarh Tehsil of Jodhpur District and Nagaur Tehsil of Nagaur District
- The entire alignment lies on the western side of the Aravalli and thus runs through an arid area.
- The alignment lies in the basin of the Luni River

2.6 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 Figure 2-16

2.7 Infrastructure Requirement for Highway Development

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

Construction Camp

Even though local labour would be employed to the extent possible, number of activities would require specialised 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 would setup a construction camp for the accommodation of the workers.

Hot Mix Plant

For the manufacturing of the Bituminous material the Contractor would setup a Hot mix Plant. The plant would be setup considering the siting guidelines specified by regulatory authorities.

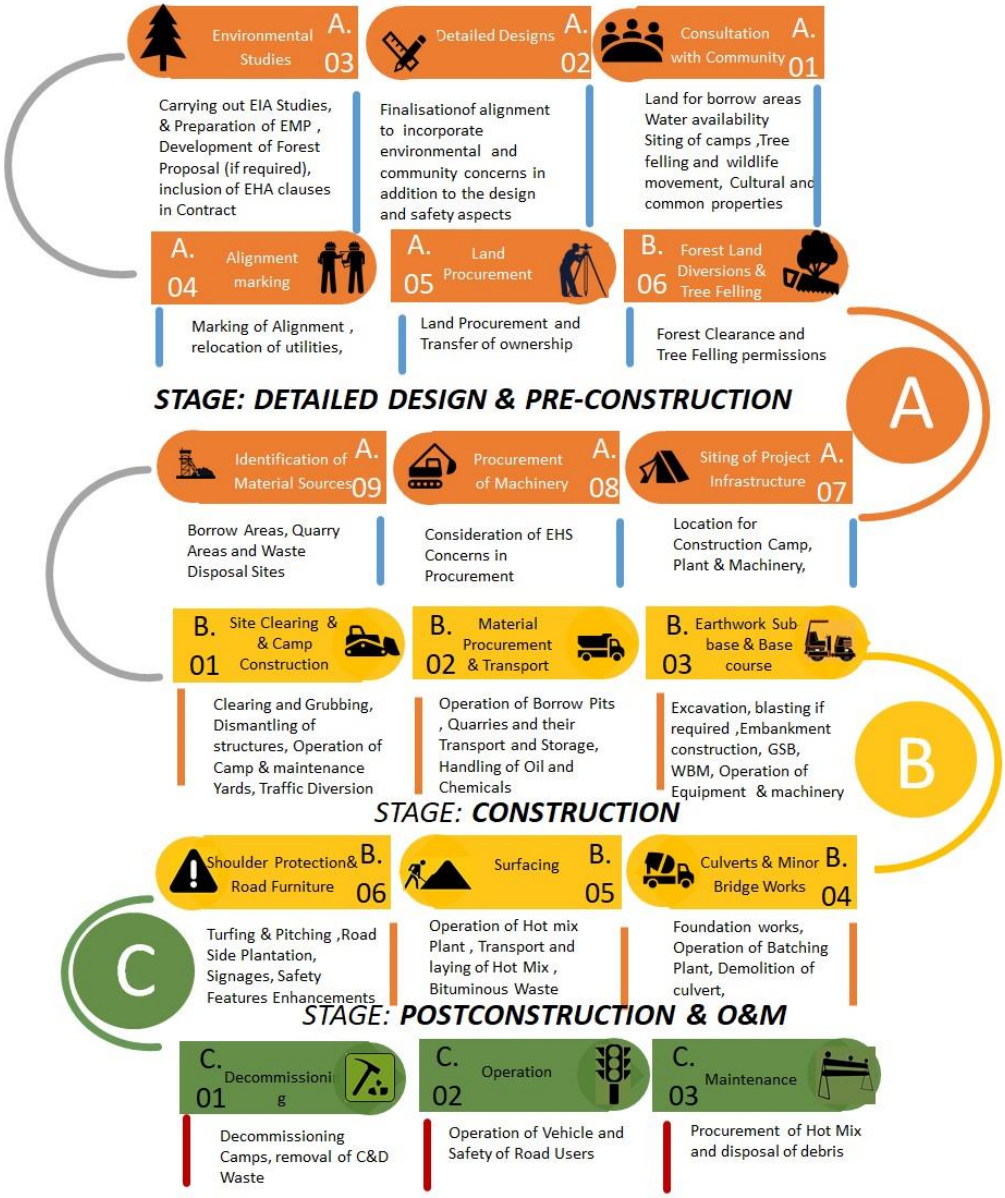
Batching Plant

The Concrete batching plant would also be 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.

Laydown Areas

The contractor would identify an area for storage of the raw-material required for construction including soil, sand GSB and aggregates. These would be stored as open heaps within the lay down area. The lay down area might also be sued as a maintenance yard for the vehicles and machinery.

Figure 2-16: Activities in the Typical Highway development project under PPP mode



Waste Storage Area

The excavate material from the pavement would have to be stored at some places before it can be utilised or disposed of at a permanent disposal site provided by the PWD or the panchayat.

2.8 Resource Requirements for The Project

Soil for the embankment, subgrade and shoulders

The Feasibility studies have estimated that 199237.52cum of earth would be required for the embankment. This would be sourced from borrow areas which would be identified by the Contractor at the time of construction. The locations of the borrow area would not only satisfy the requirements of MoRTH specifications but also meet the environmental health safety requirement.

Granular material for sub-base

The feasibility studies estimated that 340030.15 cum of granular subbase would be required. These would be sources from local sources in the proximity to the project locations. The facilities which operate with valid environmental clearance would only be selected by the contractor during the Pre- Construction stage

Stone aggregate for use in pavement course and cement concrete

The preliminary design estimates that 41074.90cum of bituminous concrete and 61514 cum of Dense Bituminous Macadam would be used for the project. The aggregate required for these works would be sources from licensed quarriers. The Contractor shall identify these during the pre-construction stage

Concrete

The construction of the Culverts and bridges would require 8237.59 cum of concrete for the cross drainage structure mentioned in Section 2.4.5

Power

Power required at the construction camp would be drawn from the grid where it is available, else DG sets would be used to supply the power to the Camp. 2 nos. of 500 KVA DG set would be used for the supply of power. 1 DG would be in running condition and 1 on standby. In addition, one nos. of 100 KVA DG set would be used for domestic purpose.

Manpower

The manpower requirement would vary over the construction period depending on the quantum and type of work involved. The peak manpower requirement would be approximately 200 of which the average manpower requirement for the project road would be approximately 100 . The skilled manpower, primarily the machine operators and concrete casting crew would be migrant labour and would be housed in the construction camp . On an average the crew in the construction camp is likely to be around 60 persons at any given point of time . The remaining 40 workmen would be local labour who would be working as day labours

Time Frame

The construction period would be 18 months and the earth work and GSB would be completed within the 6- 9 months.

Water

Water requirement during the construction stage has been calculated considering the above timeframe. The project would require water for both construction activities and domestic purpose during the construction period. The operations period of the project would also have water requirement, but the quantities required would be much lesser in quantities.

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

Considering the above, it is estimated that during the earthwork and the subgrade formation the total consumption of water is around 64,041 KL which would be an average of 150- 175 KLD during the peak construction period. This would be inclusive of 1235 KL of water required for concrete casting.

In addition to the above, approximately 10 KLD of water would be required for domestic purpose at the camp and construction site. During the operations phase the water would be required primarily for domestic use at the toll plaza and landscaping. The daily consumption would be around 5 KLD.

2.9 Pollution Sources & Characterisation

2.9.1 Construction Phase

During construction phase environmental impacts are likely to result primarily from operation of heavy machinery and equipment, vehicular movement and from influx of workforce. The potential pollutant sources for construction phase and their characterisation has been discussed in the subsequent section.

Operations of Heavy Machineries & Vehicular Movement

The operations of construction vehicles, diesel generators and machineries would contribute to Suspended Particulate Matter (SPM), Sulphur and Nitrogen dioxides (SO2 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 adoption of good engineering practices.

Also, during construction phase, noise will be generated from operating heavy machineries to be used 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

It has been estimated in the Feasibility Report that approximately 2.19 lakhs cum of material would be excavated from the existing carriageway. In addition, there would be waste from the batching plant, hot mix plant and from the demolition of existing cross drainage structures on the road. Some of the material would be recycled and used for back filling. Material which cannot be recycled would be considered as Construction and Demolition waste and has to be disposed of as per the existing rules.

Discharge from Campsites

Sewage effluent will be to 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. such

2.9.2 Operation Phase

During operations of the proposed highway both solid (municipal) and liquid waste would 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 of.

3 POLICY, LEGAL & ADMINISTRATIVE FRAMEWORK

3.1 Introduction

To address environmental risks of the project and its associated components and to protect and conserve the environment from any adverse impacts, the regulations, policy and guidelines enacted by the Government of India and Government of Rajasthan and which must be followed are presented in the sections below. In addition, The World Bank have their own set of requirements i.e. the Operational Policy to which any project funded by them must also ensure compliance.

This Section focuses on the administrative framework under the purview of which the Project will fall and the ESIA study will be governed, namely:

- The national and local, legal and institutional framework;
- World Bank Policies and framework; and
- International Safeguard Requirements.

3.2 Overview of Indian Environmental Legislation and Administrative Framework

The Constitution of India under Article 21 assures that "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country." Similarly, Article51 (A) also make say that "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures." Considering the direction from the constitution, the Government of India has laid out various policy guidelines, acts and regulations pertaining to protection of environment. Consequently, the individual states have also framed rules to further the cause of environment projection.

The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Central Ministry of Environment Forests and Climate Change (MoEF&CC) and the Central Pollution Control Board (CPCB) / State Pollution Control Board (SPCB).

3.3 Applicable Environmental Legislation

The legislation rules and policies applicable to the project has been reviewed and the actions which would be required has also been defined. The summary also provides the responsibilities for the implementation along with the statutory agency responsible for its enforcement. A summary of environmental legislations / regulations relevant to Baner-Kuchera project is furnished in Table 3-1.

Table 3-1: Summary of the Legal and Policy requirement in the Project

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
The Environment Protection Act 1986	The Environment (Protection) Act is an umbrella legislation seeking to supplement the existing laws on the control of pollution (the Water Act and the Air Act) by enacting a general legislation for environment protection and to fill the gaps in regulation of major environmental. hazards. The act empowers central government to make rules to regulate environmental pollution, such as- The standards of quality of air, water, soil for various areas and purposes etc. Prohibits carrying out of any industry, operation or process which discharges or emits environmental pollution more than the standards Regulates handling of hazardous substances States, the persons responsible for discharges, bound to prevent or mitigate environmental pollution and intimate the any accidents due to any occurrences.	MoEFCC	The Act and the Rules framed under the act defines the standards for emission and discharges. All the equipment machinery which would be used in the project has to comply with the emission and or discharge standards specified. The wastes which would be generated if gets classified under any of the said category (municipal, plastic, construction and demolition, hazardous, e-waste etc) would also have to meet the requirements of the rules framed under the provisions of the act.	The responsibility of ensuring compliance to these rules and standards under the act would lie with the Contractor. However, The PPP Division of the PWD needs to have oversight and would be responsible for ensuring compliance as an employer.

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
EIA Notification 2006 and amendments thereafter	Sand borrow soil and aggregate used for road construction has been classified as a minor mineral as per The Rajasthan Minor Mineral Concession Rules, 2017.	District Level Expert Appraisal Committee/ District Level Impact Assessment Authority	The quarry sites borrow areas and the sand mines would require a prior environmental clearance under the EIA Notification 2006.	The Contractor has to obtain necessary clearance before use of any borrow area and quarry. The PPP Division through the PIU/Authority Engineer should ensure that no un-authorised sites are used for procuring the construction material
The Forest Conservation Act 1980 and The Forest Conservation Rules 1981	The central government enacted The Forest (Conservation) Act in 1980 to stop large scale diversion of forestland for non-forest use.	The Forest Department, Government of Rajasthan and MoEF&CC	The proposed alignment does not pass through any forest area hence no clearance is required.	Any change in the alignment would require a fresh diligence to be carried out to assess the implications on forest and protected areas. Highways /sub-projects passing through any protected area (e.g. National Park, Reserve Forest, Protected Forest Wildlife Sanctuaries) or requiring use of any forest land for construction would need to obtain prior clearance[4]

[4] As per the Forest Conservation Rules (1981, amended 2003) a Forest Clearance from Department of Forests is required for diversion of forest land for non-forest purpose. Processing of the forestry clearance entails two stages: stage I and stage II. Amongst other requirements stage I clearance requires the

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
				under the provisions of the Act
The Wildlife Protection Act 1972[5] and the Supreme Court Ruling thereto	The act was enacted to protect wild animals and birds through the creation of National Parks, Sanctuaries, Conservation Reserve, Tiger Reserve.	Wildlife Division, Government of Rajasthan/ MoEF&CC	The present alignment does not pass through any wild life sanctuary	
Notification of Eco-Sensitive Zones	Non-forest activities in the eco-sensitive zone around a Wildlife Sanctuary or National Park would require recommendation[6] of the National Board of Wildlife	Wildlife Division, Government of Rajasthan/ MoEF&CC	There are no Eco-Sensitive Zone in the Project Influence Area	
The Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Rules 1974	The Act vests regulatory authority on the State Pollution Control Board and empowers them to establish and enforce effluent standards for industries and local authorities discharging effluents.	Rajasthan State Pollution Control Board	All the discharges from the project activities especially construction camps/Labour Camps need to meet the standards specified.	The Contractor has to obtain a Consent to Operate under the said Act. The Consent has to be regularly renewed during the tenure of the project. The PPP Division through the Authority Engineer

applicant to make payments for compensation of forestry land that will be acquired and trees that will be cut under the project. Accordingly timely allocation of budget for this purpose by the applicant is necessary to expedite the clearance process.

[5] Hon'ble Supreme Court though a number of order has made it essential to seek the recommendations of the National Board of Wild Life for regulating activities in the adjoining areas to the Protected Areas. Protection

[6] In pursuance to the order of Hon'ble Supreme Court dated 4th December 2006 in \Writ Petition (Civil) No. 460/2004, all non-forest activities in the Ecosensitive Zone would be under the jurisdiction of the notification. The Hon'ble Supreme Court vide its order dated 4th December 2006 had further directed that in case the Eco-Sensitive Zones are not declared by the respective states an area of 10km adjoining the sanctuary or national park would be declared as an Eco-Sensitive Zone

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
				should ensure compliance.
The Air (Prevention and Control of Pollution) Act, 1981(Amended 1987) and Rules 1982	An Act to provide for the prevention, control and abatement of air pollution The Act vests regulatory authority on the State Pollution Control Board and empowers them to establish and enforce emission standards for industries, other activities including local authorities carrying out emissions.	Rajasthan State Pollution Control Board	Applicable for equipment and machineries potential to emit air pollution e.g. hot mix plant, rock crusher, diesel generator and construction vehicles need to adhere to the norms specified in the rules. Consent for Establishment (CFE) and Consent for Operation (CFO) would be required for the plants from RSPCB prior to the establishment	The Contractor has to obtain a Consent to Operate under the said Act. The Consent has to be regularly renewed during the tenure of the project. The PPP Division through the Authority Engineer should ensure compliance.
Ancient Monuments & Archaeological Sites and Remains Act, 1958; Indian Treasure Trove Act, 1878; The Rajasthan Monuments, Archaeological Sites and Antiquities (Act 1961) & Rules (19680	This Act provides for the preservation of ancient and historical monuments, Archaeological sites, remains of national importance, sculptures, carvings, etc. According to this Act, areas within the radii of 100m and 300m from the 'protected property' are designated as 'protected areas' and 'controlled areas' respectively. No development is permitted in such areas without prior permission from the Archaeological Survey of India (ASI).	Rajasthan Archaeological Dept. & Archaeological Survey of India	The proposed alignment would not interfere or infringe on any archaeological monument in Jodhpur or Nagaur District. However, in case of Chance find the provisions of the Indian Treasure Trove Act, 1878	The Contractor and PPP Division have to ensure compliance of the Indian Treasure Trove Act, 1878 in case of chance finds
Solid Waste Management Rules 2016	Source segregation of degradable, non-degradable and hazardous wastes to be ensured.		The municipal solid waste generated from the labour camps would have to comply with the provisions of segregation of waste and its treatment & disposal.	The Contractor has to ensure compliance to the rules

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
Construction and Demolition Wastes (Management) Rules 2016	• Every waste generator shall prima-facie be responsible for collection, segregation and storage of construction and demolition (C & D) waste generated, as directed or notified by the concerned local authority in consonance with these rules. • The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed separately. • Any activity that generates 20 tonnes per day or 300 tonnes per project in a month must prepare a Waste Management Plan. • Waste generator either must store the waste within the premises or must supply to the city level collection centre and should avoid all kinds of obstruction to traffic/public or in drains.	Rajasthan State Pollution Control Board	Sub-projects would generate construction waste during the dismantling of the old pavement or cross drainage structures. These wastes must be segregated, stored and disposed of separately as per the provision of these rules. A Waste Management Plan would also be developed for the project.	The Contractor has to ensure compliance and ensure disposal. However, the excavated material can only be declared as a waste in case the Authority Engineer certifies that the same cannot be used for any other use.
Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules 2008 (Amended 2009),	The rules regulate the management and handling of Hazardous Waste generated from any activity. The rules make a distinction between hazardous waste and other waste (Waste tyre, paper waste, metal scrap, used electronic items, etc) and recognise them as resource for recycling and reuse.	Rajasthan State Pollution Control Board	The hazardous waste generated from the construction e.g. waste oils, lubricants, and bitumen would have to comply with the provisions of the rules with regards to storage and disposal. The rules also make it mandatory for maintaining records and reporting the same to the RSPCB.	The Contractor Would have to obtain an authorisation as a generator of hazardous waste from the Rajasthan pollution Control boards. All the waste oil, lubricants would have to be disposed as per the provisions of the act. The PPP

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
				Division/Authority Engineers has to ensure that the Contractor complies with these provisions
Central Motor Vehicle Act (1988) Central Motor Vehicle Rules (1988)	The standards for vehicular emission specified under the provisions of the Environment Protection Act 1986, are enforced by the provisions under this act	Transport Department, Government of Rajasthan	The vehicles must obtain a Pollution Under Control Certificate under the provisions of the Act.	The Contractor has to ensure all vehicle operating in the project ether directly under their control or through subcontractor have valid Pollution under Control Certificates.
Rajasthan Land Revenue Act,1956 and its amendments	No forest produce shall be moved into or from or within any area in the State of Rajasthan without a pass issued by a Forest Officer and as per the conditions specified in the pass	Forest Department, Government of Rajasthan	The removal of trees from forest land and those within the RoW would require authorisation from the Forest Department. For trees on private land regulatory processes as applicable shall be dealt in the Resettlement Action Plan	
Fly Ash Notification 2016	The Notification mandates road construction projects within an area of 300 Km to mandatorily use fly ash for construction of the embankment.	Ministry of Environment Forest and Climate Change	The Contractor has to use the fly ash from V S Lignite Power Private Limited in Bikaner and Giral Lignite Power Plant in Barmer	The responsibilities lie with the Contractor while the PPP division/Authority Engineer has to ensure that the fly ash utilisation takes place. As per the direction of the NGT[7] the PPP division as

[7] Application No. 102 of 2014 by Sandplast (India) & Anr. regarding Utilization of Fly Ash

Policy/Acts/Rules	Applicable /Project Relevant policies	Responsible Agency	Implications for Baner-Kuchera Road	Responsible Institution
				employer is responsible for ensuring utilisation of fly ash.
Abstraction of Ground water u/s 5 of the Environment (Protection) Act, 1986	Ground water abstracted for construction purpose shall require the prior permission of the authority. The permission would be required for sinking the bore well and wells and the quantum of water that can be extracted and the dept from which it can be extracted.	Central Ground Water Board.	In case the Contractor withdraws ground water for the construction purpose he shall have to obtain a permission from the Central Ground Water Board.	The contractor has to obtain permission from CGWB for all borewells established by him during the construction period from which water would be extracted either for use in construction activity or domestic purpose.

3.4 Operational Policies of World Bank

Projects financed with World Bank assistance should comply with World Bank Operational Policies. The objective of World Bank's environmental safeguard policies are to prevent and mitigate undue harm to people and the environment in the development process. These policies provide guidelines for the identification, preparation, and implementation of programs and projects. The World Bank Environmental Safeguard Policies which would be triggered due to the project and are presented in Table 3-2

Table 3-2:Applicable World Bank Policies in the Project

World Bank Safe Guard Policies	Objective	Safeguard Requirements	Applicability to Baner – Kuchera Project
OP 4.01: Environmental Assessment	The policy requires environmental assessment (EA) of projects under Bank financing to help ensure that they are environmentally sound and sustainable. EA considers the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects.	The environmental issues in all projects need to be addressed adequately in advance. An integrated Environmental Screening and Environmental Assessment (EA) with Environmental Management Plan (EMP) needs to be developed to manage environmental risks and maximise environmental benefits	For each of the sub project road an Environmental Assessment and Environmental Management Plan would be carried out covering all the phases of the project
OP 4.04 Natural Habitats	The policy recognises that the conservation of natural habitats is essential for long-term sustainable development. The Bank supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue.	This policy may be triggered by the sub-projects where improvement activity of road would require forest/ sanctuaries, locating close to the natural habitats. Additionally, conservations areas which are not legally protected but have significant wildlife may also be called a modified habitat and would also trigger this policy	Even though project road does not pass through any forest policy would get triggered as there is considerable concentrations of wildlife in the area outside the protected areas in modified habitats e.g. community reserves.
OP 4.36: Forest	This policy focuses on the management, conservation, and sustainable development of forest ecosystems and resources. It applies to project that may have	Efforts would be made to ensure that the widening /construction of sub-projects do not infringe upon Forest lands	This would also not be triggered in case of this road

World Bank Safe Guard Policies	Objective	Safeguard Requirements	Applicability to Baner – Kuchera Project
	impacts on (a) health and quality of forests; (b) affect the rights and welfare of people and their level of dependence upon forests and projects that aim to bring about changes in the management, protection or utilisation of natural forests or plantations, whether they are publicly, privately or community owned. The Bank does not support the significant conversion or degradation of critical forest areas or related critical natural habitats.		

The Operational Policy (OP) 4.01 classifies projects into:

- Category A- requires a full Environmental Assessment (EA).
- Category B- projects require a lesser level of environmental investigation.
- Category C- projects require no environmental analysis.

The Rajasthan State Highway Development Project II has been categorised as "Category B" project because of the project does not interfere with any natural habitat or sensitive environmental areas. Further the impacts are mostly during the construction activities and are predictable and thus mitigation measures can be clearly defined.

3.5 Guidance

The Ministry of Surface Road Transport & Highways (MOSRT&H) specifications that govern road and bridges construction in India also cover environmental aspects of the works. In addition, the Indian Roads Congress also have environmental Codes which have integrated environmental considerations in them. These sections and codes which specifically related to the environmental safeguards are presented in Box 2.1

Box 3-1:Codes and Guidelines applicable

MOSRT&H Code:

- Section 111: Protecting the Environment, and Annexure A to Clause 501 which covers pollution aspects directly address environmental issues
- Clause 301 and 305: Stipulation of topsoil conservation
- Clause 302: safety during construction for blasting
- Clause 304 for excavation and safety for operation stage

- Section 810: maintenance of existing amenities and facilities
- Clause 201: Clearing and grubbing
- Clause 2501, precautions during river training works
- Clause 305: Location of borrow areas, soil erosion and control measures
- Clause 701: and provision of geotextiles under
- Section 517 recycle and reuse of existing pavement
- Clause 407: provision of turning
- Guidelines for Design of High Embankment
- Guidelines on Utilisation of Fly ash

IRC Codes:

- **Survey** & Design:
  - IRC SP 19 2001: Manual for Survey Investigation and Preparation of Road Project
  - IRC SP 54 - 2000: Manual for bridge Projects Geometric Design:
  - IRC SP 73 - 2007 Two-lining of Highways through Public Private Partnership Manual of Specifications & Standards,
  - IRC: 86, Guidelines for Selection, Operation and Maintenance of Pavers
  - IRC 38 - 1988 Design of Horizontal Curves for Highways
  - IRC SP 23 - 1983 Vertical curves on Highways
- Embankment:
  - IRC 75 - 1979 Design of High Embankments
  - IRC 88 - 1984 Lime Fly-ash stabilised soil
  - IRC SP 58 - 2001 Guidelines for Use of Fly Ash in Road Embankment Structures
- Drainage
  - IRC SP 42 - 2004 Guidelines of Road Drainage
- Signage
  - IRC 67: Codes of Practice for Road Signs
- Plantation & Land Scaping
  - IRC SP 21 2009: Land scaping and Tree plantation

3.6 Other Applicable Laws

Environmental issues during road construction stage generally involve equity, safety and public health issues. The road construction agencies are required to comply with laws of the land, which include inter alia, the following:

- The Public Liability Insurance Act, 1991 as amended and The Public Liability Insurance Rules, 1991 as amended: These provide for public liability insurance for providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government
- Noise Pollution (Control and Regulation) Rules, 2000, and as amended: This provides for standards for noise for day and night for various land uses and specifies special standards in and around sensitive receptors of noise such as schools and hospitals. Contractors will need to ensure compliance to the applicable standards and install and operate all required noise control devices as may be required for all plants and work processes.
- The Explosives Act 1884 and the Explosives Rules, 2008: These provide for safe manufacture, possession, sale, use, transportation and import of explosive materials such as diesel, Oil and lubricants etc.; and, for regulating the use of any explosives used in blasting and/or demolition. All applicable provisions will need compliance by the contractors.
- The Petroleum Rules, 2002: This provides for safe use and storage of petroleum products and will need to be complied by the contractors.
- The Gas Cylinder Rules 2004 and amendments: This provides for regulations related to storage of gas, and possession of gas cylinder more than the exempted quantity. Contractors should comply with all the requirements of this Rule.
- Manufacture, Storage and Import of Hazardous Chemical Rules of 1989 and as amended: These provide for use and storage of hazardous material such as highly inflammable liquids like HSD/LPG. Contractors will need to ensure compliance to the Rules; and in the event where the storage quantity exceeds the regulated threshold limit, the contractors will be responsible for regular safety audits and other reporting requirements as prescribed in the Rules.
- Hazardous & Other Wastes (Management and Transboundary Movement) Rules, 2016: These provide for protection of public from improper handling storage and disposal of hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal. Contractors will need to obtain permission from the State Pollution Control Boards and other designated authorities for storage and handling of any hazardous material; and will to ensure full compliance to these rules and any conditions imposed in the permit.
- The Bio Medical Waste Management Rules, 2016: This provides for control, storage, transportation and disposal of bio-medical wastes. As and where the contractor has any first aid facility and dispensaries, established in either temporary or permanent manner, compliance to these Rules are mandatory.
- The E-Waste (Management) Rules, 2016: This provides for management of E-wastes (but not covering lead acid batteries and radio-active wastes) aiming to enable the recovery

- and/or reuse of useful material from e-waste, thereby reducing the hazardous wastes destined for disposal and to ensure the environmentally sound management of all types of waste of electrical and electronic equipment. This Rule applies to every manufacturer, producer, consumer, bulk consumer, collection centres, dealers, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste or electrical and electronic equipment listed in Schedule I, including their components, consumables, parts and spares which make the product operational.
- Plastic waste Management Rules, 2016: This provides for control and management of the plastic waste generated from any activity. Contractors will ensure compliance to this Rule.
- The Batteries (Management and Handling) Rules 2001: This provides for ensuring safe disposal and recycling of discarded lead acid batteries likely to be used in any equipment during construction and operation stage. Rules require proper control and record keeping on the sale or import of lead acid batteries and recollection of the used batteries by registered recyclers to ensure environmentally sound recycling of used batteries. Contractors will ensure compliance to this Rule.
- The Ozone Depleting Substances (Regulation and Control) Rules, 2000 and as amended: This provides for regulation of production and consumption of ozone depleting substances in the country, and specifically prohibits export to or import from countries not specified in the Rules, and prohibits unless specifically permitted, any use of ozone depleting substance.
- Easement Act, 1882: This provides for the rights of landowners on groundwater. Contractors will need to ensure that other landowners' rights under the Act is not affected by any groundwater abstraction by the contractors.
- State Groundwater Acts and Rules as may be in force and the Guidelines for Groundwater Abstraction for drinking and domestic purposes in Notified Areas and Industry/Infrastructure project proposals in Non-Notified areas, 2012: These provide for regulating extraction of ground water for construction/industrial and drinking and domestic purposes. Contractors will need to obtain permission from Central/State Groundwater
- Boards prior to groundwater abstraction through digging any bore well or through any other means; and will ensure full compliance to these rules and any conditions imposed in the permit.
- The Insecticides Act, 1968 and Insecticides Rules, 1971 and as amended: These provide for to regulate the manufacture, sale, transport, distribution, export, import and use of pesticides to prevent risk to human beings or animals, and for matters connected therewith. No one should import or manufacture; sell, stock or exhibit foe sale; distribute, transport, use: (i) any misbranded insecticides, (ii) any insecticide the sale, distribution or use of which is for the time being prohibited under the Act; and (iii) any insecticide except in accordance with the condition on which it was registered under the Act.

- National Building Codes of India, 2005 and as amended: This provides guidelines for regulating the building construction activities in India. The code mainly contains administrative regulations, development control rules and general building requirements; stipulations regarding materials, structural design and construction; and building and plumbing services. Contractors will be required to comply with all Bureau of Indian Standards Codes dealing with: (i) use and disposal of asbestos containing materials in construction; (ii) paints containing lead; (iii) permanent and temporary ventilations in workplace; (iv) safety, and hygiene at the workplace; (v) prevention of fire; (vi) prevention of accidents from faulty electrical gadgets, equipment and accessories; and all other such codes incidental to the Contract.

4 EXISTING ENVIRONMENTAL CONDITIONS

4.1 INTRODUCTION

This section describes the existing environmental and social baseline of the study area around the Project Road. It includes relevant components of physical, biological and socio-economic environment.

The purposes of describing the environmental settings of the study area are:

- To understand the project needs and environmental characteristics of the area; and
- To assess the quality of the existing environment, as well as the environmental impacts of the future developments being studied.

The baseline environment for the EIA was studied through primary survey, information collected from secondary sources and discussion with local stakeholders.

4.2 METHODOLOGY

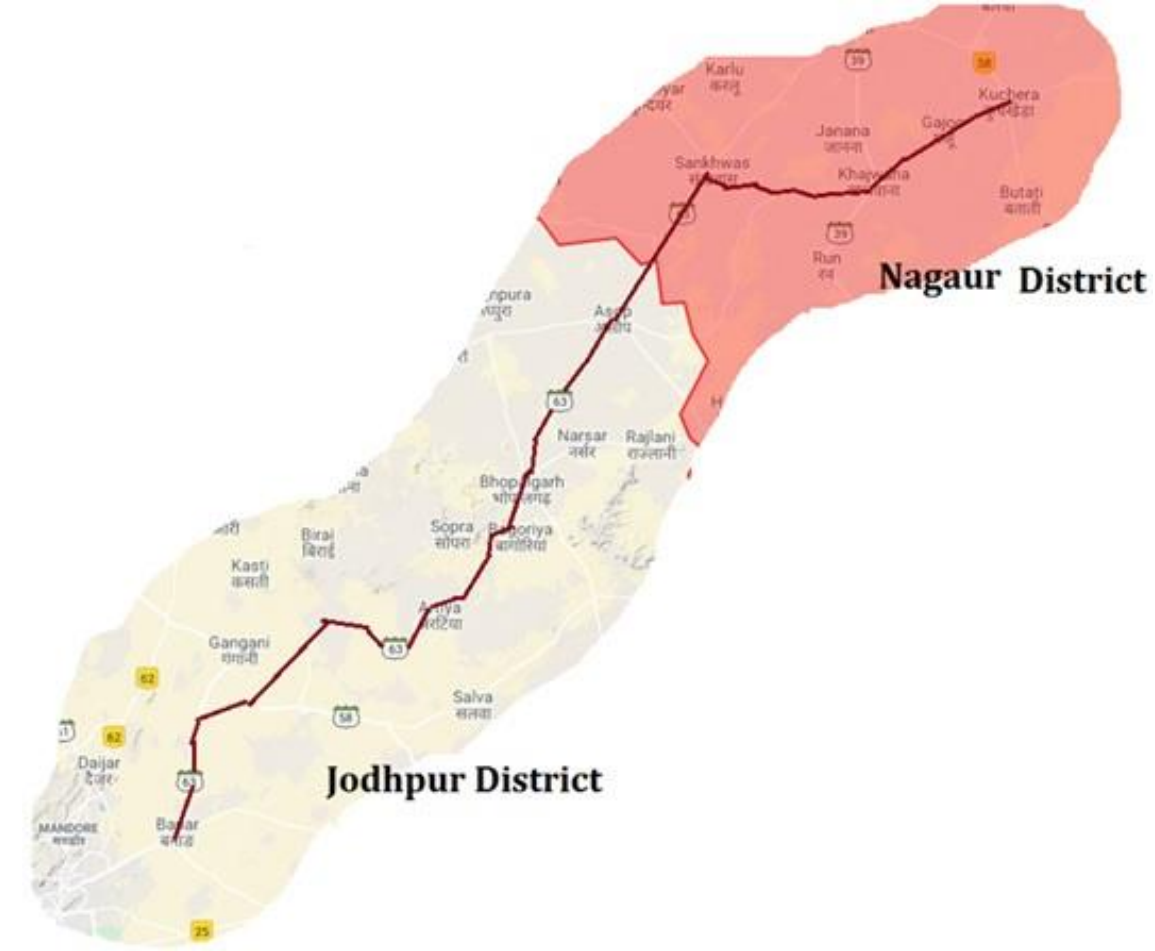
4.2.1 Study Area

As discussed in Section 1.8.1 the study area has been defined as follows

Corridor of Impact (CoI): The area of 500 m on either side of the proposed road centreline is considered as the corridor of impact. The proposed RoW i.e. 30 m is thus included within the CoI This area is more vulnerable to the project's direct impacts.

Project Influence Area (PIA): In accordance with MoEF&CC' s EIA Guideline Manual for Highways and as per guidelines of EIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arial distance) from boundary of road. Collection of secondary data, including likely impacts due to ancillary sites like borrow areas, quarry, material storage, disposal areas, etc. are done within this influence area.

Figure 4-1: The Project Influence Area



4.2.2 Environmental Surveys and Studies

The baseline information on physical, chemical, biological, social and economic aspects of the project area is the most important reference for conducting environmental impact assessment studies. The environmental setting, in which the activity of the project road including proposed bypasses would occur would determine the nature, and severity of the impact. Thus, for conducting EIA, existing environmental conditions along the project road have been obtained by primary data collection, monitoring, sampling and secondary data collection from published source and various government agencies. The primary studies focused on the Corridor of influence but the sensitivities in the project influence area has been collected through secondary literature.

To assess the baseline environmental status of the Corridor of Impact, monitoring of various environmental attributes were conducted by the consultants during October to December 2015. Primary data for ambient air quality, ambient noise status, water quality (Ground and surface) and soil quality was generated through NABL approved laboratory.

4.3 LAND ENVIRONMENT

4.3.1 Topography

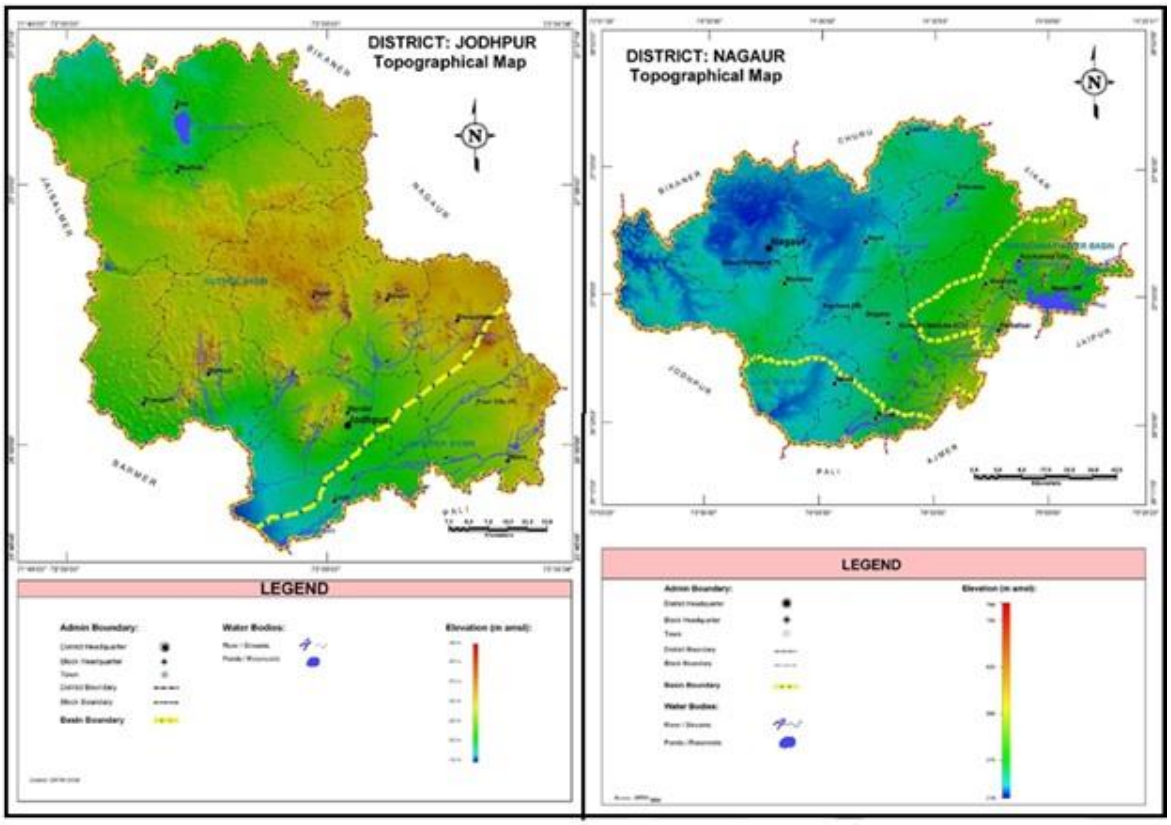
The Aravalli Range runs across the state from the southwest to the northeast. This range divides the state into two regions; 60% in the northwest of the range and 40% in the southeast of the Aravalli Range. The northwest region tract is sandy and unproductive with little water thus having characteristics of a desert. This is the Thar Desert region of Rajasthan. The condition improves gradually from desert land in the far west and northwest to comparatively fertile and habitable land towards the east. However, the area west of the Aravalli the conditions are still arid. The south-eastern region, and more fertile, and has a diversified topography. In the southeast, a large area within the districts of Kota and Bundi forms a tableland while the northeast of these districts is the rugged region (badlands) following the line of the Chambal River. Further, north the country levels out; the flat plains of Bharatpur district are part of an alluvial basin. Merta City in Nagaur district lies in the geographical centre of the state but is in the arid north-western region.

The project road also lies in the arid north-western region. It traverses through the eastern part of the Jodhpur districts and the south western part of Nagaur Districts. Physiographically, the Jodhpur district can be divided into three distinct units, viz. Alluvial plain, Escarpment and Sand dunes. The alluvial plain between Jodhpur and Bilara has a gently undulating topography with maximum elevation of 260m. The initial part of the alignment passes through this area and are thus characterised by almost a flat topography. The plain from Bilara in the east to Shergarh in the west is encircled by a group of hills, isolated hillocks and ridges separated by alluvium and sand filled valley. Minimum elevation (150 m) is found in the extreme lower part of Luni block whereas highest elevation is reached (448 m) in Bhopalgarh block. The alignment passes through this region and crosses the escarpment just before approaching Bopalgarh. This portion of the alignment is characterised by undulating terrain. The western and north-western parts of the district are characterised by sand dunes. The Luni River enters the district near Jhak and flows in south-westerly direction covering Bilara, Mandor and Luni blocks, leaving the district at Dhundara to enter in the Barmer district.

The general topography of Nagaur district is undulating. Eastern part of the district comprises small scattered hillocks. The slope of the area is towards west. The north-western part of the district is extensively covered with sand dunes. The general topography in the district ranges between 275 m to 375 m above mean sea level. Elevation ranges from a minimum of 275.0 m above mean sea level in Nagaur block in the NW part of the district and maximum of 794.0 m above mean sea level In Parbatsar block in eastern part of the district. As the alignment cross over from Bopalgarh Block in Jodhpur to Mundawah Block in Nagaur it passes to mostly flat terrain with small undulations.

The alignment passes along the edge of the Luni river basin and most of it passes through the undulating terrain characterised by local depressions. The physiography of both the districts are presented in Figure 4-2.

Figure 4-2: Physiography of the Jodhpur and Nagaur Districts

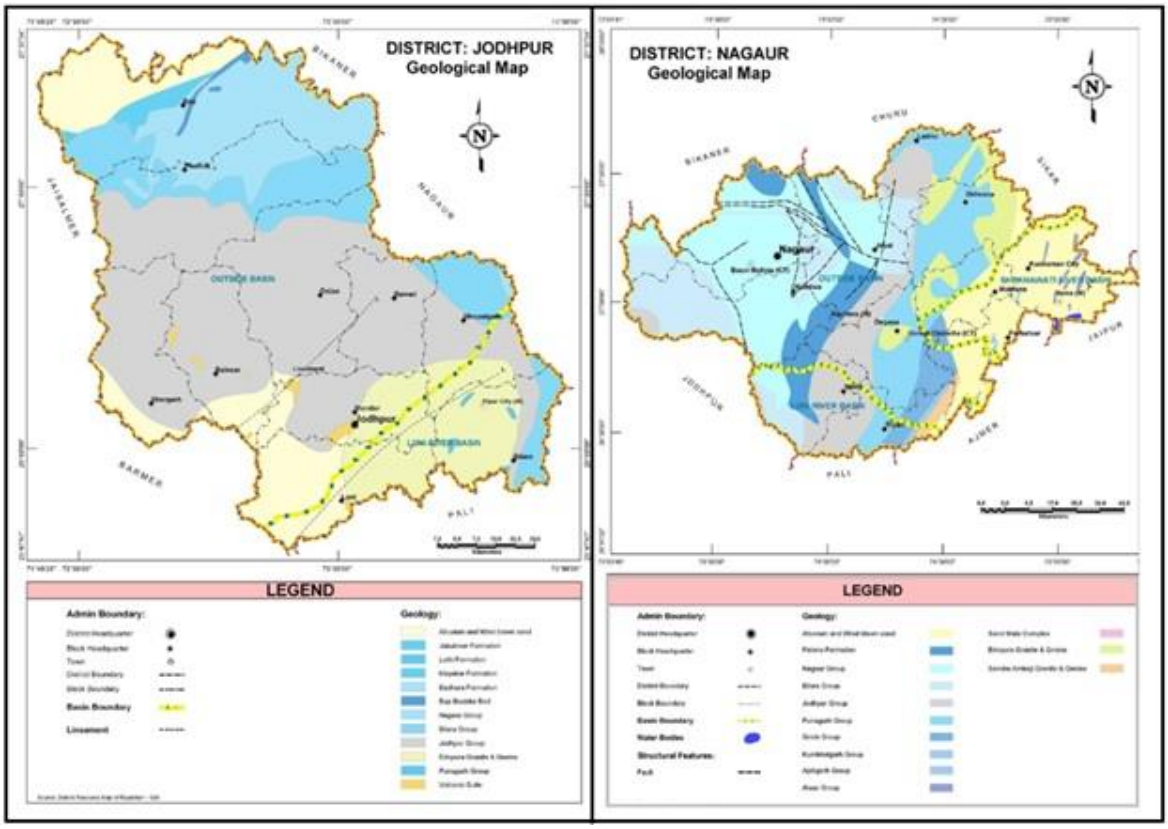


4.3.2 Geology

The regional geological set up of Jodhpur district indicates that the older rocks of Delhi super Group represented by Punagarh group include basic volcanic rocks, whereas of the Marwar Super Group is present in major part of the district & is represented by Jodhpur-Bilara and Nagaur groups. In the border region of Jodhpur, Jaisalmer and Bikaner some pockets of clays and fuller's earth of Jogria and Mudh formation can be seen in Figure 4-3.

The Nagaur Group is characterised by the presence of evaporite sequence i.e. anhydrite and gypsum in Nagaur area and halite in Lakhasar area. Youngest lithounits exposed in the district are of Lower Eocene age named as Jogria Fullers Earth which has locally been described as Kuchera-Khawaja Formation by the recent workers who had carried out geological mapping in Nagaur district. This formation is represented by calcareous shale, siltstone, marl, limestone and sandy limestone with highly fossiliferous horizons as can be seen in Figure 4-3.

Figure 4-3: Geological profile of Jodhpur and Nagaur Districts



4.3.3 Seismicity

Though the state of Rajasthan did not have any major earthquake in recent years, small to moderate earthquake have been felt in the state. Several faults have been identified in this region out of which many show evidences of movement during the Holocene epoch. The Cambay Graben terminates in the south-western part of the state. The Konoi Fault near Jaisalmer trends in a north-south direction and was associated with the 1991 Jaisalmer earthquake. Several active faults criss-cross the Aravalli range and lie parallel to each other. The most prominent of them is the north-south trending Sardar Shahr fault and the Great Boundary Fault which runs along the Chambal River and then continues in the same direction into Uttar Pradesh.

The Jodhpur and Nagaur districts in which the project road passes however fall in Seismic Zone II i.e. low earthquake damage risk zones.

4.3.4 Soil Type and Quality

The soil in the state is primarily divided into 7 distinct classes. The soil west of the Aravalli where the project road is located is Desert Soil. These soils have high nitrate content. The precipitation in these areas are low and thus this soil remain unproductive The Grey Brown (Desert) Soil which occurs in the areas adjacent to the Desert Soil occurs in the districts of Barmer, Jalor, Jodhpur, Sirohi, Pali, Nagaur, Sikar and Jhunjhunu.

Soils of the Jodhpur district have been classified as red desertic soil, desert soil and Lithosols and regosols of hills. The red desertic soils are predominant in central, eastern and southern parts of the district. The alignment also passes through this region. These are pale brown to reddish brown soils, loose and well drained and texture varies from sandy loam to sandy clay loam. The lithosols and regosols of hills are found in hills and hill slopes of central and western parts of the district. These are shallow, light textured, fairly drained and reddish brown to greyish brown in colour. These soils ae available in the central part of the alignment near Bopalgarh.

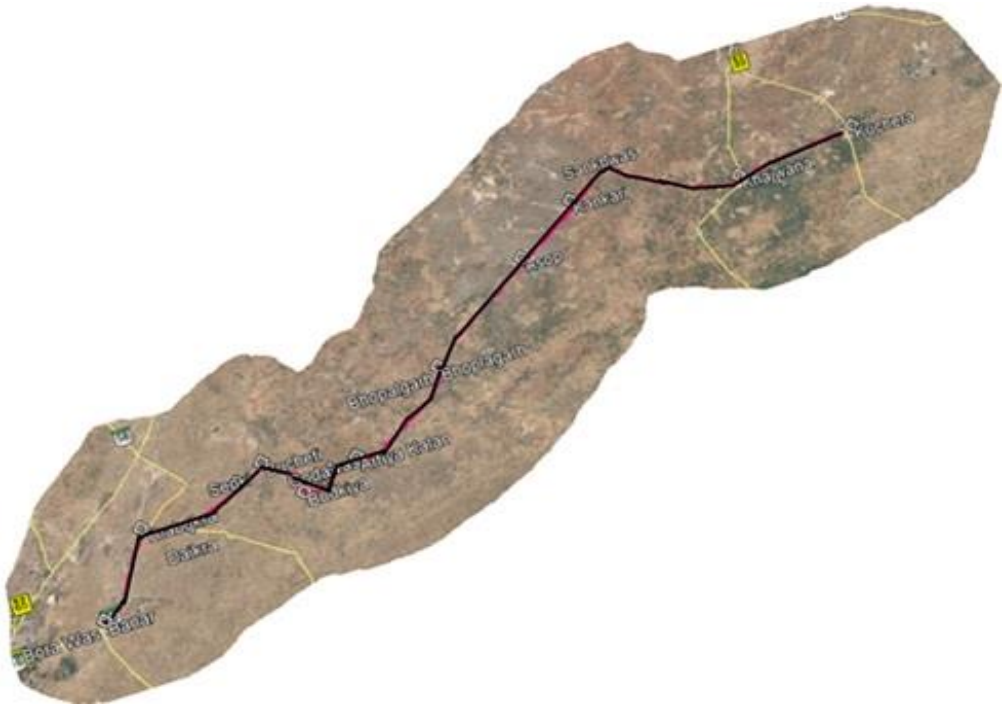
The desert soil occupies a considerable area covering northern and western parts of the district. These are mainly wind-blown sand and soils of interdunal depressions. The sand dunes occupy a small part in northern and north-western margin of the district. These are sandy to loamy sand, loose, structure less and well drained.

Four types of soils have been reported in the Nagaur district viz, clay, clay loam, sandy loam and sandy soil. The general texture of the soil in the area is sandy loam to clayey loam which is further classified into “Barani” or un-irrigated and “Chahi” or irrigated soil. A part of Nagaur tehsil and south-eastern part of Merta tehsil have deep sandy loam, while red loamy soil exists elsewhere in Merta tehsil except on the banks of river Luni. Light loamy soil occurs in Parbatsar tehsil away from hill ranges. The alignment lies east of Nagaur district and is thus characterised by sandy loam to clayey loam.

4.3.5 Land Use

In Jodhpur district about 70.03% of the total area (22, 56,405 ha) and are being cultivated.

Figure 4-4: Landuse in the Project Influence Area



The forest covering only 6996 hectares, i.e.0.31% of the total area of the district. Net cultivable area of the district is 131703 hectares whereas non-agriculture land area including fallow land is 514,159 hectares. Maximum cultivated area lies in Osian tehsil followed by Bhopalgarh tehsil. Similar land use patterns are observed in Nagaur' s where about 69.58% of the total area (1,771,800 ha) is being cultivated. The district had only 1.01% forest cover. Net cultivable area of the district is 1338,100 ha whereas non-agriculture land area including fallow land is 317,400 ha. Agriculture is the main occupation of the rural population in both the district.

The project road falls in the plain area. Land use pattern abutting the project road is mainly agricultural area followed by built-up areas. The landuse within the project influence area and the settlement along the project corridor is presented in figure 4.4.

Table 4-1:Landuse along the Project Corridor

Sl. No	Chainage		Landuse	Habitation	Landuse in between Habitation
	From	To			
1.	00+000	00+500	BU	Baner village	AG/BU/BA/SU
2.	04+000	04+500	BU	Jariwala Kalan	AG/BU/SU
3.	08+000	08+500	BU	Jajiwal Gehlotan	AG/SU
4.	12+000	12+500	BU	Thabukada Village	AG/SU
5.	18+000	18+500	BU	Daikra Village	AG
6.	21+000	21+600	BU	Gangani Village	AG/SU
7.	26+000	26+500	BU	Sevki Kalan	AG
8.	29+000	29+500	SU	Bucheti village	AG/SU
9.	33+500	34+000	SU	Nandiya Prabhawa Village	AG
10.	36+500	37+000	BU	Budkiya Village	AG
11.	39+500	40+000	SU	Dewatra Village	AG/SU
12.	41+000	41+500	BU	Godawas village	AG
13.	44+000	44+500	BU	Artiya Kalan Village	AG
14.	54+500	55+000	SU	Durga ki Dhani	AG
15.	57+000	57+500	BU	Bhadua ki Dhani	AG
16.	59+000	59+500	BU	Bopalgarh	AG
17.	64+500	65+000	SU	Basani Sandwa Village	AG/SU
18.	70+000	70+500	BU	Khumara Village	AG/SU

Sl. No	Chainage		Landuse	Habitation	Landuse in between Habitation
	From	To			
19.	77+500	78+000	BU	Asop Village	AG/SU
20	88+000	88+500	BU	Kankarai Village	AG/SU
21.	94+500	95+000	BU	Saanai Village	AG/SU
22.	96+000	96+500	BU	Sankhwas Village	AG
23.	103+000	103+500	BU	Gawaloo Village	AG/SU
24	113+000	113+500	SU	Khajwana Village	AG/SU
25.	123+000	123+500	SU	Gaju village	AG/SU
26.	127+500	128+000	BU	Kuchera	AG/SU

Note: AG: Agriculture Land; BU: Built-up Area; BA: Barren Area; CA: Commercial Area

Source: Primary Surveys

4.3.6 Sensitive Receptors along the Project Corridor

The sensitive land use along the project corridor either with respect to the ambient environment (both air quality and noise) or safety of the community in general and children in particular were identified. These included educational institutions, religious structure and healthcare institutions. Along the project corridor the 2 nos. of healthcare facilities, 19 nos. of schools and 32 nos. of religious structures have been identified. The location and their details are provided in Table 4-2.

Table 4-2:Sensitive land use/receptors along the alignment

Sl. No	Particulars	Chainage (kms)	Side (LHS/RHS)	Approximate Distance from CL
HEALTHCARE INSTITUTIONS				
1	Veterinary Hospital, Daikra	18+500	RHS	20m
2	Bhargav Clinic, Asop	78+200	RHS	12.6m
EDUCATIONAL INSTITUTIONS				
1	Govt. School	12+350	LHS	6.55m
2	Higher Secondary School, Daikra	18+500	LHS	16m
3	Higher Secondary School, Sev ki Khur Bawadi	25+200	RHS	12m
4	School	32+900	RHS	50m

Sl. No	Particulars	Chainage (kms)	Side (LHS/RHS)	Approximate Distance from CL
5	Higher Secondary School	36+400	LHS	7.75m
6	School, Godawas	40+550	LHS	10.4m
7	School, Artiya Kalla	49+650	LHS	6.6m
8	Higher Secondary Sanskrit School	54+500	LHS	9.9m
9	School	55+300	RHS	12.8m
10	High School, Jaivanji ki Dhani, Bopalgarh	57+050	LHS	5m
11	Jai Aman Public School	59+180	RHS	6.4m
12	High School, Bhodva ki Dhani, Bopalgarh	59+420	RHS	7m
13	High School, Basni, Sandva	63+900	LHS	9.96m
14	High School, Asop	78+550	RHS	12.6m
15	School	79+400	LHS	100m
16	Mahadev Public School	85+730	LHS	100m
17	Higher Secondary School, Khajwana	112+700	RHS	1m
18	School	120+740	LHS	16.4m
19	High School, Gaju	125+800	LHS	20m
	RELIGIOUS INSTITUTIONS			
1	Temple Baba Ramdeoji	1+000	LHS	9.15m
2	Temple –Balaji	4+310	RHS	16m
3	Temple	4+320	LHS	16m
4	Temple	4+400	RHS	30m
5	Temple	4+600	RHS	17m
6	Temple	6+200	LHS	20m
7	Temple	10+173	RHS	18.2m
8	Jagnathji Temple, Thubkheda village	12+350	RHS	30m
9	Temple	12+345	RHS	15.3m
10	Ashapura Maa Temple, Daikra	17+875	RHS	72m
11	Temple	18+330	RHS	81m

Sl. No	Particulars	Chainage (kms)	Side (LHS/RHS)	Approximate Distance from CL
12	Temple	18+600	LHS	10m
13	Temple, Surpore Village	21+150	RHS	35m
14	Temple	25+400	RHS	15.7m
15	Temple	29+152	RHS	7.5m
16	Temple	29+795	RHS	14.7m
17	Temple, Budkiya Village	35+620	RHS	15.3m
18	Temple	36+200	LHS	25m
19	Temple	38+850	RHS	9.5m
20	Temple	46+530	RHS	7.2m
21	Temple, Mata Rani, Bhatiyanji	54+080	LHS	40m
22	Mosque	58+500	RHS	7.23m
23	Temple, Bhopalgarh	59+700	LHS	5m
24	Temple	63+430	RHS	6.3m
25	Temple	67+000	LHS	17.5m
26	Vishwakarma Temple, Asop	77+580	RHS	16m
27	Temple	85+740	RHS	3.8m
28	Temple	103+800	LHS	100m
29	Baba Ramdeo Temple	112+050	Both Sides	14m LHS & 15.5m RHS
30	Temple	118+525	LHS	3.2m
31	Panchmukhi Balaji Temple, Chillora	120+100	RHS	12.8m
32	Temple	120+300	RHS	16m

Source: Primary Surveys

As pointed out in the above table some of these receptors are very close to the highway and with the expansion of the highways these would have to be relocated. Such cases would be discussed separately and included in the Resettlement And Rehabilitation Plan In case of some schools there would be land available between the edge of the alignment i.e. the drain and the boundary of the school but in some the formation width would almost touch the boundary wall making it a safety concern. Most of the schools visited have space in front of the classrooms between the boundary wall and the classroom, only in some cases it was

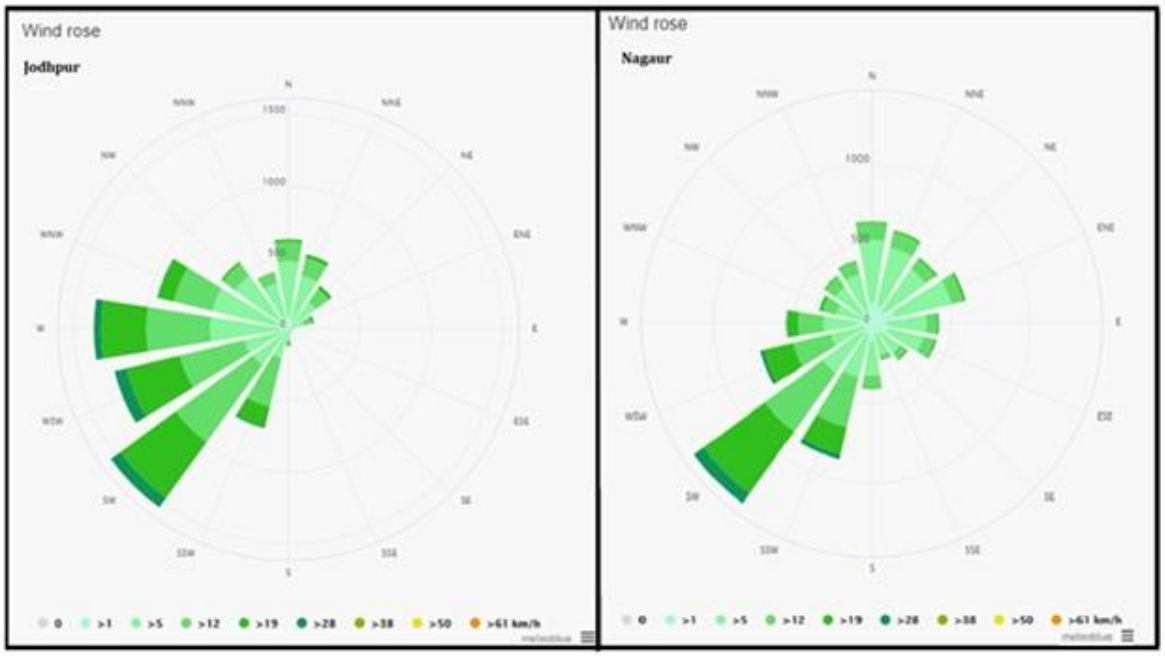
observed that the classrooms are adjoining the highway. In such classroom, students complained of high noise levels.

4.4 AIR ENVIRONMENT

4.4.1 Climate & Meteorology

Rajasthan has varying climate influenced to a large extent by the topography. The average temperature in winter ranges from 8° to 28° C (46° to 82° F) and in summer the average temperature ranges from 25° to 46° C (77° to 115° F). The rainfall is largely influenced by the Aravalli Range. The western part i.e. areas to the west of the Aravalli's that consists of the desert receives an annual rainfall of 100 mm (about 4 inches). The south-eastern part of Rajasthan, i.e. areas south east of the Aravalli Range, receives annually 650 mm (26 inches). Like most parts of India, the state receives a maximum rainfall during the monsoon season during the months of July to September. The annual spatially averaged rainfall is highly variable and it is most erratic in the western region with frequent dry spells, punctuated occasionally by heavy downpour in some years associated with the passing low pressure systems over the region.

Figure 4-5: Windrose of Jodhpur and Nagaur Districts



Source: https://www.meteoblue.com/en/weatherjodhpur_india/Nagaur

The project road lies in the arid to semi-arid regions of the eastern part of the desert area. The study area thus experience extremes of heat in summer and cold in winter which is the characteristic of the desert. Both day and night temperatures increase gradually and reach their maximum in May and June respectively. The temperature varies from 49°C in summer to 1°C in winter. In the months of April, May and June, high temperatures routinely exceed 40 degrees Celsius. During the monsoon season, average temperatures decrease slightly. The highest temperature recorded in Jodhpur was on 18 May 2016 when it rose up to 53.2 degrees Celsius.

Mean annual rainfall (1971-2012) varies between 374 mm – 410 mm whereas normal rainfall (1901-1970) is lower than average rainfall and is placed between 314 mm- 363.1mm in the study area. Rainy days are limited to maximum 15 in a year. Almost 80% of the total annual rainfall is received during the southwest monsoon, which enters the study area in the first week of July and withdraws in the mid-September. Probability of annual rainfall exceeding 650 mm is only 10%. However, there is 90% probability that the annual rainfall will be more than 190 mm. The probability of occurrence of mean annual rainfall is 45%.

Atmosphere is generally dry except during the monsoon period. Humidity is the highest in August with mean daily relative humidity at 81%. The annual maximum potential evapotranspiration in the district is quite high and is highest (264.7 mm) in the month of May and lowest (76.5 mm) in the month of December.

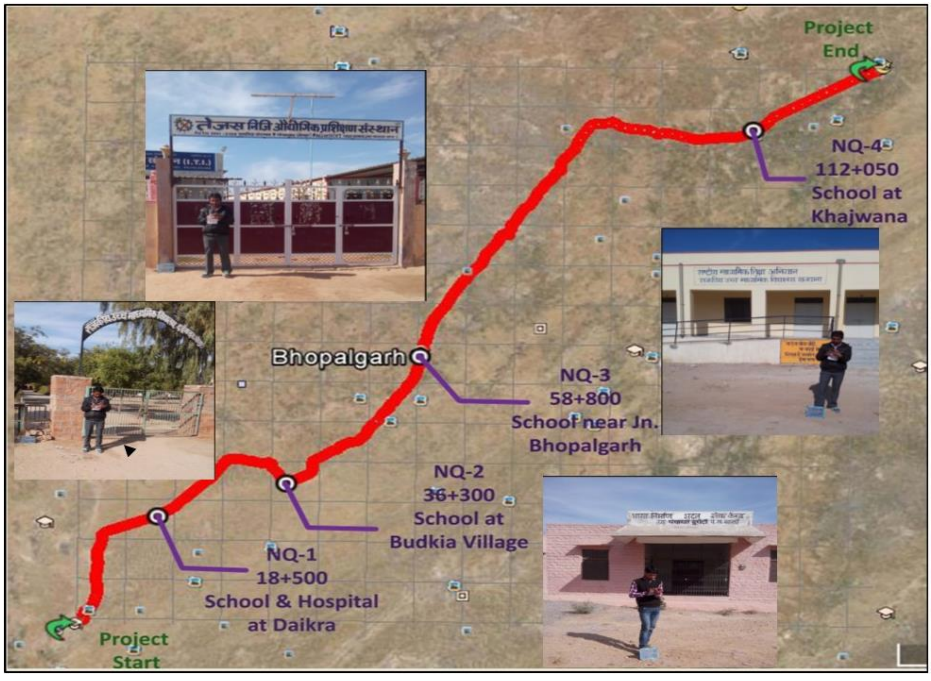
The wind direction, frequency and magnitude are shown in Figure 5.5. The predominant wind direction is from South-West (SW) to North-East (NE). Nagaur district have a dry climate with hot summer. Sand storms are common in summer season.

The wind direction, frequency and magnitude are shown in Figure 5.5. The predominant wind direction is from South-West (SW) to North-East (NE).

4.4.2 Ambient Air Quality

A network of four ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone.

Figure 4-6: Ambient Air Monitoring Locations Along the Project Corridor



S

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 project road including the baseline at Sensitive Receptors along the project. The heights of the sampling locations were kept between 3.2 to 4.0 m in all the

locations. The selected locations of ambient air monitoring (is presented in Figure 4-6) and details of surroundings are presented in Table 4-3

The monitoring of the Ambient Air Quality (AAQ) for the various land uses along the project corridor was carried out at each selected location as per guidelines of Central Pollution Control Board (CPCB) and the requirements of MoEF&CC.

Table 4-3:Rationale of selection of the Air Monitoring Location

Sl. No	Location Code	Chainage	Location Name	Category as per AAQ Standards	Distance from Project Road (m)	Environmental Setting and Justification for Selection
1.	AAQ- 1	Km. 18+500	School & Veterinary Hospital at Daikra Village	Rural	15	The monitoring Station at location of Daikra near School & Veterinary Hospital was selected as it is a sensitive receptor in a rural location along the project road.
2.	AAQ- 2	Km. 36+300	School at Budkiya Village	Rural	40	The ambient air quality location is a Sensitive Receptor in Rural area and data of AAQ at this location will characterise ambient air quality at such sensitive location in the project region.
3.	AAQ- 3	Km. 58+800	School near Junction in Bhopalgarh	Urban	10	The ambient air quality location is a Sensitive Receptor in heavily built-up Urban area and data of AAQ at this location will characterise ambient air quality at such sensitive location in the project region.
4.	AAQ-4	Km. 112+050	School at Khajwana	Urban	50	The monitoring Station was selected as this location will characterise AAQ at a sensitive receptor in the built-up area of Khajwana village.

Source: Primary Surveys

The summary of ambient air quality results for the project stretch is presented in Table 4-4. The results indicate that the even though the results are within the standards specified in the NAAQS the level of PM 10 and PM2.5 is quite high compared to the gaseous pollutants.

Table 4-4:Results of Ambient Air Quality Monitoring

Sl. No	Location	PM10 (µg/m3)	PM 2.5 (µg/m3)	SOx (µg/m3)	NOx (µg/m3)	CO (µg/m3)
1	AAQ- 1	89.52	53.11	16.31	30.6	0.76
2	AAQ- 2	83.33	48.54	15.25	34.18	0.75
3	AAQ- 3	88.65	52.20	15.72	32.24	0.72
4	AAQ-4	93.65	51.20	16.42	29.91	0.69
NAAQS Limit		100	60	80	80	04

Source: Primary Surveys

4.4.3 Ambient Noise Quality

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. Four monitoring sites were identified for noise monitoring to characterise the baseline noise levels in the project area. Locations for noise monitoring along the corridor are identified based on the criteria same as those used for air monitoring. The description of environmental settings of noise

Table 4-5:Rationale for selection for noise monitoring location

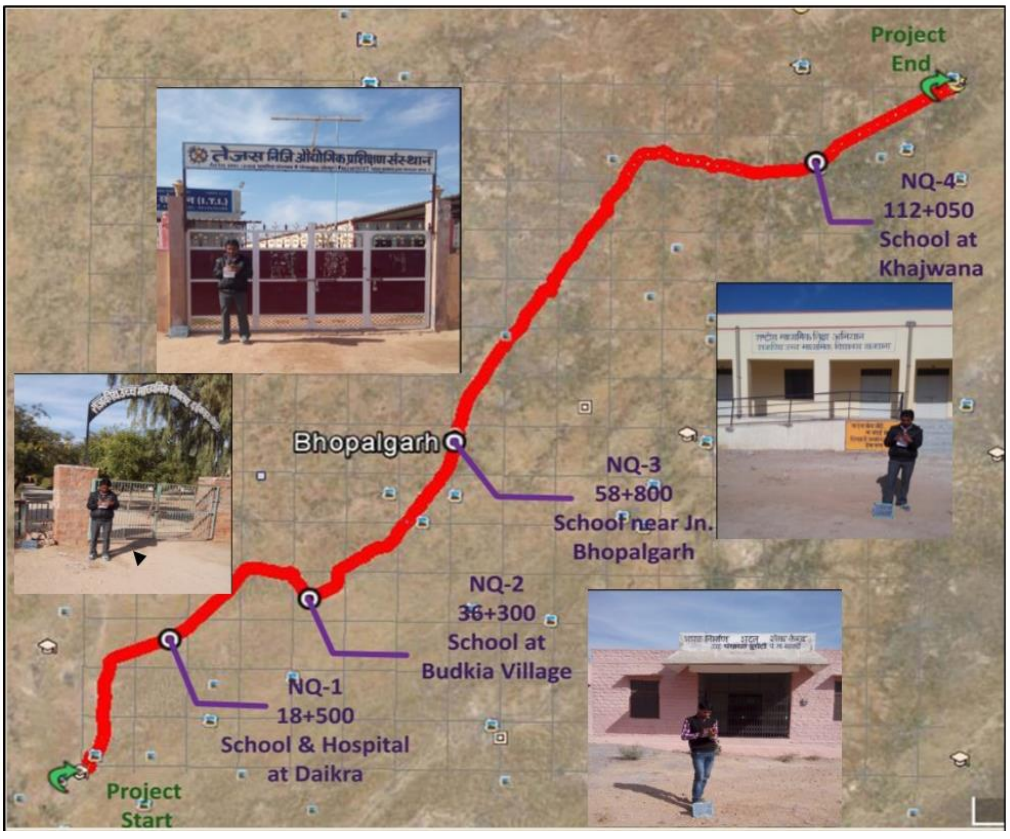
Location Code	Chainage	Location Name	Category as per AAQ Standards	Distance from Project Road (m)	Environmental Setting and Justification for Selection
NQ-1	Km. 18+500	School & Veterinary Hospital at Daikra Village	Rural	15	The monitoring Station at location of Daikra near School & Veterinary Hospital was selected as it is a sensitive receptor in a rural location along the project road.
NQ-2	Km. 36+300	School at Budkiya Village	Rural	40	The selected location is a Sensitive Receptor in Rural area and will characterise Noise level at such sensitive location in the project region.
NQ-3	Km. 58+800	School near Junction in Bhopalgarh	Urban	10	in heavily built-up Urban area, the selected location is a sensitive receptor which is a school and will characterise Noise level at such sensitive location in the project region.

Location Code	Chainage	Location Name	Category as per AAQ Standards	Distance from Project Road (m)	Environmental Setting and Justification for Selection
NQ-4	Km. 112+050	School at Khajwana	Urban	50	The monitoring Station was selected as this location will characterise Noise level at a sensitive receptor in the built-up area of Khajwana village.

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 the 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 (HTC made in Taiwan Model No. SL-1350) 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 at 4 locations in the study area. 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.

Figure 4-7: Location of Noise Monitoring Along the Project Corridor



The Noise quality result presented in Table 4-6 show Leq Day time varies from 67.56 to 70.14 dB(A) and Leq Night time varies from 58.66 to 70.00 dB(A).

Table 4-6: Results of Primary Noise Monitoring

Sl. No	Monitoring Location	Leq dB (A) day	Leq dB(A) night	Limits in Leq dB (A)	
				Day	Night
1	NL-1 School & Veterinary Hospital at Daikra Village at km 18+500	70.10	62.42	65.0[8]	55.0
2	NL-2 School at Budkiya Village Km. 36+300	67.56	60.23		
3	NL-3 School near Junction in Bhopalgarh Km. 58+800	69.24	58.66		
4	NL-4 School at Khajwana 112+050	70.14	70.00		

Source: Primary Survey

The results of the noise monitoring clearly indicate that the noise levels near these schools are already higher. One of the reason for this high noise levels is the locations of the school within the settlement adjoining the highway. The congestions on the roads in the settlement areas and the honking by the drivers lead to the higher noise levels.

4.5 WATER ENVIRONMENT

4.5.1 Hydrogeology

Based on the hydrogeological formation Jodhpur and Nagaur Districts can be divided into three hydrogeological units namely, unconsolidated sediments, semi-consolidated sediments and consolidated rocks. The unconsolidated sediments are of two types- alluvial sediments and aeolian deposits. The Alluvial sediments are confined to Barmer, Jalore and Jodhpur district, consisting of sand, clay, gravel and cobbles. The Aeolian sediments constitute one of the major aquifers east of a major fault, east of Bikaner. These forms the chief source of ground water in the district. Confined condition is also met sometimes at deeper levels in the north western part of the district. Aquifer

Ground water occurs under unconfined to semi-confined conditions in rocks of Delhi Super Group, Jodhpur sandstone, Bilara limestone, Nagaur sandstone, Lathi sandstone and

[8] The results of noise have been compared against commercial Zone noise levels considering that these schools are located inside settlements where there is mixed landuse. However, as per the provision of The Noise Pollution (Regulation and Control) Rules, 2000 the school can be declared by the Government as a silence zone. In case of silence zone, the noise standards are 50 dB(A) and 40 dB(A) respectively for day and night times.

unconsolidated sediments (valley fills and alluvium). Delhi Super Group generally form poor aquifer.

Notified Blocks

CGWA has notified Bilara, Bhopalgarh, Mandore, Osian in Jodhpur District and Mundwa, Merta and Kuchaman in Nagaur District as "Notified Blocks[9]". Project road section is traversing through "overexploited"[10] and notified areas as can be seen in Figure 5.15 and 5.16.

The CGWA has appointed the concerned District Collectors as the authorised officers for implementation of regulatory measures. In notified areas, drilling/ construction of new tube wells is banned without prior permission of the Authority. Artificial recharge measures are being implemented by Government of Rajasthan on large scale for augmenting ground water resources by roof top rain water harvesting, construction of sub surface barriers, anicuts and other suitable recharge structures at appropriate locations.

Consultation during the site visits indicated that for the initial part of the project corridor till Bopalgarh the water supply scheme from Indira Gandhi Canal has been developed. However, there are issues with sufficiency of water, as a result people are still dependent on ground water for meeting the daily needs. Families purchase water from tanker (500 - 800 l) operated by local people for INR 1000 and have to live on it for 5-7 days. At time the people also sell off the water from the borewell which yield saline water to Contractor for construction purpose.

4.5.2 Groundwater Quality

There is a large variation in chemical quality of ground water in the Jodhpur district depending on the characteristics of water bearing formation, movement of ground water, depth to water levels etc. The ground water in southern, south-eastern parts of the district, south and south west of district is saline. In northern part around Bap and extreme north, ground water quality is brackish to saline with electrical conductance generally ranging from 4000 to 10000 ms/cm at 25^{o}C. High salinity of more than 10000 ms/cm at 25 0 C electrical conductance has been noticed at Sangaria Ki Dhani, Narnadi, Agolai, Lunawas Charnan, Sajjara and Jhanwar. The ground water quality in deeper zones in the area north of Phalodi is better due to encountering of Bilara Limestone below Nagaur sandstone.

Textile and steel rolling mills are most polluting industries in Jodhpur city specially the groundwater quality. The effluent mainly contains alkalies residual dyes, starch and cellulose, soluble sodium salts, silicates, sulphates and nitrate chemicals. In discharge area

[9] Notified areas are those blocks / talukas / mandals / areas which have been notified under Environment (Protection) Act, 1986 by Central Ground Water Authority for regulation of ground water development and management. In notified areas abstraction of ground water is not permissible for any purpose other than drinking and domestic use.

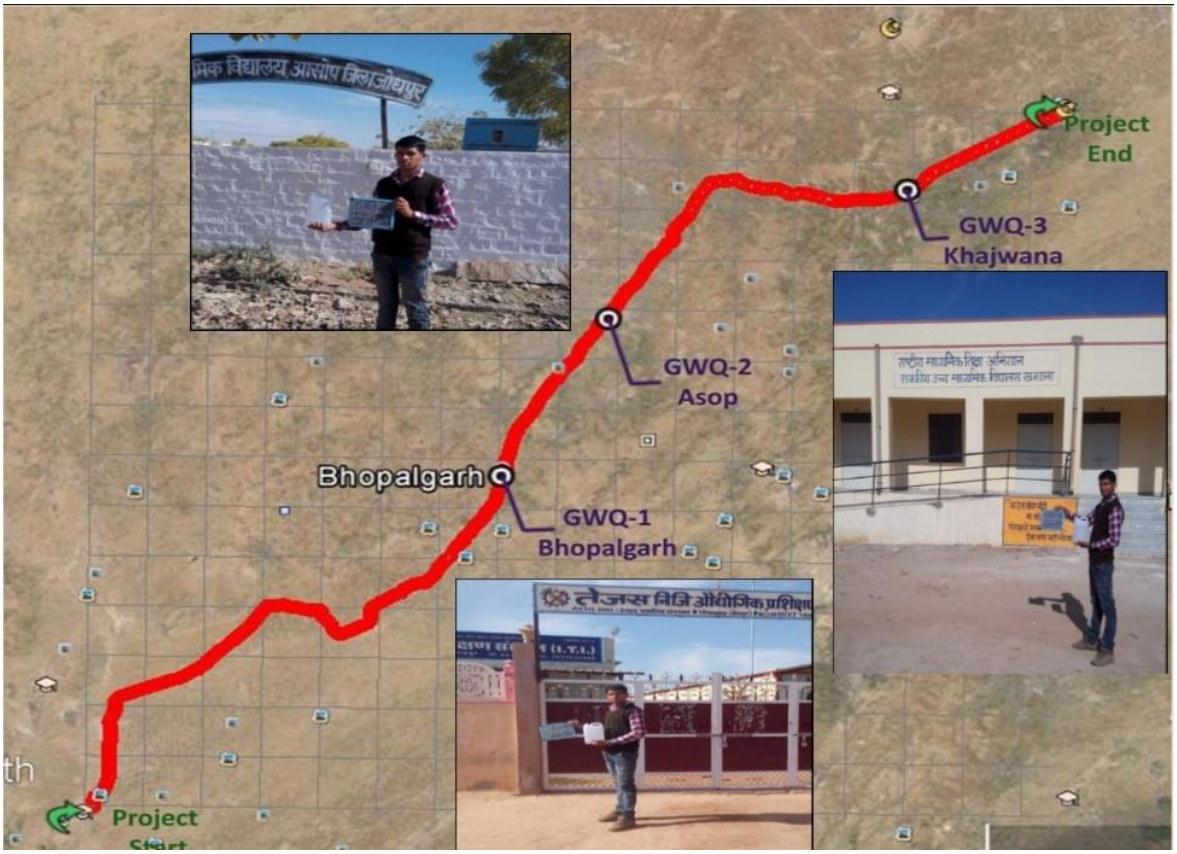
[10] The ground water resources are assessed in units i.e blocks/ talukas/ mandals/ watersheds by the Central Ground Water Board. These assessment units are categorized for ground water development based on two criteria - a) stage of ground water development, and b) long-term of pre and post monsoon water levels. The long term ground water level trends are computed generally for the period of 10 years. The significant rate of water level decline are taken between 10 to 20 cm per year depending upon the local hydrogeological conditions. There are four categories, namely - 'Safe' areas which have ground water potential for development; 'Semi-critical' areas where cautious groundwater development is recommended; 'Critical' areas; and 'Over-exploited' areas, where there should be intensive monitoring and evaluation and future ground development be linked with water conservation measures.

of effluents, the ground water quality is brackish to saline. Due to pollution, there is an increase in concentration of sodium, sulphate, chloride and nitrate in ground water which further deteriorates the already existing poor quality of ground water and making it unfit for human or consumption by animals.

Higher concentration of nitrate more than 100 ppm is reported in northern, eastern and western part of the district. This includes the areas of Bap, Shergarh, Balesar, Mandore, Osian and Bhopalgarh blocks. Fluoride concentration in groundwater exceeding permissible limit (1.5 mg/l) has been reported from all the blocks. Higher values i.e. more than 5mg/l of fluoride are observed in Bap, Balesar, Shergarh, Mandore, Bilara and Luni blocks.

Keeping in view the importance of ground water to the local population, three representative ground water quality-monitoring stations at Bhopalgarh (GWQ1), Asop village (GWQ2) and Khajwana village (GWQ3) in the study corridor were identified and analysed for assessment of ground water quality. The location for the groundwater sampling is provided in Figure 4-8

Figure 4-8: Location for Groundwater monitoring



The water was analysed in a laboratory as per the methods prescribed in “Standard Methods for the Examination of Water and Wastewater (American Public Health Association)” and the result was compared against IS 10,500: 2012 for drinking water standards. The results are presented in Table 4-7.

Table 4-7:Results of analysis of the Ground Water Monitoring

Sr. No.	Test parameters	Unit	Test Method	As per IS: 10500: 2012		GWQ- 1	GWQ-2	GWQ-3
				Desirable limit (Max)	Permissible Limit in absence of Alternate Source (Max.)			
1	pH (at 25°C)	-	APHA 22nd Edition, 4500-H+ B	6.5 to 8.5	No Relaxation	7.380C	7.720C	7.560C
2	Colour	Hazen	APHA 22nd Edition, 2120 B	5	15	BDL	BDL	BDL
3	Turbidity	NTU	APHA 22nd Edition, 2130 B	1	5	BDL	BDL	BDL
4	Odour	--	APHA 22nd Edition, 2150 B	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Taste	--	APHA 22nd Edition, 2160 B	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Total Hardness as CaCO3	mg/l	APHA 22nd Edition, 2340 C	200	600	252	302.10	220.10
7	Calcium as Ca	mg/l	APHA 22nd Edition, 3500 Ca B	75	200	43.1	64.20	25.30
8	Alkalinity as CaCO3	mg/l	APHA 22nd Edition, 2320 B	200	600	310.0	356.42	201.50
9	Chloride as Cl	mg/l	APHA 22nd Edition, 4500-Cl B	250	1000	191.2	108.26	146.52

Sr. No.	Test parameters	Unit	Test Method	As per IS: 10500: 2012		GWQ- 1	GWQ-2	GWQ-3
				Desirable limit (Max)	Permissible Limit in absence of Alternate Source (Max.)			
10	Cyanide as CN	mg/l	APHA 22nd Edition, 4500-CN D	0.05	No Relaxation	BDL (DL 0.02 mg/l)	BDL (DL 0.02 mg/l)	BDL (DL 0.02 mg/l)
11	Magnesium as Mg	mg/l	APHA 22nd Edition, 2340 B	30	100	35.11	34.48	38.14
12	Total Dissolved Solids	mg/l	APHA 22nd Edition, 2540 C	500	2000	590.10	625	356.0
13	Sulphate as SO4	mg/l	APHA 22nd Edition, 4500 E	200	400	49.10	99.18	39.65
14	Fluoride as F	mg/l	APHA 22nd Edition, 4500-F D	1.0	1.5	0.45	1.25	0.85
15	Nitrate as NO3	mg/l	IS 3025 (P-34) 1988	45	No Relaxation	18.50	15.2	6.12
16	Iron as Fe	mg/l	APHA 22nd Edition, 3500-Fe B	0.3	No Relaxation	0.28	0.35	0.29
17	Aluminium as Al	mg/l	APHA 22nd Edition, 3111 B	0.03	0.2	BDL (DL 0.03 mg/l)	BDL (DL 0.03 mg/l)	BDL (DL 0.03 mg/l)
18	Boron	mg/l	APHA 22nd Edition, 4500 B C	0.5	1	0.62	0.67	0.59
19	Hexa Chromium as Cr+6	mg/l	APHA 22nd Edition, 3111 B	0.05	No Relaxation	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)

Sr. No.	Test parameters	Unit	Test Method	As per IS: 10500: 2012		GWQ- 1	GWQ-2	GWQ-3
				Desirable limit (Max)	Permissible Limit in absence of Alternate Source (Max.)			
20	Phenolic Compounds	mg/l	APHA 22nd Edition, 5530 C	0.001	0.002	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)
21	Mineral Oil	mg/l	Clause 6 of IS:3025 (Part 39)	0.5	No Relaxation	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)
22	Anionic Detergents as MBAS	mg/l	APHA 22nd Edition, 5540 C	0.2	1.0	BDL (DL 0.02 mg/l)	BDL (DL 0.02 mg/l)	BDL (DL 0.02 mg/l)
23	Zinc as Zn	mg/l	APHA 22nd Edition, 3111 B	5	15	0.29	0.42	0.29
24	Copper as Cu	mg/l	APHA 22nd Edition, 3111 B	0.05	1.5	0.15	0.24	0.21
25	Manganese as Mn	mg/l	APHA 22nd Edition, 3111 B	0.1	0.3	BDL (DL 0.10 mg/l)	BDL (DL 0.10 mg/l)	BDL (DL 0.10 mg/l)
26	Cadmium as Cd	mg/l	APHA 22nd Edition, 3111 B	0.003	No Relaxation	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)
27	Lead as Pb	mg/l	APHA 22nd Edition, 3111 B	0.01	No Relaxation	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)
28	Selenium as Se	mg/l	APHA 22nd Edition, 3111 B	0.01	No Relaxation	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)
29	Arsenic as As	mg/l	APHA 22nd Edition, 3111 B	0.01	No Relaxation	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)	BDL (DL 0.01 mg/l)

Sr. No.	Test parameters	Unit	Test Method	As per IS: 10500: 2012		GWQ- 1	GWQ-2	GWQ-3
				Desirable limit (Max)	Permissible Limit in absence of Alternate Source (Max.)			
30	Mercury as Hg	mg/l	APHA 22nd Edition, 3111 B	0.001	No Relaxation	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)	BDL (DL 0.001 mg/l)
31	Total Coliform	MPN/100ml	IS 1622, 1981 (Reaffirmed 2003)		10.00	<2/100ml	<2/100ml	<2/100ml
32	E. Coli	MPN/100 ml	IS 1622, 1981 (Reaffirmed 2003	Absent	Absent	Absent	Absent	Absent

Source: Primary Survey

Analysing the tests result of the groundwater analysis, it was observed that the hardness in area both calcium and magnesium was higher than the desirable limit. In some pockets e.g. in Bopalgarh the fluoride content was high.

4.5.3 Hydrological Flow & Drainage

The Luni is the only river west of the Aravalli and is drains the dessert region of Rajasthan. The Luni basin lies on the eastern fringes of the Jodhpur and Nagaur district as is presented in Figure 4-2. The project influence area lies outside the boundaries of the luni basin. As a result, there is no major rivers which cuts the alignment. Thus, there are only three minor bridges at km 46+315, km 48+709 and km 50+185. In addition, there are 3 pipe culverts and 13 slab culverts.

However dur to the undulating topography there are a number of local channels and depression along the alignment. There are7 water bodies along the project corridor. Some of them are used even for drinking water. The location of the water bodies adjoining the project corridor is presented in Table 4-8.

Table 4-8:Location of water bodies along the corridor

Sl. No	Location of Water body	Side	Distance from Highway	Use
1.	Jajiwal Kalan	LHS	15.0m	Reserved for Drinking Purpose
2.	Thabukada	RHS	50.0 m	Reserved for Drinking Purpose
3.	Bopalgarh	LHS	6.0m	Used for Domestic Purpose

4.	Kumbha	LHS	35.0 m	Reserved for Drinking Purpose
5.	Asop	RHS	60.0m	Used for domestic purpose
6.	Asop	LHS	7.0 m	Used for collecting wastewater
7.	Asop	RHS	3.5 m	Used for drinking water
8.	Kankarai	RHS	3.5 m	Used for Drinking

Figure 4-9: Water bodies along the Alignment

Pond at 4+950 on LHS

Pond at Asop at 78+650 on RHS

Pond at 84+950 on LHS

Pond in Bhavanda at 90+460 on LHS

During site visits it was observed that the catchment of these water bodies is protected to prevent any contamination to the water bodies. Additionally, in case the periphery of the waterbody or the catchment abuts the road the same has been bunded to prevent the runoff from the highway entering these water bodies. People are not allowed to extract water for any purpose other than drinking not even for domestic purpose. Extracting water for construction purpose from these waterbodies is thus strictly prohibited.

A realignment is proposed at Kankarai settlement to the east of the settlement. The present alignment would sever the waterbody from its catchment (apprimately 22 sq km). The preliminary design has considered only one culvert at his location . The adequacy of the culvert in allowing unhindered flow of water needs to be evaluated.

4.5.4 Surface water quality

Since water was not available in any of the waterbodies / channels during the period of monitoring. Hence their water quality could not be monitored on account of absence of water in the rivers.

4.6 BIOLOGICAL ENVIRONMENT

4.6.1 Forest

According to Champion and Seth (1968), the forest in the region has been classified under Group 6 : Tropical Thorn Forest". The forest in Jodhpur district are classified under Sub-Group 6B : Northern tropical dry deciduous forest.

The total forest area of Jodhpur District, which is 23650.51 ha is approximately 9% of the total area of the district. There is 467.60 ha of Non-reserved forest and 16930.79 ha Reserved forest area while 6252.12 ha area is Unclassified forest. The important tree species include Neem, Sirsa, Siamea, Cassia, Acacia Tortilis, Propepis, Juliflas, Par Kinsonia, Eucalyptus are being found in the forests. Due to sandy soil only scrub and thorny bushes of vegetation are found in the forest areas of the district. The main species of trees are Kumat, Kair, Khejri, Babul, Bir, Jal khara, Pilu, etc. Fruit bearing trees are pomegranates and guavas.

The district of Nagaur is poor in forest resources, with only be 240.92 Sq.km under forest, which is 1.3 percent of total geographical area of the district. In the western part of the district because of the scanty rainfall, the vegetation is restricted to low shrubs & grass which grows on low sand dunes. However, the south-eastern part of the district has much greater greenery as compared to north-west part of the district. Khejri trees are commonly found in the district, whose leaves are used as fodder. Besides, the tree provides gum and also plays an important role in checking soil erosion. The other common species found in the district are babul, neem, shisham, peepal, rohira kalsi, dhangood, akara etc. Rohira & shisham trees provide timber that is used for making furniture.

4.6.2 Flora

The prevailing and pre-dominant floral species observed in the direct area of influence and in the study areas of the project road is presented in Table 4-9.

Table 4-9: List of Flora in the Study Area

Local Name	Scientific Name
Khejri	Prosopis Cineraria
Ker	Capparis Decidua
Babul	Acacia Nilotica

Local Name	Scientific Name
Israeli Babul	Acacia Tortilis
Kardhai	Anogeissus Pendula
Vilayati Kikar	Juliflas
Adanti	Par Kinsonia
Boor	Cenchrus Jwarancusa
Peepal	Ficus Religlora
Jal Khara	Salvadora Persica
Ber	Zizyphus Mauritiana
Banyan	Ficus Bengha Lensis
Pilu	Salvadora Oleoides
Bamboo	Dendor Calamus Strictus
Kumat	Acacia Senegal
Pomogranate Tree	Punica Granatum
Guava Tree	Psidium Guajava
Salai	Boswellia Serreta
Palash	Buteo Monosperma
Adusa	Adhatoda Vasica
Madar	Calotropis Gigantean
Dhaturo	Datura Metel
Dhaturo	Datura Sp
Dasni	Rhus Mysurensis
Neem	Azadirachta indica
Kheep	Leptadaenia pyrotechnica
Imli	Tamarindus indica
Shisham	Dalbergia sisoo

Source Forest Working Plan

Figure 4-10: Vegetation in the Study Area



It is estimated that 781 trees would be felled during the construction of the road. An inventory of the trees to be felled was prepared by girth size and species. The species wise count is presented in Table 4-10

Table 4-10:Trees to be felled along the baner – Bopalgarh – Kuchera alignment

Section of the Road	Girth Size (cm)				
	30-50	50-80	80-120	> 120	Total
Road Section Banera -Kuchera	205	16	7	553	781

Source; Primary Survey

4.6.3 Wildlife

The wildlife in Rajasthan includes species like Indian gazelles or chinkaras, black bucks, Indian foxes, great Indian bustards, the Nilgai, and wild cats. Nilgai and Chinkara have been spotted at some spots along the alignment, currently identification of the spots is going on. Disturbance of Chinkara and Nilgai is minimized by redesigning some of the pipe to box culverts and allow Chinkara movement and installation of animal crossing to warn drivers. Road crashes emanating from existing poor alignment will be corrected. The prevailing and

pre-dominant Fauna in the direct area of influence and in the study areas of the project road is presented in Table 4-11.

Table 4-11:List of Fauna along the Project Influence area

Local Name	Scientific Name
Chinkara	Gazella Benetti
Blackbuck	Antilope cervicapra
Nilgai	Boselaphus tragocamelus
Rhesus Monkey	Macca Mulatta
Jackal	Canis aureus
Cat Snake	Boiga spp.
Red vented bulbul	Pycnonotus cafer
Indian cuckoo	Megalaima merulinus
Common House Rats	Rattus Rattus
Indian Fox	Vulpes Bengalensis
Indian Hare	Lepus Nigricollis
Indian Palm Squirrel	Fanambulus Palmarum
Wild Boar	Sus Scrofa
House Sparrow	Passer Domesticus
Common Myna	Acridotheres Tristis
Common kingfisher	Acledo atthis
Common Peafowl	Pavo Cristatus
Common Pigeon	Columbo Livia
Goose Greylag	Anser Anser
Grey Heron	Ardeo Cinerea
House Crow	Carvus Splendens
Indian Courser	Cusorius Coromandelicus
Indian Pond Heron	Ardeola Grayii

Source: Forest Working Plan

Box 4-1: Wildlife in the Modified habitats

- The outstanding feature of the wildlife fauna in the Jodhpur district is the presence of five to ten thousand Black bucks11, Antelope Cerricapra Rajputanae, around the villages of Bishnoi community which regard them in veneration. They also aggressively protect them. Dhawa, Gudha , Bishnoi and Hingoli are the major localities where very large herds of black buck are still found. These are by far the largest population of this animal found at a place in whole of India.Along with them a fair number of the India Gazelle12, (Gazelle bennetli) .Whereas Black buck are found mainly in the southeastern villages, the Chinkara is also found in grasslands in the sand dune.

- In the Jodhpur district, three regions are worthy of receiving attention of Wildlife conservationists with a view to augment the vegetal resources which will in turn improve the multiplicity of primary consumers and they in turn of secondary consumers. These area Pheench ,Doli, Gudha Bishnoi and Sardarsamand Kharda. These regions are dominantly inhabited by the Vishnoi people.

- It will be prudent to use the religious sentiments of Bishnui commun:ty for the conservation of Wildlife. At present, however, the grassland in Doli and Gudha area is highly degraded and there is need for enhancing the carrying capacity of the bare patches by re-seeding the grasses. The ungulates mostly thrive by feeding on crops but if the ranges are improved, the crop loss due to them can be reduced. Another important requirement of developing these areas into good wildlife reserves is to provide drinking water to the black bucks. Unlike gazelles, the antelopes do need at least one drink per day. During summer the river dry up and Black buck scatter out of the Bishnoi dominated areas for search of drinking water and are shot by poachers.

In the Baner – Bopalgarh - Kuchera , most of the concentration of the chinkaras and blackbucks are observed in the initial part of the alignment near Jajiwal.. It was also informed by the local people that mostly night time wild animals like Jackal (*Canis Aurens*), Indian Fox (*Hystrix Leucura*) , Nilgai (*Boselaphus Iragocamelus*) , Black Buck (Antelope bezoarrica) , Chinkara or Indian Gazelle (*Gazella Benetti*) etc. cross the road . Accidents of wild animals were reported by the local people.

4.6.4 Legally protected areas

There is a small pocket of protected forest, near Dhakria Kalan but the proposed alignment would not interfere with it. There are No National Parks or Wildlife Sanctuary within 10 km of the proposed alignment.

Figure 4-11: Protected Forest Along the Alignment

[11] The animal is provided Schedule I status as per the provisions of the Wildlife Conservation Act 1972.The Blackbuck is an animal of short grass plains where surface water is easily available, as it has to drink frequently.

[12] The Indian Gazelle, (Gazella bennetti) is small slender and gracefully built animal. The animal is also provided Schedule I status under the Wildlife Protection Act, 1972. During summer the coat colour is reddish buff with the fur smooth and highly glossy.

4.7 ECONOMY

4.7.1 Agriculture

Agriculture is the main occupation of the rural population in Jodhpur. Net cultivable area of the district is 1265944 hectares whereas non-agriculture land area including fallow land is 636069 hectares. Maximum cultivated area lies in Osian tehsil followed by Bopalgarh block. Since the district comes under arid zone, due to the non-availability of water, most of the land in the district are single cropped. Only 2.91% of the net cultivated area are being utilised for double / multiple cropping. The total area under Kharif (Monsoon) crop is 561200 hectares. During Kharif season , Bajra, Jawar, Moong, Moth, Guawar and til are the main crops cultivated and during Rabi season(winter), wheat, Barley and Mustard are the main crops in the district.

Like Jodhpur agriculture is also the main occupation in Nagaur District. Bajra, wheat, jowar, til, barley and pulses are the major crops of the Nagaur District. The other crops of the district are taramira, rape and mustard seeds and gram. Since here also the agriculture is dependent on rains Kharif crops constitute the bulk of the food production in the district.

Due to the paucity of water irrigation facilities are not developed in the district. The irrigation structures are primarily being dug well, in some cases borewells are used.

4.7.2 Industries

Jodhpur District

The Handicrafts industry has in recent years eclipsed all other industries in Jodhpur city. By some estimates, the furniture export segment is a $200 million industry, directly or indirectly employing as many as 200,000 people. Other items manufactured include textiles, metal utensils, bicycles, ink and sporting goods. A flourishing cottage industry exists for the manufacture of such items as glass bangles, cutlery, carpets and marble products.

The upcoming 9 MMTPA Refinery and Petrochemical complex to be set up by Hindustan Petroleum Corporation Limited (HPCL) in Pachpadra, Barmer will transform the industrial scene of the city drastically. Pachpadra lies just 60 kilometres from the industrial area of Boranada in Jodhpur. Around 120 by-products that are produced by the refinery are going to provide opportunities for new industries to be set up in and around Jodhpur.

The Delhi-Mumbai Industrial Corridor Project is also going to impact industry in Jodhpur. Marwar Junction which is located about 100 kilometres from Jodhpur will be one of the nine freight loading points along the DMIC route. Jodhpur district fall under the region that is going to be developed as a manufacturing hub for the DMIC.

Nagaur District

The industrial scenario, though not much developed, is slowly moving along the path of development. Earlier, there were minor manufacturers having a market in the neighbouring areas while for the rest of the trades there were hereditary artisans like carpenters, blacksmiths, potters, goldsmiths and other artisans to meet the local demands.

Even after independence, Nagaur district has been practically industrially backward on account of the lack of exploitation of natural resources and under developed infrastructural facilities. Now the industrial climate is changing, and a number of incentives and concessions

are being offered to prospective entrepreneurs and they are looking forward to establishing their units in the district.

There are seven large and medium scale industries which exist in Nagaur district. The growth of small scale industries in the district has been quite fast which mainly cover sectors viz. food-based industries, agriculture-based industries etc. Some of these units are old and traditional industries. Besides, Industrial Areas, Khadi and Village Industries, Hand Tools Industry, Salt Industry, Gypsum, Limestone, Wolframite Tungsten are prominently established industries of the districts. Apart from the mentioned industries, famous traditional crafts industries also flourish in the district of Nagaur. These include the Jatu Saree of Ren, the Bronze Industry of Nagaur, the Leather Mojari of Nagaur and the Durries of Tankla.

4.8 SOCIOECONOMIC ENVIRONMENT

4.8.1 Demographic Profile

Population

In 2011, Jodhpur had population of 3,687,165 of which male and female were 1,923,928 and 1,763,237 respectively. The corresponding figures in Nagaur district as per Census 2011 are 3,307,743, 1,696,325 and 1,611,418 respectively .The corresponding figures as per 2001 census, for Jodhpur are 2,886,505 ,1,513,890 and 1,372,615 respectively while that for Nagaur were 2,775,058, 1,424,967 and 1,350,091 respectively. There decadal growth rate was of 27.74 percent and 26.65 percent in Jodhpur and Nagaur respectively.

Sex Ratio

With regards to Sex Ratio in Jodhpur, it stood at 916 per 1000 male compared to 2001 census figure of 907. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 891 girls per 1000 boys compared to figure of 920 girls per 1000 boys of 2001 census data.

Sex Ratio in Nagaur on the other hand is 950 per 1000 male compared to 2001 census figure of 947. this is more than the national average of 940 as per latest reports of Census 2011 Directorate. Child sex ratio continued to be less at 915 girls per 1000 boys of 2001 census data which further dropped to 897 girls per 1000 boys in 2011as per census data.

4.8.2 Population profile of the Project Area and affected People

The socio-economic profile of the likely Project Affected Households has been detailed in the Social Impact Assessment Report

4.9 Utilities

Different types of existing utility services like Optical Fiber Cables (OFC),Electric poles, Transformers, Telephone poles are existing which shall be affected during implementation stage and may require shifting for construction of proposed carriageway. The summary of existing utilities is in

Table 4-12:

Figure 4-12 Rainwater harvesting structures

Table 4-12 Summary of existing Utilities

Sr .No.	Description	Unit	Quantity
1.	Hand Pumps	Nos	0
2.	Transformer	Nos	39
3.	Telephone Poles	Nos	18
4.	Electric Poles	Nos	458
5.	Optical Fibre	R mts	17125

Source: Engineering surveys

5 ANALYSIS OF ALTERNATIVES (Technology & Alignment)

5.1 Introduction

This chapter discusses the analysis of alternatives that have been considered for the proposed widening/upgradation. It also includes a discussion on the "With" and "Without" project scenario. Further, the evaluation and selection of alternative bypass alignments to the Kankarai and Sankhwas are based on engineering, economic, environmental and social considerations. The minimisation of environmental impacts by considering design alternatives determines the extent of mainstreaming of the environmental component. An evaluation of the various alignment options has been done for arriving at the most promising alignment for the bypass.

5.2 No Project Scenario

The entire stretch of SH-63 passing through Bopalgarh Kankarai and Sankhwas has both engineering and physical constraints which results in congestion in habitation areas coupled with roadside commercial activities. In absence of the project the situation would be aggravated. Thus to address these physical obstructions which pose problems for smooth passage of through traffic and at the same time address the issue of traffic congestion, road users safety, travel time, vehicle operating cost, exposure of residents to vehicular emission etc. improvement of the road in terms of upgradation and widening is required.

The potential benefits of the proposed road improvements are substantial and far reaching both in terms of the geographical spread and time. The project will have significant benefits as under:

- It will reduce the travel time substantially.
- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost.
- Increased employment opportunities for the locals.
- Development of local industries and agriculture.
- Development of tourism and pilgrimage.
- Transporting processing and marketing of agricultural products.
- Reduction in accidents.
- Reduction in pollution
- Opening up of opportunities for new occupations.
- Better approach to Medical & Educational services
- Improved quality of life for people and so on.

Hence, it is clear that the implementation of the project will be a definite advantage to the districts of Nagaur and Jodhpur in particular and the State of Rajasthan in general to achieve all-round development of its economy and progress for its people

5.3 Alternative Alignment

The need for bypass around the congested towns along the project road was identified in consultation with the PWD and other stake holders and also considering the quantum of

development within the towns. Accordingly, Kankarai and Sankhwas were identified for bypass provision as the proposed improvement and widening of the road within the town is very difficult on account of significant Resettlement & Rehabilitation problem.

5.3.1 Proposed Kankarai Bypass alignment study

Segmentation

Location of start point has been determined mainly on the considerations of Traffic dispersal, Junction suitability, availability of land to improve junction and segregation of local traffic and through traffic. The different alignment options have been divided segment wise where each node is numbered around Kankarai town along project road. These nodes were selected based on reconnaissance survey and are listed with their relative ground positions in Table 5-1.

Table 5-1:Description of Nodes on Kankarai Bypass

Node No	Description
N1	Proposed start of bypass of SH-63 for Option-1 & 2 @ km 88+000
N2	Intersection following 0.43 km with side road
N3	Intersection following 0.29 km with another Road
N4	End point following 0.68 km meeting with SH-63 @ km 89+000
N5	Proposed start of bypass of SH-63 for Option-3 @ km 87+700
N6	Intersection point with connecting road to MDR-90

Alignment Options

After the identification of various nodes and segments on the Project Study Area, combinations of these segments form the possible options for the alignments. The different alternative alignment options are given in Table 5-1 and Figure 5-1

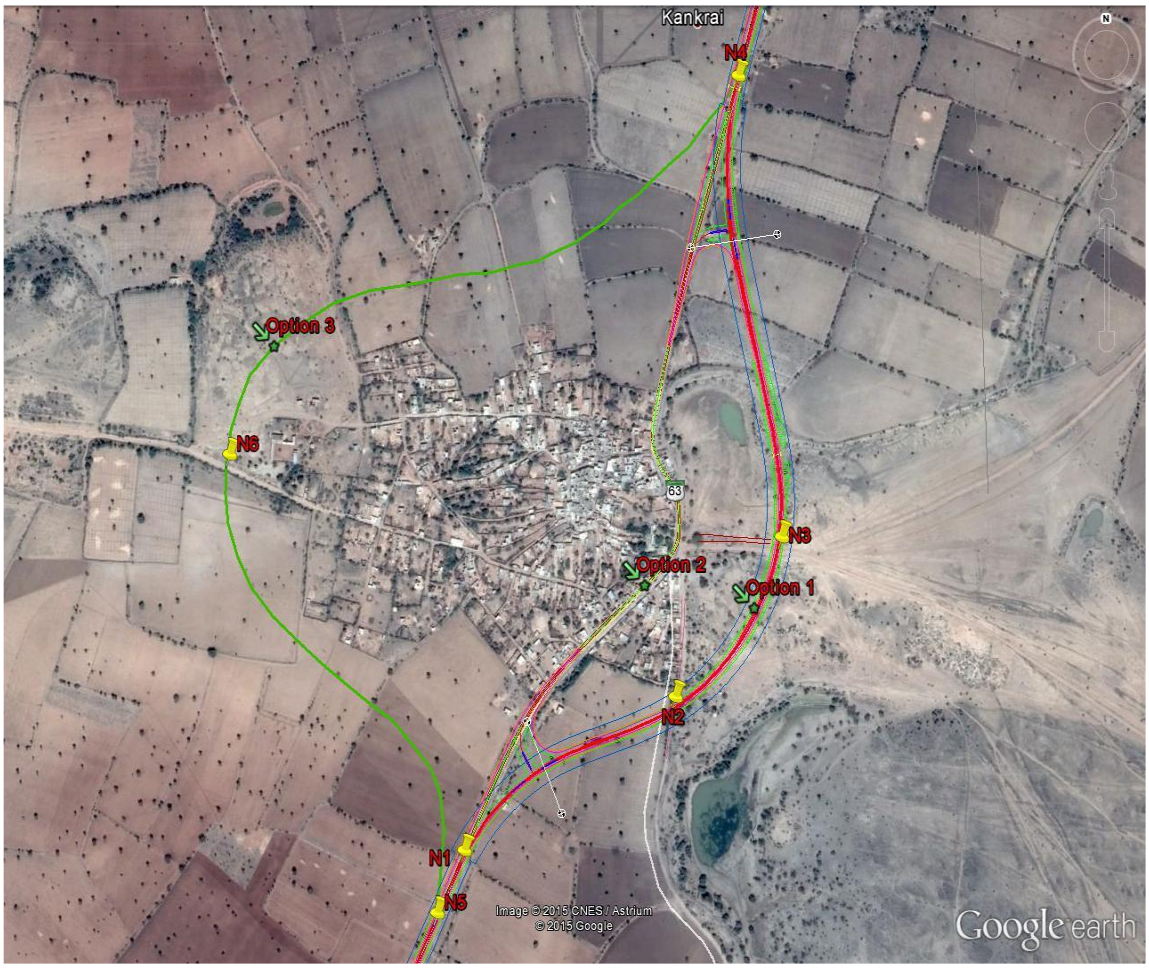
Table 5-2: Alternative Road Alignment Options

Alignment Option	Nodes	Description of the Selected Option
Option 1	N1 – N2– N3– N4	Alignment starting @ km 88+000 at N1 bypassing the town at RHS* through open agricultural fields following about 0.43 km to intersect a side road at N2 and again through open agricultural fields avoiding habitations for about 0.29 km to intersect with another road at N3 to finally culminate traversing 0.68 km into SH-63 at N4 @ km.89+000.
Option 2	N1 – N4	Alignment starting @ km 88+000 at N1 following existing SH-63 through habitated area of Kankrai town for about 1km to end at N4 @ km.89+000.

Option 3	N5 – N6 – N4	Alignment starting @ km 87+700 at N5 bypassing the town at LHS* through open agricultural fields following about 0.82 km to intersect a connecting road to MDR-90 at N6 and again through open agricultural fields to finally culminate traversing 1.15 km into existing SH-63 at N4 @ km.89+000.

* LHS and RHS are considered from project road direction from Banar to Kuchera

Figure 5-1: The alternative options of Kankarai Bypass on Google earth Imagery



Evaluation of Options

A comparative evaluation of all these alternatives has been given in Table 5-3, which will help in selecting the alignment with least social and environmental issues as well addressing the engineering requirements.

Table 5-3:Subjective analysis of the 3 alignments in Kankarai Bypass

Sl. No	Particulars	Option -1		Option -2		Option -3	
		Merits	Demerits	Merits	Demerits	Merits	Demerits
1.	Length(km)		1.4	1			1.97
2.	Land requirement (ha)		6.3	4.5			8.87
3.	Geometry	Good			Poor		Fair
4.	Structure	0		0		0	
5.	Environmental/ Tree cutting		Tree cutting will be comparatively more	Tree cutting will be comparativ ely less			Tree cutting will be comparatively more and water body getting intersected.
6.	Social	Land Acquisition n is easier as only agricultural fields with least habitation areas.			Land Acquisition is most difficult as alignment passes through lots of habitation areas.		Land Acquisition is comparatively difficult, as it involves more agricultural area with least habitations.
7.	Cost	Resettlement cost is least			Resettlement Cost is Highest		Resettlement Cost is comparatively more

*: these ae estimates of the land requirement. The actual land acquisition is presented in the Social Impact Assessment Report

Mathematical Evaluation Matrix for Alternative Alignment of Kankarai Bypass

The options for the different alignment has been discussed above and a qualitative evaluation of the same was carried out for different environmental and social factors. A mathematical model was developed using relative factors for engineering, social, environmental and traffic aspects. The result of the mathematical model is presented in Table 5-4.

Table 5-4:Mathematical Model for Analysis of the Alternative Alignment for Kankarai Bypass

Sl. No	Particulars	Maximum Points Allotted	Option -1		Option -2		Option -3	
			Actual Factor	Points	Actual Factor	Points	Actual Factor	Points
1	Length (km)	15	1.4	10.71	1	15	1.97	7.61
2.	Land requirement* (ha)	15	6.3	10.71	4.5	15	8.87	7.61
3.	Structure	0	0		0		0	
4.	Traffic Dispersal / Access Control	15	Good	15	Poor	5	Fair	10
5.	Environmental Constraint	10	Low	10	High	0	Medium	5
7.	Construction Problem %	25	Low	20	High	5	Medium	17.5
8.	Cost	20	Low	20	Highest	10	Medium	15
	Total	100		65		20		47.5

*: these ae estimates of the land requirement. The actual land acquisition is presented in the Social Impact Assessment Report

% The Construction problem also includes a qualitative judgement to estimate the social issues which might occur in each of the alignment.

Conclusion and Recommendation for Kankarai Bypass

Out of the various alternative alignments, Option-2 of following existing alignment is not a feasible solution as this does not solve the problem of traffic congestion through habitation area of Kankarai and land is not available to accommodate four lane road within Kankarai town as required in accordance with terms of reference. Hence Option 1 is preferred as it fully bypasses the congested Kankarai town, scores maximum points (91.42) from mathematical evaluation matrix analysis and would allow smooth flow for through traffic. The assessment made by the consultant has covered the Techno-economic viability of the proposed alignment. Therefore the preferred and finalised Kankarai bypass alignment is Option-1.

5.3.2 Proposed Sankhwas Bypass alignment study

Segmentation

Location of start point has been determined mainly on the considerations of Traffic dispersal, Junction suitability, availability of land to improve junction and segregation of local traffic and through traffic. The different alignment options have been divided segment

wise where each node is numbered around Sankhwas town along project road. These nodes were selected based on reconnaissance survey and are listed with their relative ground positions in Table 5-5.

Table 5-5: Description of Nodal Points

Nodes	Description
A1	Proposed start of bypass of SH-63 @ km 95+000
A2	Intersection following 0.43 km with side road from A1
A3	Intersection following 1 km with MDR 37B (to Golasani) from A2
A4	End point meeting with SH-63 @ km 97+700
A5	Intersection following 1.28 km with MDR 37B from A1
A6	Intersection point with Kaliyash - Dhundhiyari road
A7	Intersection point with road to Gowan Palan from A6
A8	Intersection following 0.98 km with MDR 37B from A7

Alignment Options

After the identification of various nodes and segments on the Project Study Area, combinations of these segments form the possible options for the alignments. The different alternative alignment options are given in Table 5-6

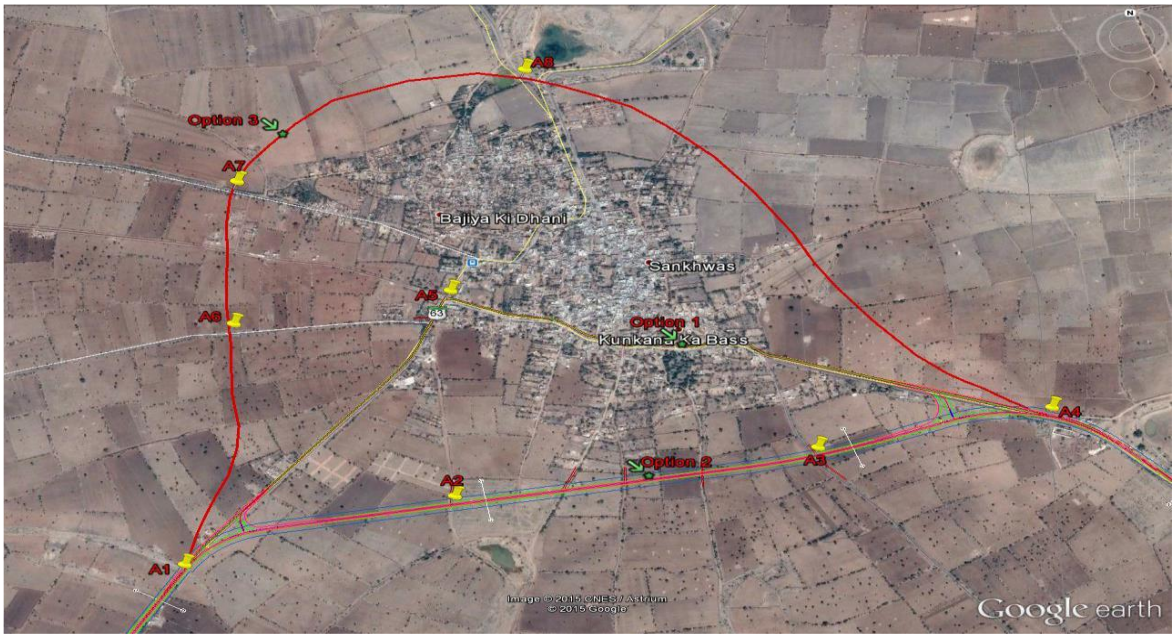
Table 5-6: Alternative Road Alignment Options for Shankawas Bypass

Option No	Nodes	Description of Selected Options
Option 1	A1- A5 -A4	Alignment starting @ km 95+000 at A1 following exiting SH-63 through habitated area of Sankhwas town for about 1.28 km intersecting with MDR 37B at A5 and then finally after traversing 2.08 km ending at A4 @ km.97+700.
Option 2	A1-A2-A3-A4	Alignment starting @ km 95+000 at A1 bypassing the town at RHS* through open agricultural fields following about 0.77 km to intersect a side road at A2 and again through open agricultural fields avoiding habitations for about 1 km to intersect with MDR 37B (to Golasani) at A3 to finally culminate traversing 0.63 km into SH-63 at A4 @ km.97+700.
Option 3	A1-A6-A7-A8-A4	Alignment starting @ km 95+000 at A1 bypassing the town at LHS* through open agricultural fields following about 0.72 km to intersect Kaliyash-Dhundhiyari Road at A6 and again through open agricultural fields intersecting first with Road to Gowan Palan following 0.45km and then with MDR-37B following 0.98km to finally culminate

Option No	Nodes	Description of Selected Options
		traversing 1.45 km into existing SH-63 at A4 @ km.97+700.

* LHS and RHS are considered from project road direction from Baner to Kuchera

Figure 5-2: Alternative Alignment for Sankhwas Bypass on Google Imagery



Evaluation of Options

A comparative evaluation of all these alternatives has been given in Table, which will help in selecting the alignment with least social and environmental issues as well addressing the engineering requirements.

Table 5-7:Subjective analysis of the 3 alignments in Shankawas Bypass

Sl. No	Particulars	Option -1		Option -2		Option -3	
		Merits	Demerits	Merits	Demerits	Merits	Demerits
1.	Length(km)		3.36	2.5			3.6
2.	Land Requirement (ha)		15.12	10.8			16.2
3.	Geometry		Poor	Good			Good
4.	Structure	0		0		0	
5.	Environmental/ Tree cutting		Tree cutting Will be highest		Tree cutting will be comparatively more	Tree Cutting would be least	

Sl. No	Particulars	Option -1		Option -2		Option -3	
		Merits	Demerits	Merits	Demerits	Merits	Demerits
6.	Social	Land Acquisition is Most difficult as alignment passes through lots of habitation areas.		Land Acquisition Is easier as only agricultural fields with least habitation areas			Land Acquisition is comparatively difficult, as it involves more agricultural area with least habitations.
7.	Cost	Cost is highest.		Cost is least.			Resettlement cost is comparatively more.

Mathematical Evaluation Matrix for Alternative Alignment of Sankhwas Bypass

The options for the different alignment has been discussed above and a qualitative evaluation of the same was carried out for different environmental and social factors. A mathematical model was developed using relative factors for engineering, social, environmental and traffic aspects. The result of the mathematical model is presented in Table 5-4.

Table 5-8:Mathematical Model for Analysis of the Alternative Alignment for Sankhwas Bypass

Sl. No	Particulars	Maximum Points Allotted	Option -1		Option -2		Option -3	
			Actual Factor	Points	Actual Factor	Points	Actual Factor	Points
1	Length (km)	15	3.36	10.71	2.4	15	3.6	10
2.	Land requirement* (ha)	15	15.12	10.71	10.8	15	16.2	10
3.	Structure	0	0	0	0	0	0	0
4.	Traffic Dispersal / Access Control	15	Poor	5	Good	15	Fair	10
5.	Environmental Constraint	10	High	0	Medium	5	Low	10

Sl. No	Particulars	Maximum Points Allotted	Option -1		Option -2		Option -3	
			Actual Factor	Points	Actual Factor	Points	Actual Factor	Points
7.	Construction Problem %	25	High	5	Low	25	Medium	17.5
8.	Cost	20	Highest	10	Low	20	Medium	15
	Total	100		41.42		95		72.5

*: these estimates of the land requirement. The actual land acquisition is presented in the Social Impact Assessment Report.

% The Construction problem also includes a qualitative judgement to estimate the social issues which might occur in each of the alignment.

Conclusion and Recommendation for Kankarai Bypass

Out of the various alternative alignments, Option-1 of following existing alignment is not a feasible solution as this does not solve the problem of traffic congestion through congested Sankhwas town having few sharp curves and land is not available within Sankhwas town for geometric improvement of these sharp curves and to accommodate four lane road within Sankhwas town as required in accordance with terms of reference. Hence Option 2 is preferred as it fully bypasses the congested Sankhwas town, scores maximum points (95) from mathematical evaluation matrix analysis and would allow smooth flow for through traffic. The assessment made by the consultant has covered the Techno-economic viability of the proposed alignment. Therefore the preferred and finalised Sankhwas bypass alignment isOption-2.

5.4 Re-Alignments

In the entire stretch of SH-63 in order to improve existing poor road geometry, eight re-alignments have been proposed as presented in Table 5-9

Table 5-9: Realignments Proposed in Baner Kuchera Alignment

Chainage	Length (km)	Type of Deficiency	Remark
17+765 to 19+270	1.505	Deficient Curves to be improved through Realignment along additional proposed ROW	Re-alignment at Daikra
28+480 to 28+690	0.210		
32+220 to 32+370	0.150		
32+980 to 33+450	0.470		
33+660 to 33+900	0.240		
76+634 to 76.804	0.170		
78+584 to 78+784	0.200		
101+464 to 102+894	1.430		Re-alignment at Gawaloo

5.5 Alternative Materials and Technologies

Increasing demand for natural material for other construction activities e.g. building construction, urban development projects has put pressure on the exiting natural resources e.g. aggregates, sand, soil. Procuring natural construction material for the road construction has thus not only become difficult due to increased competition from other sectors but also escalated both time and money required for procuring them. Increased regulatory compliance requirements have also made availability difficult. Added to this is the increase lead distance because at times these materials have to be procured from quarries away from the construction site. This not only increases cartage cost but also increases the carbon-footprint of the project.

The use of alternate materials for construction focuses on the management and reuse of alternate material including waste materials locally available in the project area or generated by the project itself.

5.5.1 Use of Alternate Recycled Material or Waste in Road Construction

Use of fly ash in construction

In tandem with the IRC Guidelines for promoting the use of fly ash in road embankments (IRC:SP:58-2001), MoEF&CC issued an amendment to their fly ash notification which make it mandatory for road construction within a radius of hundred kilometres of thermal power plant to undertake construction or approve design for construction of roads or flyover embankment with fly ash as mentioned in the IRC specification No. SP:58.

Further, a number of guidelines been formulated by for promoting use of fly ash in different structural parts of road and bridge construction, these include:

- IRC: SP:63-2004 “Guidelines for the Use of Interlocking Concrete Block Pavement”
- IRC:44-2008 “Guidelines for Cement Concrete Mix Design for Pavement”
- IRC: SP:89-2010 “Guidelines for Soil and Granular Material Stabilization using Cement, Lime & Fly Ash”
- IRC:36-2010 “Recommended Practice for Construction of Earth Embankments and Subgrade for Works”
- IRC: -2011 “Specifications and Code of Practice for Construction of Concrete Roads”
- IRC: -2011 “Code of Practice for Concrete Road Bridges”
- IRC:37-2012 “Tentative Guidelines for the Design of Flexible Pavements”
- IRC: SP:102-2014 “Guidelines for Design and Construction of Reinforced Soil Walls”

Since the Suratgarh Power Plant is within 300 km of the project road fly-ash would be used to the maximum extent possible

5.5.2 Reduction in Water Usage

Concrete Casting is of the major water consuming components of the road construction. To reduce the water content in the cement mixture IRC SP 015: 2100: Standard Specifications and Code Of Practice For Construction of Concrete Roads makes specification of the use of plasticizers/super plasticizers on concrete. The Plasticizers are water-reducing agents, so

that for a given workability, the water-cement ratio can be reduced to achieve a higher strength as compared to mix without the additive. The plasticisers alter the physio-chemical forces at the interface between two phases. The plasticizers are adsorbed on the surface of the cement particles, which gives them a negative charge, which cause mutual repulsion, leading to their dispersal. Even air bubbles are repelled and cannot attach themselves to the cement particles. The negative charge causes a sheath of oriented water molecules around each particle which separates them. The water, free from the flocculated system, is thus available to lubricate the mix, thereby increasing its workability. The decrease in mixing water varies between 5 and 15 percent in case of plasticizer and more than 15 percent in case of superlicizers, and depends on the cement content, aggregate type, presence of pozzolana or admixture etc. The water/cement ratio shall however, not be less than 0.25.

5.5.3 Resilience to Heat

Since the project area experiences extreme heat, it also has impact on the road asset. Bitumen normally used for road construction i.e. VG 10/VG 20 has a softening point of <45oC. Thus, in extreme temperature conditions of western Rajasthan in May and June there is bleeding of asphalt resulting in damage to the pavement. To prevent such damages in this project, VG 30 with a softening point of 47oC is being recommended.

6 IMPACT ASSESSMENT AND MITIGATION MEASURES

6.1 Impact Assessment and Mitigation Measures

The impacts due to proposed project activities across different phases have been identified and predicted. The proposed project activities will impact the environment in two distinct phases:

- Construction phase
- Operational phase

Impacts are identified and predicted based on the analysis of the information collected from the following:

- Project information (as outlined in Chapter 2);
- Baseline information (as outlined in Chapter 4).

The identification of likely impacts during construction and operational phases of the proposed project has been carried out based on likely activities having their impact on environmental parameters.

6.2 Potential Impact on Land Use

6.2.1 Impact Assessment

Since the road strengthening would follow the existing alignment of the road the change in land use would be limited only to areas where realignment is proposed, or improvement of geometrics is required, or widening is undertaken and at the Sankhwas and Kankarai Bypass. Most of the land along the corridor is single cropped agricultural land. In few instances dug wells were observed along the alignment which was used for irrigation. Impact on these irrigated lands or the structure would have significant impact on the scare agricultural land. As per preliminary design none of the structure are likely to be impacted. Due to the poor agricultural condition in the district the impact on conversion of agricultural land for road construction is low.

Some temporary changes in land use might occur due to setting up of construction camp, material storage yards and plant and machinery. These would be fallow land or waste land and would be for a period of 2-3 years and the impacts would be low. With the development of the road there is a likelihood of induced ribbon development along the project roads. The agricultural or other landuse would change to commercial and or residential use over time.

6.2.2 Mitigation Measures

To prevent any adverse impacts on land-use the following measures need to be adopted:

- For realignments, irrigated agricultural lands, grazing land would best be avoided if possible. In case the same is not feasible least amount of agricultural land would be used for road construction;
- No agricultural land, fallow land (current or temporary), grazing land should be used for setting up of construction camps, material storage or staging of plant and machinery. The following parameters would be considered while selecting site for construction camp:

Box 6-1: Guidance on Site Selection of Contractor's Camp

- Sites /land types to be avoided:

• Lands close to habitations	• Irrigated agricultural lands
• Lands belonging to small farmers	• Lands under village forests
• Lands within 100m of community water bodies and water sources as rivers	• Lands supporting dense vegetation and Forest with/without conservations status
• Low lying lands	• Lands within 100m of watercourses
• Grazing lands and lands with or without tenure rights	• Lands where there is no willingness of the landowner to permit its use
• 2km from Class A and above towns	• 500m from any villages

- Community land ((Gochars, mandir vans (dev vans) or banis, Kakad bani Orans, Kesar chhanta, Radi) which is traditionally used as conservation areas

- Land Types Preferred
  - Waste lands.
  - Waste Lands belonging to owners who look upon the temporary use as a source of income.
  - Community lands or government land not used for beneficial purposes.
  - Private non-irrigated lands where the owner is willing.
  - Lands with an existing access road.

6.3 Potential Impact on Soil

6.3.1 Impact Assessment

The impacts on the soil are expected along the alignment especially in case of expansion of carriageway, realignment as well as in the borrow areas and construction camp. The impact on the soil is primarily due to the:

- Loss of topsoil. The topsoil on the land parcels which is ether used for short term (e.g. borrow areas, construction camps etc) or permanent use (expansion of the road alignment) would be lost unless the same has been preserved.

- Soil Erosion: The alignment passes through areas which have sandy loam or sandy clayey loam. These soils are light textured and are thus prone to erosion by winds.
- Compaction: The movement of vehicle over the agricultural land to access the construction site would also cause compactions of soil and affect soil fertility.

It is estimated that approximately 2.19 lakhs cu.m of material would be excavated during construction. This would be primarily from the construction of minor bridge or culvert, construction and demolition and waste generated during the dismantling of the existing cross drainage structure and bituminous waste generated during dismantling of pavement. In addition, waste from off-spec hot-mix as wells as from the regular operations of the machinery e.g. layers and bitumen sprayers during the surfacing of the roads. The concrete wastes from the batching plant and transit mixer wash would also be generated.

The labour camps would be setup for construction which would generate municipal solid waste and hazardous waste (waste oil from the maintenance and operation of machinery). These wastes have potential to contaminate the soil around the site if it is not properly stored, handles and disposed.

If these excess excavated material, construction and demolition wastes are disposed on agricultural land it may result in loss of productivity of land.

6.3.2 Mitigation Measures

Mitigation measures which would be considered to reduce impacts on soil during road and bridge construction are given below:

- The borrow areas should be developed as per the guideline presented in Annexure 6.1 to minimise impacts.
- Excess excavated material should not be dumped by the contractor on any adjoining property. The excess excavated material to be stored at a specified location so that it can be reused wherever possible or used for strengthening of shoulders of village roads;
- All demolition debris especially from cross drainage structures and pavement should be utilised in the backfilling wherever possible. No virgin material shall be utilised unless the demolition debris are certified by the Engineer as “not fit for use”. All construction debris which cannot be reused should be disposed at pre-designated sites. The Contractor should identify site for temporary storage of the construction debris during the pre-construction
- Since the project road is within 300 Km of Giral Lignite Power Plant in Barmer. The Contractor thus has to mandatorily ensure utilisation of fly ash as per the provisions of IRC Codes
- Vehicular movement should be restricted over the open fields or agricultural land.

The storage, handling and disposal of Municipal Solid Waste, Hazardous Waste and construction demolition waste the Contractor should follow all the provision of the respective rules. The guidance for storage of these waste are presented in Annexure 6.2 The same guidance (storage of Hazardous Waste) may be used for storage of hazardous materials (oil, lubricants)

6.4 Potential Impact on Surface Water Resources

6.4.1 Impacts Due to Construction

Surface water is scarce in most parts of the project area and is primarily used by community for drinking water. The construction activities e.g. earthwork, concreting of structure and labour camps, would require large quantities of water and may result in conflicting situations with local communities. In addition, the construction activities would also witness influx of skilled labour who would be housed in the construction camps. Water would also be required for domestic requirement and the ground water at places also does not meet the required standards of IS 10500: 2012.

The projects districts are affected by water crisis during the summer months. Additional water requirement for construction would not only put stress on the resource but also lead to conflict with the local community.

In addition to usage of water the encroachment of the road on any surface waterbody or its catchment or even severance of the catchment from the waterbody as in case of the Kankarai bypass would also severely affect the drinking water availability in the region and would have significant impacts. Additionally two community ponds along the project road are going to be partially impacted due to proposed widening. The toe of the embankment would touch the edge of the embankment created around the pond. The details of the identified ponds are as under:

- Pond at 4+950 on LHS - Partially impacted
- Pond at 84+950 on LHS - Partially impacted

Since the population is depend on the water of these ponds for drinking any impact on enve the embankment would have severe impacts as breach of the embankment would result in polluted water getting into the pond.

6.4.2 Mitigation Measures

- Water for construction should not be sourced from any waterbody used for drinking purpose.
- The contractor should preferably identify local depression along the alignment in consultation with the local panchayat to be developed as water storage areas. The PIU can enter into an agreement with the panchayat for development of this water body and using the water stored on it for construction purpose. The runoff of from the pavement can also be channelized into them. This waterbody would be handed over to the community for use and maintenance after the completion of construction.
- In water scare areas dust suppressant /dust binders shall be used to reduce water consumptions. The acceptable dust suppressants include: Acrylic polymers, Solid recycled asphalt, Chloride compounds (calcium chloride and magnesium chloride), Lignin compounds (lignin sulphate and lignin sulfonate powders), Natural oil resins (soybean oil) and Organic resin emulsions.
- The water from the longitudinal drains should not be allowed to drain into any water body used for drinking water. In case the drinking water body is the lowest point in

the topography the Contractor shall identify a separate location and used it for storage of water as described above.

- None of the project components i.e. existing alignment, realignment or toll plaza shall encroach into any waterbody. In such cases a realignment would be carried out to prevent any encroachment. In case such realignment is not possible the entire alignment would be elevated on piers so that there is no hinderance to the water from the catchment reaching the waterbody. During construction, no construction and demolition debris shall be left in the catchment of the water body.
- The Contractor should notify the PIU its source for procurement of water. It should provide monthly reports of water consumed and its source.
- The water consumption for concrete mixing can be reduced by use of plasticizers/ super plasticizers as mentioned in IRC 015:2011
- Enhancement measures may be considered in all the ponds along the corridor. These could include the strengthening of the embankment, excavation of the pond to increase its holding capacity, construction of the silt traps at the end of the pond so that the siltation reduces.

6.5 Potential Impact on Surface Water Quality

6.5.1 Impacts Due to Construction

In addition to competition over the scarce resource, the construction camp and the construction activities would generate waste water. These would include domestic wastewater from the construction camp and the wash water from the machinery e.g. batching plant concrete transit mixers would cause deterioration of the water quality These liquid wastes have potential to contaminate the water bodies around the site if it is not properly handled.

6.5.2 Mitigation Measures

- No wastewater should be discharged from construction camps. Runoff from the camp shall be passed through an oil-water separator. All peripheral drains shall be linked to the oil water separator. The design of the oil water separator is presented in Annexure 6.3. The construction camps would have the measures specified in Box 6-2.

Box 6-2: Facilities in Contractors Camps

- Security:
  - The contractor shall put in place the following security measures to ensure the safety of the workers. The following measures shall be incorporated:
    - The contractor/sub-contractor shall provide Identity cards to all the employees/workers;
    - Access to the campsite shall be limited to the residing workforce;

- The contractor shall be responsible for deploying adequate number of guards;
- Adequate, day-time night-time lighting shall be provided;
- The security personnel shall be provided with training to respect the community traditions and in dealing with, use of force etc.; and
- The rental accommodation shall be provided with firefighting equipment and portable fire extinguishers.

- Provision of Drinking Water:
  - Access to an adequate and convenient supply of free potable water is a necessity for workers. The domestic water supply shall be made available by the contractor.
  - Safe drinking water conforming to the IS 10500:2012 for drinking water shall be provided;
  - Bottled Potable drinking water would be provided to all the employee/workers both at the worksite and at the construction camps;
  - Every water supply or storage shall be at a distance not less than 15m from any wastewater / sewage drain or other source of pollution. Water sources within 15m proximity of toilet, drain or any source of pollution will not be used for any consumption purpose in the project
  - The Contractor should regularly monitor (every quarter) the quality of drinking water available. In case of non-compliance with the Drinking Water Specifications, additional treatment shall be provided, or alternative sources of water supply shall be arranged; and
  - All tanks used for the storage of drinking water shall covered as to prevent water stored therein from becoming polluted or contaminated.
  - The tanks shall be cleaned at regular interval (minimum every 3 months) to ensure hygiene conditions are maintained.
- Cooking Arrangement:
  - The construction phase will involve engagement of large number of migrant people in the project area for a limited time. Hence, there shall be requirement of provision of cooking facilities (kitchen) as listed below:
  - The cooking area shall be separate from the Living quarters;
  - Places for food preparation are designed to permit good hygiene practices, including protection against contamination between and during food preparation;
  - The cooking area should be provided with water connections which is fit for consumption;
  - Adequate personal hygiene including designated areas for cleaning hands and cleaning of utensils; and

- All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas are built using durable, non-absorbent, easily cleanable, non-toxic materials;
- Food preparation area to be durable, easily cleanable, non-corrosive surface made of non-toxic materials.
- To ensure that the fuel need of labourers in the project area does not interfere with the local requirements, necessary arrangements for supply of cooking fuel to the labourers shall be done by the contractor. Clean fuels shall be used in no circumstance fuel wood shall be used for cooking or heating.

- Washing and Bathing Facilities
  - In every site, adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labour employed therein. Separate and adequate bathing shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic conditions.
- Toilets Facilities
  - Sanitary arrangements, latrines and urinals shall be provided in every work place separately for male and female workers. The arrangements shall include:
  - A latrine for every 15 females or part thereof (where female workers are employed).
  - A latrine for every 10 males.
  - Every latrine shall be under cover and so partitioned as to secure privacy and shall have a proper door and fastenings.
  - Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by most of the workers —" For Men Only" or —" For Women Only" as the case may be. Pictographic signages can also be used
  - The latrines and urinals shall be adequately lighted and shall be maintained in a clean sanitary condition at all times and should have a proper drainage system;
  - Water shall be provided in (preferably) or near the latrines and urinals by storage in suitable containers
- Waste Water Generation:
  - There will of generation of wastewater from the campsite. About 80% of water used shall be generated as sewage/wastewater. Contractor shall ensure that the campsite/s is/are equipped with:
  - Septic tank and soak pit for disposal of sewage or with mobile bio-toilets. The toilets and the septic tank and soak pit should not be located near any drinking water sources either within or outside the camp.

- The storm water and sewage system should be separate. The surface water drainage shall include all necessary gutters, down pipes, gullies, traps, catch pits, manholes etc. An Oil water separator should be in the drains leading out of the maintenance area. Water passing out of the camp should be passed through a sedimentation tank of at-least 3hrs holding capacity.
- Sanitary and toilet facilities are constructed of materials that are easily cleanable. Sanitary and toilet facilities are required to be cleaned frequently and kept in working condition.

- Solid Waste Management:
  - The solid waste generated from campsite will mostly comprise of compostable wastes like vegetable residues (kitchen waste) and combustible waste like paper, cans, plastic and some non-degradable waste like glass/glass bottles. Improper disposal of solid waste will lead to environmental degradation and health hazards to labour as well as nearby community.
  - The following measures shall be adopted by contractors for ensuring effective management of solid waste:
    - The solid wastes of domestic nature (especially food waste, waste from canteen) shall be collected and stored separately in appropriate containers with proper covers on them so that they are not littered;
    - Separate bins with proper markings in terms of recyclable or non-recyclable waste shall be provided in the houses and kitchen premises in sufficient numbers for collection of garbage;
    - Food waste and other refuse are to be removed from the kitchen frequently to avoid accumulation; and
    - The contractor shall ensure that the all food waste generated is composed within the camp premises. All recyclables except for the waste which are covered by any other act/rules other than the Municipal Solid Waste Rules 2016.

- Roads
  - All the internal roads shall be paved. The concrete slurry from the batching plant shall be used for paving the roads

- Medical Facility:
  - Effective health management is necessary for preventing spread of communicable diseases among labour and within the adjoining community. The following medical facilities shall be provided by contractors for the construction workers:
  - A first aid centre shall be provided for the labour within the construction site equipped with medicines and other basic facilities;

- Adequate first aid kits shall be provided in the campsite in accessible place. The kit shall contain all type of medicines and dressing material;
- Contractor shall identify and train an adequate number of workers to provide first aid during medical emergencies;
- Regular health check-ups shall be carried out for the construction labourers every six month and health records shall be maintained;
- Labours should have easy access to medical facilities and first aid; where possible, nurses should be available for female workers;
- First Aid Box will be provided at every construction campsite and under the charge of a responsible person who shall always be readily available during working hours. He shall be adequately trained in administering first aid-treatment. Formal arrangement shall be prescribed to carry injured person or person suddenly taken ill to the nearest hospital. The first aid box shall contain the following.
- small sterilised dressings
- 3 medium size sterilised dressings
- 3 large size sterilised dressings
- 3 large sterilised burns dressings
- 1 (30 ml) bottle containing 2 % alcoholic solution of iodine
- 1 (30 ml) bottle containing Sal volatile
- 1 snakebite lancet
- 1 (30 gms) bottle of potassium permanganate crystals
- 1 pair scissors
- Ointment for burns
- A bottle of suitable surgical antiseptic solution
- In case, the number of labour exceeds 50, the items in the first aid box shall be doubled. All the vehicles and equipment shall be provided with a fir-aid box with all the above. The medicines should be regularly checked for the expiry of the medicines.
- Information and awareness of communicable diseases, AIDS etc. shall be provided to workers.
- Basic collective social/rest spaces are provided to workers.;

- Fire-fighting arrangement
  - The contractor shall carry out demarcation of area susceptible to fires and put in precautionary signages as specified in IS 9457
  - Portable fire extinguishers and/or sand baskets shall be provided at easily accessible locations in the event of fire as per the provisions of IS 2190

- The contractor shall carry out fire safety drill every quarter and Workers shall be trained on the usage of such equipment/s

Fuel and Chemical Storage

- Licence is required for storage and transport of any such product (i.e. petroleum class B) if the total quantity in in possession does exceed 2500 litres in non-bulk (i.e. drums) or 1000litres in a receptacle / tank (i.e. bulk).
- All fuel and chemical storage area should be made impermeable either by concrete flooring or by placing an HDPE liner.
- The storage area shall be provided with a bunded. The capacity of the bund shall be 110% of the volume of the maximum storage tank
- The area shall be covered and secured under lock and key.
- In no condition shall the fuel be decanted by tilting of drums. An approved fuel pump manual or energy driven shall be used.
- In case of spills Emergency Spill care procedures as presented in Annexure 6.4 shall be used.

- The Contractor with support from the project, shall consider development of new surface water bodies or renovation of existing surface water bodies with prior permission of the village panchayat for harvesting of water. This water can be used for construction purpose and on completion of the construction the same can be handed over to the community for maintenance and use. To facilitate the selection of the site for location of the surface water bodies a Digital Elevation Model for the study area may be created.
- During the detailed design the longitudinal drains shall be so planned that it does not discharge into any waterbody used for drinking or its catchments.
- Small check dams can be considered in the longitudinal drains to allow the recharge of water
- Rainwater water harvesting puts can also be considered as per the feasibility. During the detailed design these can be considered. The schematic drawing of rainwater harvesting pits is presented in Annexure6.5

6.5.3 Impacts During Operation

During the operation if discharge from the longitudinal drains enters into the water bodies used for drinking water it would pollute these sources and severely affect the availability of water in the region.

6.5.4 Mitigation Measures

- Water from longitudinal drain should not be disposed into any surface water body or its catchments used for drinking purpose and at all times.
- Water used for domestic purpose at the toll plaza shall conform to IS 10500: 2012.

6.6 Potential Impact on Ground Water Resources

6.6.1 Impact Identification

Like surface water, groundwater is also scarce in number of block which is already declared as notified blocks by CGWB. In such blocks withdrawal of water is prohibited for any purpose other than drinking purpose. Using groundwater especially freshwater for domestic and construction activities would have serious impacts on the availability of the resource for domestic purpose.

6.6.2 Mitigation Measure

- Construction water would not be procured from any unauthorised wells or existing wells. The permission of CGWB would be obtained in case new wells are sunk;
- In Notified areas, freshwater shall not be used for construction activity. The saline water should preferably be used for the construction activities after treatment. The feasibility of using the saline water for construction and the treatment technologies shall be identified during the project design and pre-construction;
- Water usage for construction work would be reduced by adopting following best practices:
- Use buckets etc. to wash tools instead of using running water;
- Use of auto shut off taps (without sensors) in labour accommodation;
- Install water metres with main supply pipes/water tanks/bore well to assess quantity of consumed water and
- Use of plasticizers/superplasticizers in the concrete production to reduce water consumption.

6.7 Potential Impact on Ground Water Quality

6.7.1 Impact Identification

The construction activities would also witness influx of skilled labour who would be housed in the construction camps. Water would also be required for domestic requirement and the ground water at places also does not meet the required standards of IS 10500: 2012 as is presented in Section 4.5.2. The limited/non-availability of fit for use drinking water would also affect the workforce.

6.7.2 Mitigation Measures

- The Contractor shall make arrangement for bottled drinking water which conforms to IS 14543 (2004).
- In case the contractor uses groundwater for drinking purpose he shall install adequate treatment technologies e.g. reverse osmosis and fluoride removal filters.

6.8 Potential Impact on Ambient Air Quality

The impact on the air environment are likely both during the construction as well as the operations phases.

6.8.1 Impacts Due to Construction

In the construction phases the activities related to the earthwork is likely to generate large quantities of particulates. The possible sources of generation of such particulates are borrow area operations, transport of material, storage of construction material, carrying out of earthwork, movement of vehicles on unpaved road. Vehicular movement due to the project would also add to PM 2.5 and SOx and NOx emissions. In case of the project road both PM 10 and PM 2.5 are identified as a major source of pollutant.

The operations of the Hot-mix plant, handling of cement in batching plants is also likely to generate the air pollutant. The generation of PM2.5 due to the construction activities would add on the already stressed air environment.

6.8.2 Mitigation Measures During Construction

To prevent the generation of dust during the construction activity the following measures may be considered:

- The speed limit of project vehicle movement over unpaved surface should be limited to 15 kmph;
- All vehicles carrying construction material should be covered;
- The construction material should be stored against wind breaks so that they are not carried away by wind. The length of the windbreak wall shall be twice the height for it to effectively work. The stockpiling of material should be carried out considering the prevailing wind direction;
- Water sprinkling should be restricted due to the scarcity of water. Dust suppressant[13] should be applied on the surface of the unpaved earthwork to reduce the consumption of water;
- Vehicular movement on the unpaved pavement should be strictly restricted. The access roads within the construction camp should be paved using the waste concrete or batching plant and concrete mixer wash;
- All project related vehicles and equipment should have valid Pollution Control Certificates.
- The pollution control equipment in the Hot-mix plant shall be kept in working condition at all times. The plant shall not be operated if the pollution control equipment is not functional;
- Requisite permits shall be obtained from the RSPCB for operation of the Hot Mix Plant and Quarry (in case of new Quarry);

6.8.3 Impacts During Operation

The strengthening of the carriageway would improve vehicular movement, congestion is likely to get reduced and speed to vehicles are likely to improve. Even though there would

[13] Dust Suppressants include: Acrylic polymers, Solid recycled asphalt, Chloride compounds (calcium chloride and magnesium chloride), Lignin compounds (lignin sulphate and lignin sulfonate powders),

be a decrease in vehicular emission due to the reduction in congestion the increased vehicular traffic on the state highways would increase the pollution load.

6.8.4 Mitigation During the Operations

To mitigate the impacts of vehicular pollution during operations phase:

- Green belt shall be developed along the corridors. Local species which can arrest both gaseous and particulates shall be planted

6.9 Potential Impact on Noise Quality

6.9.1 Impact due to Construction

The principal source of noise during construction of highway would be from operation of equipment, machinery and vehicles. Earth moving machineries e.g. excavators, graders and vibratory rollers has potential to generate high noise levels. These machineries produce noise level of more than 70 dB (A). This can cause disturbance to the settlement, adjacent to the carriageway or at 500 m from the worksite. The vibration produced by rollers can be transmitted along the ground. This may cause damage to kutcha structure located along the alignment. The extent of damage would be dependent on the type of soil, the age and construction of the structure.

The noise generated during the construction would cause inconvenience to the population adjoining the highways especially within 500 m of the alignment after which it would be attenuated to acceptable levels. Since, the settlement along the road alignment would be sparse the severity of the impact would be low. The impact on the workers however would be dealt with in the section 6.14.

6.9.2 Mitigation Measures

- The DG sets used in the project should conform to the CPCB stimulated standards and have obtained the COP (Conformity of Product Verification) certification.
- Regular maintenance of the machinery, equipment and vehicle would be carried out to prevent excessive noise. A maintenance schedule would be prepared and maintained by the contractor.
- Night time construction activity would be prohibited in case settlement/habitation is located within 500 m of the construction site.

6.9.3 Impact During Operation

The development of the road is expected to increase the traffic volume but at the same time reduce the congestion in the settlements. The noise levels are still expected to increase with the increase in traffic. As pointed out in section 4.4.3 the noise measured in front of the sensitive receptors e.g. schools are not only more than standards prescribed for sensitive receptors e.g. educational institutions but also for more than residential areas.

The increase in traffic would further aggravate the problem and would cause inconvenience especially at educational institution. As pointed out earlier in some case due to the proximity of the classroom to the exiting highway student have complained about noise. The operations of the highways and the increased traffic would further aggravate the noise levels.

6.9.4 Mitigation Measures

- In cases where land is available three-layer plantations would be carried out with local species to act as a vegetative barrier for noise
- In some cases, the height of the boundary wall may be increased depending on the existing construction. For e.g. construction without any reinforcement, it may not be possible to increase the height of the boundary wall
- If the above two options are not possible the classroom/s which are adjoining the highway may be relocated.

6.10 Potential Impact on Physiography and Drainage

6.10.1 Impact Identification

The alignment follows the existing topography for most of the route. However, in few sections the vertical profile has been changed and the height of the finished level has been increased by approximately 2 m. Since the only small portion of the alignment has been elevated e.g. near causeways which has been converted into minor bridge and no cut and fill is envisaged the impact on topography is minimal. Even though the rainfall in the area is low, the soil is sandy loam or clayey sandy loam which are prone to erosion.

There is no major river along the alignment, all the existing CD structure have been retained. Three minor bridges 3 pipe culverts, 13 slab culverts and 5 causeways are provided. Thus, any change in the drainage is also not envisaged.

6.10.2 Mitigation Measures

- At all locations where the preliminary design have indicated in raise in the level of the embankment the final design should review the feasibility of the same and if possible reduce the embankment height.
- At all location where the vertical profile has increase by 2.0 m or more protections of embankment is required.

6.11 Potential Impact on Biological Environment

6.11.1 Impact on Flora

It is estimated that 761 trees would be felled for the proposed road improvement project. Even though no major change in habitat is envisaged, being an arid area with sparse vegetation the felling of trees would have an impact on the flora. The impact is would also not be significant as the because the alignment would not affect any forest area.

6.11.2 Mitigation Measures

- Plantation would be taken along the corridor to compensate for the tree felled. At least 10 trees would be planted for every tree felled or as mentioned in the permission for tree felling provided by the Department of Forest, Government of Rajasthan
- The Guidance on site clearance is presented in Annexure 6.6: Guidance for Site Clearance

- Only local tree species which are less water consuming should be used for plantation.

6.11.3 Impact on Fauna during construction

There are no National Park or wildlife sanctuary along the alignment. However, there are some community conserved areas e.g. gochars[14] within the project influence area. The alignment would not encroach into the natural habitats so there would be no impact on ecological resources. Additionally, there is a large population of Chinkaras, black buck and Nilgai along the corridor. These animals have been reported to cross the road in search of food and water.

During the construction of the culvert, excavation have to be carried out for developing the foundation. In areas where there is wildlife movement is reported to be at risk is primarily due to falling of the animal into the excavation carried out for foundation.

6.11.4 Mitigation Measures During Construction

- During the detailed design the areas with known roadkills and wildlife movement would be identified. Consultation can be held with the forest department or the veterinary hospital at Nagaur to identify the location where the movement is happening. Additionally, modern techniques e.g. camera traps may be used for identification of the wildlife movement. At such location:
    - Traffic calming measures would be undertaken
    - Reflectors should be installed along the highway in these areas to prevent wildlife from approaching the road
    - Display boards (as per IRC 30 - 1968 - Numerals of Different Height for Use on Highway Signs and IRC 67 - 2012: Code practice for Road Signs) should be placed ahead of the stretch to warn drives of the approaching wildlife crossing areas
- During the construction areas which have proven wildlife movement temporary woven wire mesh guards of about 2.4 m (8 ft.) high will be put around the excavated areas to prevent small wild animal from falling. No harm would be done to the animal if they are trapped in the excavated area. The contractor in association with PIU and Forest Department would ensure safe release of the animal.

6.11.5 Impact on Fauna during Operation

Large number of roadkills especially reptiles and mammals have been reported along the highways at some location. The movement of these wild animal primarily occurs primarily for search of food and water.

6.11.6 Mitigation Measures During Operation

- A survey of the vulnerable stretches of the road especially with respect to road kill would be carried out. The following measures would be taken:

[14] Gochars are community land reserved for grazing of cattle. These are usually a reserved gategory of land registered in the records under the possession of the "Government of India" of any subordinate government Authority.

- Reflectors should be installed along the highway in these areas to prevent wildlife from approaching the road
- Display boards (as per IRC 30 - 1968 - Numerals of Different Height for Use on Highway Signs and IRC 67 - 2012: Code practice for Road Signs) should be placed ahead of the stretch to warn drives of the approaching wildlife crossing areas
- The facilities of treatment at the veterinary centre at Jodhpur would be augmented in consultations with the Forest Department

6.12 Potential Impact on Socio-economic Environment

The socio-economic impacts have been detailed in the Social Impact Assessment and Resettlement and Rehabilitation study carried out under the project.

6.13 Community Health and Safety Issues

6.13.1 Impacts during Construction

The construction activities would be carried out without hampering the existing traffic since there is no alternate corridor for diversions of traffic. The construction activities would also remove the additional spaces i.e. shoulder to accommodate the construction of the additional carriageway or strengthening of the carriageway and shoulders. Since the local slow-moving traffic including pedestrians and the through highway traffic would be using a reduced road space the congestions on the highway would increase during construction. This situation would be further aggravated by the additional vehicle used in the construction activity using the road for haulage of construction material.

The local slow-moving traffic and pedestrians are thus prone to collision with the through highway traffic and the construction vehicle. Also, at times the excavations are carried out close to a village access road or settlement. These work sites may also cause potential injuries to the public unless they are protected.

6.13.2 Mitigation measures

- All worksites should be barricaded, and the integrity of the workspace segregation from the traffic maintained at all times;
- In settlement area the workplace should be segregated by erecting barriers. Separate walkway should be identified in the settlement areas for use by pedestrians and slow moving traffic. Crossover points should be provided at the worksite locations in settlement areas so that people can easily crossover without coming in close proximity with the construction work or equipment.
- At the point of entry or exit from the work site flagman should be provided. The entry and exit vehicle shall be regulated by the flagman to prevent collision;
- All worksite shall be provided with reflective stickers so that it can be easily identified during night;
- Precautionary signages should be put-up well in advance to warn drivers of impending construction works;
- Flashers should be provided near excavation to warn the traffic of the excavations;

- The worksite within the settlement shall be properly illuminated as a safety precaution;
- The construction debris should not be placed on the road as it would further constrict the space available for the public.

Impacts During Operations

During the operations phase of the highway, the traffic volumes and vehicular speeds are both likely to increase. This can potentially be risky both for pedestrian as well as slow - moving traffic. In case of sensitive receptors mentioned above in addition, as traffic speeds increase the chances of vehicular collisions are also expected to increase.

Mitigation Measures

- During the design activity a traffic hotspot study should be carried out to identify the location of accident or areas of conflicting traffic. Design interventions should be carried out at these locations
- During the operations of the highway traffic hotspot studies should be carried out every year as per the MoRTH's Circular. The traffic safety expenditure should be included in the annual budget.

6.14 Occupational Health and Safety Issues

6.14.1 Impact Identification

Highway workers are at risk of injury from i.) passing traffic vehicles, ii) Construction equipment operating within the work zone and in ancillary areas which support the work zone e.g. batching plant, hot-mix plants iii) construction vehicles entering and leaving the work zone. The statistical information[15] indicate that the worker on foot are the most vulnerable in the Highway Construction work zone. Similarly, there are occupational risks during operation of the highway is from traffic. Accidents primarily occur due to collisions with passing vehicle.

The sub-project districts experience extreme weather conditions especially during summers. This can cause fatigue and lead to issues of dehydration and heat-stoke.

6.14.2 Mitigation Measures

The following mitigation measures need to be adopted to protect the workers:

- Temporary traffic control devices such as signages, warning devices, concrete barriers can be used to segregate the highway traffic from the work zone. These control devices should be setup at a distance ahead of the work zone to control traffic. Cover or remove the precautionary signages when the workers are not present;
- Flaggers/Flagmen should be placed with high reflective jackets and other devices so that they can slow down the traffic;

[15] Building Safer Highway Work Zones: DHHS (NIOSH) PUBLICATION No. 2001-128, April 2011, https://www.cdc.gov/niosh/docs/2001-128/pdfs/2001-128.pdf

- No equipment or vehicle should enter the work zone without the flagmen being present to guide the equipment/vehicle;
- All vehicle should be fitted with reverse siren. Rotating equipment should also be fitted with siren which should come on when the equipment rotates to the reverse;
- To prevent the workers from getting dehydrated or being affected by heat stroke the following measures may be considered:
- All workplace to have adequate provisions of drinking water,
- The workplace should be provided with temporary shelters where the workers can rest during prolonged exposure to sun
    - In case of extreme temperatures, the working hours may be regulated. Night time working can be considered especially in areas outside settlement with the permission of the Employer/Engineer.

These measures as discussed above would also be made part of the Standard bidding document of Contractor involved in sub-projects, The detailed Guidance on Occupations Health and Safety is presented in Annexure 6.7

7 PUBLIC CONSULTATIONS AND DISCLOSURE

7.1 Introduction

Stakeholder consultation was carried out with the objective of finding out the views and opinions of the stakeholders, mainly the community in and around, on issues relating to the project, its operations and also on peripheral development.

Through public participation, key social issues of the stakeholder were identified, and strategy was formulated. It included sociocultural analysis and design of social strategy, institutional analysis. It specifically addressed the issue of how poor and vulnerable groups may benefit from the project. The consultation process established during preparation stage of the project used different types of consultation such as in-depth interviews with key informants, focus group discussions, and meetings. The consultation program included the following:

- Heads of households likely to be impacted;
- Household members including women;
- Villagers in the Project Influence area;
- Village panchayats; and
- Government Agencies and Departments.

The main objectives of the consultation program were to minimise the negative impact of the project corridors and to make people aware of the road rehabilitation project. During the process efforts were made to ascertain the views and preferences of the people. The aims of community consultation were:

- To understand views of the people affected w.r.t to the impacts of the road
- To resolve the issues relating to the impacts on community property.

7.2 Local Level Consultation

Local level consultations were carried out in affected villages and all the comments received have been incorporated in the document. Efforts were made to select both small and big habitations along the project road in order to get representation of all the segments of affected population. Prior intimation of at least 15 days before the planned consultation meeting was given to Village office /Sarpanch /Villagers, so that the villagers were aware of date and location of meeting before hand for active participation.

The objectives of local level consultations were to inform the population about the project, solicit their opinion on the proposed development and understand their requirement with respect to a transportation corridor. The apprehensions about the project both during the construction and operation phases were also considered and incorporated their views into the policy making and design.

7.2.1 Key findings of the local level consultations

The key findings of the local level consultations are as follows:

- The size of participants in each consultation ranges between 10-20.

- The participants were aware of the fact that road will be widened, but they didn't know the details of the project.
- The participants, in general, were in favour of road widening and improvement, however they had apprehensions regarding safety.

Table 7-1:Public Consultation during the EIA Preparation

Name of the Village	No of Participants	Issues/Suggestions
Daikra Date – 04/12/2015	18	The villagers insisted to the widening of the existing road passing through the village Daikra. However the villagers were apprehensive that the construction of new bypass will pollute the water of the nearby pond and also reduce the flow of water. So they are opposed to any proposal of bypass but rather insisted the road passes through the settlement. . The villagers further informed that previously due to construction of District road between Daikra and Surpura villages, there was conflict between the two villages for a long time with instances of gun fire in the area. Hence they requested to cancel the proposal for new bypass and widen the existing road.
Gawaloo Date – 05/12/2015	15	All the villagers were in favour of the widening and realignment.
Khajwana Date – 05/12/2015	26	It was concluded that the widening of road should not be done along the middle of village along the existing road, as it will entail loss of property/assets to many villagers. The villagers also suggested the alignment for possible bypass from Kuchera to Khajwana Bus Stand and Khajwana Bus stand to Medta-Nagaur State Highway-39 towards bus stand from turn near G.S.S. (Mundwa) to the Gawaloo-Sankhwas road. It will require only limited acquisition through 3 agricultural fields, which will also reduce compensation outlay by the Govt. The villagers also provided a village map.
Sankhwas Date – 06/12/2015	23	In favour of road widening and improvement. However they urged that the road should be widened / improved at its current location. The location of proposed bypass is not suitable as per the villagers; hence they declined to support it.
Village Asop	16	Villagers and Sarpanch were in favour of road

Date – 29/12/2015		widening as it will not affect the villages. They did not have any other query. They proposed to widen the existing road.
Bopalgarh 11/01/2016	22	All villagers were in favour of road improvement

Figure 7-1: Public Consultation during the preparation of the Baner Kuchera EIA Studies

7.3 Conclusion of Stakeholder Consultations

All the stakeholder's suggestions and comments were conveyed to the design team for consideration and incorporation in the project design. It can be concluded that all the concerns of stakeholders have been taken into account in the project planning and design issues

8 ENVIRONMENT MANAGEMENT PLAN

8.1 Introduction

This Environmental Management Plan has been drawn based on the understanding of the interactions between the environmental setting and the project components and the assessment of the likely impacts. Mitigation measures described earlier in the report has been further elaborated as specific actions which would have to be implemented during the project implementation . The EMP would help the PPP Division implement the project in an environmentally sustainable manner and where all contractors, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage such risk.

This EMP can thus be considered to be an overview document that will guide environment management of all aspects of PPP Divisions activities in Baner – Bopalgarh – Kuchera Road Project. This EMP may also be considered as flexible and will be further developed by the Contractor in the Contractor's Environment Management Plan.

8.2 Environment Management Plans

The Environment Management Plan furthers detail out the mitigation measures discussed earlier during the Pre-Construction , Construction and Operation Phases of the project. This will ensure that environmental issues are properly addressed during road upgradation. The Environmental Management Plan is presented in

Table 8-1

Table 8-1: Environmental Management Plan

Pre-Construction Stage

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
Pre-construction activities by Project Implementation Unit				
P.1	Land Acquisition	The acquisition of land and private properties will be carried out in accordance with the RAP and entitlement framework for the project. PIU has to ascertain that any additional environmental impacts resulting from acquisition of land shall be addressed and integrated into the EMP and other relevant documents.	PIU, Revenue Dept., NGOs, Collaborating Agencies	PIU
P.2	Preservation of Trees	All efforts will be made to preserve trees including evaluation of minor design adjustments/alternatives (as applicable) to save trees. Specific attention will be given for protecting giant trees and locally important trees (religiously important etc.). Tree cutting is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances from the Forest Dept./DoEF/MoEF are completed and subsequently a written order is issued to the Contractor. Particular species declared as 'protected' by the State's Forest Dept. in the private land will be felled only after due clearance from the Forest Dept. is obtained.	PIU, Forest Department, Contractor	Authority Engineer and PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
		In the event of design changes, additional assessments including the possibility to save trees shall be made. Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees cut and those saved will be maintained by the PIU.		
P.3	Relocation of Community Utilities and Common Property Resources	All community utilities and properties i.e., water supply lines, sewer lines, bank buildings, health centers, schools, health clinics and veterinary hospitals will be relocated before construction starts, on any section of the project corridor. The PIU will relocate these properties in consultation and written agreement with the agency/ owner/community. The schools and health centers will be constructed as per the relevant state norms. All other community property resources within the corridor of impact such as hand pumps, ponds, grazing lands etc. will be relocated. The relocation sites for these schools will be identified in accordance with the choice of the community. Environmental considerations with suitable/required actions including health and hygiene aspects will be kept in mind while relocating all community utilities and resources.	PIU, Concerned Agencies, Contractor	PIU
P.4	Relocation of affected Cultural and Religious Properties	All religious property resources such as shrines, temples and mosques within the project zone will be relocated. Sites for the relocation of these religious structures will be identified in accordance with the choice of the community.	PIU, NGOs, Contractor	PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
		The NGO and PIU in consultation with local people will finalize design of these temples. As far as possible, the architectural elements of the structure should be conserved/ reflected/translated into the design of new structures. The entire process (i.e. selection of relocation sites and designs) will be under supervision of Environmental Expert of the Authority Engineer. The relocation will be completed before the construction starts in these sites.		
Pre-construction activities by the Contractor/Environmental Expert of Authority Engineer				
P.6	**Field Verification and Suggested Changes in Design**			
P.6.1	Joint Field Verification	The Environmental Expert of the Authority Engineer and the Contractor will carry out joint field verification to ascertain the possibility to saving trees, environmental and community resources. The verification exercise should assess the need for additional protection measures or changes in design/scale/nature of protection measures including the efficacy of enhancement measures suggested in the EMP. Proper documentation and justifications/reasons shall be maintained in all such cases where deviation from the original EMP is proposed.	Contractor/ Environmental Expert of the Authority Engineer	PIU
P.6.2	Assessment of Impacts due to Changes/Additions in the Project	The Environmental Expert of the Authority Engineer will assess impacts and revise/modify the EMP and other required sections of the project document/s in the event of changes/revisions (including addition or deletion) in the project's scope of work.	Contractor/ Environmental Expert of the Authority Engineer	PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
P.6.3	Crushers, hot-mix plants and Batching Plants Location	Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1000 m away from the nearest village/settlement preferably in the downwind direction. The Contractor shall submit a detailed lay-out plan for all such sites and approval of Environmental Expert of the Authority Engineer shall be necessary prior to their establishment. Arrangements to control dust pollution through provision of wind screens, sprinklers, dust encapsulation will have to be provided at all such sites. Specifications of crushers, hot mix plants and batching plants will comply with the requirements of the relevant current emission control legislations and Consent/NOC for all such plants shall be submitted to the SC and PIU. The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted.	Contractor/ Environmental Expert of the Authority Engineer	PIU
P.6.4	Other Construction Vehicles, Equipment and Machinery	All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. Noise limits for construction equipment to be procured such as compactors, rollers, front loaders concrete mixers, cranes	Contractor/ Environmental Expert of the Authority Engineer	PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
		(moveable), vibrators and saws will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986. The Contractor shall maintain a record of PUC for all vehicles and machinery used during the contract period.		
P.7	**Identification and Selection of Material Sources**			
P.7.1	Borrow Areas	Finalizing borrow areas for borrowing earth and all logistic arrangements as well as compliance to environmental requirements, as applicable, will be the sole responsibility of the contractor. The Contractor will not start borrowing earth from select borrow area until the formal agreement is signed between land owner and contractor and a copy is submitted to the SC and the PIU. Locations finalized by the contractor shall be reported to the Environmental Expert of the Authority Engineer and who will in turn report to PIU. Format for reporting will be as per the Reporting Format for Borrow Area and will include a reference map. Planning of haul roads for accessing borrow materials will be undertaken during this stage. The haul roads shall be routed to avoid agricultural areas as far as possible (in case such a land is disturbed, the Contractor will rehabilitate it as per Borrow Area Rehabilitation Guidelines) and will use the existing village roads wherever available.	Contractor/ Environmental Expert of the Authority Engineer	PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
		In addition to testing for the quality of borrow materials by the SC, the environmental personnel of the SC will be required to inspect every borrow area location prior to approval (follow criteria for evaluation of borrow areas).		
P.7.2	Fly Ash	Contractor will work out proper haulage network for transportation of fly ash from plant to project site. If any village road is identified for transportation of fly ash, the road will be improved before starting the transport work. The haul road will avoid using agricultural land (in case such a land is disturbed, the Contractor will rehabilitate it as per Borrow Area Rehabilitation Guidelines) and try to use the existing road network of the area wherever possible. The contractor will consult the Environmental Expert of the Authority Engineer before finalizing the haulage network and also take necessary approval from the expert. SC in turn report to the PIU before giving final approval to the contractor.	Contractor/ Environmental Expert of the Authority Engineer	PIU
P.7.3	Quarry	Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials and other logistic arrangements. In case the contractor decides to use quarries other than recommended by DPR consultants, then it will be selected based on the suitability of the materials.	Contractor	Environmental Expert of the Authority Engineer and PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
		The contractor will procure necessary permission for procurement of materials from Mining Department, District Administration and State Pollution Control Board and shall submit a copy of the approval and the rehabilitation plan to the PIU and Environmental Expert of the SC. Contractor will also work out haul road network and report to Environmental Expert of the Authority Engineer and SC will inspect and in turn report to PIU before approval.		
P.7.4	Arrangement for Construction Water	To avoid disruption/disturbance to other water users, the contractor will extract water from fixed locations and consult the Environmental Expert of the Authority Engineer before finalizing the locations. The Contractor will provide a list of locations and type of sources from where water for construction will be used. The contractor will not be allowed to pump from any irrigation canal and surface water bodies used by community. The contractor will need to comply with the requirements of the State Ground Water Department and seek their approval for doing so and submit copies of the permission to SC and PIU.	Contractor	Environmental Expert of the Authority Engineer and PIU
P.8	Labor Requirements	The contractor preferably will use unskilled labor drawn from local communities to give the maximum benefit to the local community.	Contractor	Environmental Expert of the Authority Engineer and PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
P.9	Construction Camp Locations – Selection, Design and Lay-out	Siting of the construction camps will be as per the guidelines below. Locations identified by the contractor will report as per format given. Construction camps will not be proposed within 500 m from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. Location for stockyards for construction materials will be identified at least 1000 m from water courses. The waste disposal and sewage system for the camp will be designed, built and operated such that no odor is generated. Unless otherwise arranged by the local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert of the Authority Engineer will have to be provided by the contractor.	Contractor	Environmental Expert of the Authority Engineer and PIU
P.10	Arrangements for Temporary Land Requirement	The contractor as per prevalent rules will carry out negotiations with the landowners for obtaining their consent for temporary use of lands for construction sites/hot mix plants/traffic detours/borrow areas etc. The Environmental Expert of the Authority Engineer will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the contract.	Contractor	Environmental Expert of the Authority Engineer and PIU

S. No.	Environmental Issue	Management Measures	Responsibility	
			Planning and Execution	Supervision/Monitoring
P.11	Orientation of Implementing Agency and Contractors	The PIU shall organize orientation sessions and regular training sessions during all stages of the project. This shall include on-site training (general as well as in the specific context of a sub-project). These sessions shall involve all staff of Environmental Cells, field level implementation staff of PIU, Environmental Experts of SCs and Contractors.	PMU/PIU	PIU

Construction Stage (Activities to be carried out by the Contractor)

S.No.	Environmental Aspect/Issue	Management Measure/s
C.1	**Site Clearance**	
C.1.1	Clearing and Grubbing	Vegetation will be removed from the construction zone before commencement of civil works. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is avoided or minimal. Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval from the Environmental Expert of the Authority Engineer. The contractor, under any circumstances will not cut or damage trees. Trees identified under the project will be cut only after receiving clearance from the Forest Dept./MoEF/concerned authority (as applicable) and after the receipt of PIU's written permission in this regard. Vegetation with girth of over 30 cm only will be considered as trees and shall be compensated, in the event of PIU's instruction to undertake tree cutting.
C.1.2	Stripping, stocking and preservation of top soil	The top soil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the temporarily acquired area and/or Right of Way will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Environmental Expert of the Authority Engineer. The following precautionary measures will be taken to preserve them till they are used: (a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile will be protected by silt fencing. (b) Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation.

S.No.	Environmental Aspect/Issue	Management Measure/s
		(c) It will be ensured by the contractor that the top soil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be utilized for - ➢ covering all disturbed areas including borrow areas (not those in barren areas) ➢ top dressing of the road embankment and fill slopes ➢ filling up of tree pits, in the median and ➢ in the agricultural fields of farmers, acquired temporarily. Residual topsoil, if there is any will be utilized for the plantation at median and side of the main carriageway. Construction on the cleared soils shall begin as soon as possible to avoid soil erosion. Top soil shall not be unnecessarily trafficked either before stocking or when in stockpiles. Slope stabilization shall be done by turfing and planting bush grass. Stockpiled top soil shall be returned to cover the disturbed area & cut slopes. Residual top soil shall be used for redevelopment of borrow areas, landscaping along slopes, medians etc
C.1.3	Compaction of Soil	Heavy, wide and slow moving vehicles should be kept away from the sensitive routes such as agricultural land. Use of heavy machinery on productive land is to be minimized. Limitation on the axle load shall be identified such that topsoil is protected from compaction.
C.1.4	Generation of Debris from dismantling structures and road surface	Debris generated due to the dismantling of the existing structures or scarification of the road will be suitably reused in the proposed construction, subject to the suitability of the materials and approval of the Authority Engineer (Resident Engineer and Environmental Expert) as follows: ➢ The sub grade of the existing pavement shall be used as embankment fill material. ➢ The existing base and sub-base material shall be recycled as sub-base of the haul road or access roads

S.No.	Environmental Aspect/Issue	Management Measure/s
		➢ The existing bitumen surface may be utilized for the paving of cross roads, access roads and paving works in construction sites and campus, temporary traffic diversions, haulage routes etc. The contractor will suitably dispose off unutilized debris materials either through filling up pre-designated disposal locations, subject to the approval of the Environmental Expert of the Authority Engineer. At locations identified for disposal of residual bituminous wastes, the disposal will be carried out over a 60-mm thick layer of rammed clay so as to eliminate the possibility of leaching of wastes into the ground water. The contractor will ensure that the surface area of such disposal pits is covered with a layer of soil. All arrangements for transportation during construction including provision, maintenance, dismantling and clearing debris, will be considered incidental to the work and will be planned and implemented by the contractor as approved and directed by the Environmental Expert of the Authority Engineer. The pre-designed disposal locations will be a part of Comprehensive Solid Waste Management Plan to be prepared by Contractor in consultation and with approval of Environmental Expert of the Authority Engineer. Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area. The contractor shall identify dumping sites. The identified locations will be reported to the Environmental Expert of the Authority Engineer. These locations will be checked on site and accordingly approved by Environmental Expert of the Authority Engineer prior to any disposal of waste materials.
C.1.5	Other Construction Wastes Disposal including Fly Ash (if used)	The pre-identified disposal locations will be a part of Comprehensive Waste Disposal Solid Waste Management Plan to be prepared by the Contractor in consultation and with approval of Environmental Expert of the Authority Engineer. Location of disposal sites will be finalized prior to completion of the earthworks on any particular section of the road.

S.No.	Environmental Aspect/Issue	Management Measure/s
		The Environmental Expert of the Authority Engineer will approve these disposal sites after conducting a joint inspection on the site with the Contractor. Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed off near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and low-lying areas located in barren lands along the project corridors (is so desired by the owner/community). No fly ash will be disposed in any disposal site. Contractor will take care of residual fly ash, if any that remains after construction work. Either this will be returned to the source or used in construction of embankment elsewhere with proper protection measures. Authority Engineer will keep strict vigil on this aspect. Non-bituminous wastes other than fly ash may be dumped in borrow pits (preferably located in barren lands) covered with a layer of the soil. No new disposal site shall be created as part of the project, except with prior approval of the Environmental Expert of the Authority Engineer. All waste materials will be completely disposed and the site will be fully cleaned and certified by Environmental Expert of the Authority Engineer before handing over. The contractor at its cost shall resolve any claim, arising out of waste disposal or any non-compliance that may arise on account of lack of action on his part.
C.2	**Procurement of Construction Material**	
C.2.1	Earth from Borrow Areas for Construction	No borrow area will be opened without permission of the Environmental Expert of the Authority Engineer. The location, shape and size of the designated borrow areas will be as approved by the Environmental Expert of the Authority Engineer and in accordance to the IRC recommended practice for borrow pits for road embankments (IRC 10: 1961). The borrowing operations will be carried out as specified in the guidelines for siting and operation of borrow areas.

S.No.	Environmental Aspect/Issue	Management Measure/s
		The unpaved surfaces used for the haulage of borrow materials, if passing through the settlement areas or habitations; will be maintained dust free by the contractor. Sprinkling of water will be carried out twice a day to control dust along such roads during their period of use. During dry seasons (winter and summer) frequency of water sprinkling will be increased in the settlement areas and Environmental Expert of the Authority Engineer will decide the numbers of sprinkling depending on the local requirements. Contractor will rehabilitate the borrow areas as soon as borrowing is over from a particular borrow area in accordance with the Guidelines for Redevelopment of Borrow Areas or as suggested by Environmental Expert of the Authority Engineer.
C.2.2	Fly Ash	Contractor will ensure that they will strictly follow the specification given in IRC: SP: 58 for fly ash embankment construction. Further, Contractor will also ensure that - ➢ Fly ash will be transported in covered dump truck to the project site and is directly dumped on the embankment. This will not be stockpiled at project site. ➢ Weathered (at least not freshly generated) fly ash will be collected from the fly ash pond to reduce the possibility of water contamination due to leaching of heavy metals. ➢ Fly ash surface will be graded and sloped at the end of each working day to provide drainage and to prevent the ponding of water or the formation of run-off channel. ➢ The side slope will be properly benched and covered with soil and later vegetation will be grown to prevent the erosion. ➢ Run-off from the fly ash embankment/stockpile will be collected and discharged into proper drainage system. ➢ Further handling, if any will be restricted within RoW. During such handling and also after placing on embankment, if the fly ash surface is dries up completely, contractor will arrange for frequent sprinkling of

S.No.	Environmental Aspect/Issue	Management Measure/s
		water for dust suppression. Otherwise, surface of the fly ash will be covered with tarpaulin or polyethylene sheets or other suitable material. ➢ The fly ash will be placed on an aggregate drainage blanket to prevent water from rising into the fly ash by way of capillary action. Contractor will ensure that fly ash layer is separated from the drainage blanket by an appropriate filter fabric/sand blanket of adequate thickness over full width of embankment as capillary cut-off. Environmental Expert of the Authority Engineer will be required to inspect and report regularly to ensure the compliance in this regard.
C.2.3	Quarry Operations	The contractor shall obtain materials from quarries that are the licensed one. If new quarries are to be opened, the contractor shall obtain permission from Department of Mining & Geology of the respective state as well as from Environmental Clearance from SEIAA/MOEF&CC and consents from State Pollution Control Board. The quarry operations will be undertaken within the rules and regulations in force.
C.2.4	Construction Water	Contractor will arrange adequate supply and storage of water for the whole construction period at his own costs. The Contractor will submit a list of source/s from where water will be used for the project to Authority Engineer and PIU. The contractor will source the requirement of water preferentially from ground water but with prior permission from the Ground Water Board. A copy of the permission will be submitted to Authority Engineer and PIU prior to initiation of construction. The contractor will take all precaution to minimize the wastage of water in the construction process/ operation.
C.2.5	Transporting Construction Materials and	Contractor will maintain all roads (existing or built for the project), which are used for transporting construction materials, equipment and machineries as précised. All vehicles delivering fine materials to the site will be covered to avoid spillage of materials.

S.No.	Environmental Aspect/Issue	Management Measure/s
	Haul Road Management	All existing highways and roads used by vehicles of the contractor or any of his sub-contractor or suppliers of materials and similarly roads, which are part of the works, will be kept clear of all dust/mud or other extraneous materials dropped by such vehicles. Contractor will arrange for regular water sprinkling as necessary for dust suppression of all such roads and surfaces. The unloading of materials at construction sites in/close to settlements will be restricted to daytime only.
C.5	**Safety During Construction**	
C.5.1	Increased Accident Risks in Work Zones - Planning for Traffic Diversions and Detours	Detailed Traffic Management Plans prepared prior to commencement of works on any section of road shall be executed fully. Temporary diversions will be constructed with the approval of the Resident Engineer and Environmental Expert of the Authority Engineer. Detailed Traffic Control Plans will be prepared and submitted to the Environmental Expert of the Authority Engineer for approval, seven days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures undertaken for transport of hazardous materials and arrangement of flagmen. The Contractor will provide specific measures for safety of pedestrians and workers at night as a part of traffic control plans. The Contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. The contractor will also inform local community of changes to traffic routes, conditions and pedestrian access arrangements with assistance from Authority Engineer and PIU. The temporary traffic detours will be kept free of dust by sprinkling of water three times a day and as required under specific conditions (depending on weather conditions, construction in the settlement areas and volume of traffic).

S.No.	Environmental Aspect/Issue	Management Measure/s
		The contractor shall make sure that adequate traffic measures are available especially near sensitive receptors. The contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic or closer of traffic on the highway shall be drawn up. One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights Temporary diversion shall be constructed with the approval of the Engineer. The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The Contractor shall take all necessary measures for the safety of traffic during construction. Care shall be taken to ensure that the working conditions for the workers in stone quarries are up to the required standards. Construction related activity resulting in direct release of criteria pollutants (CO, NO2, SO2, PM2.5, PM10) to be avoided at busy locations at night during winters.
C.5.2	Traffic and Safety	The contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control

S.No.	Environmental Aspect/Issue	Management Measure/s
		Plan/Drawings and as required by the Environmental Expert of the Authority Engineer for the information and protection of traffic approaching or passing through the section of any existing cross roads. The contractor will ensure that all signs, barricades, pavement markings are provided as per the MoRTH specifications. Before taking up of construction on any section of the existing lanes of the highway, a Traffic Control Plan will be devised and implemented to the satisfaction of the Environmental Expert of the Authority Engineer.
C.5.3	Loss of Accessibility and Unsafe Access	The construction works shall not interfere with the convenience of the public or the access to use and occupation of public or private roads, railways and any other access footpaths to or of properties, whether public or private. Temporary access shall be built at the interchange of the highway and other roads. The contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project road, providing temporary connecting road. The contractor will also ensure that the existing accesses will not be undertaken without providing adequate provisions and to the prior satisfaction of the Authority Engineer. The contractor will take care that the cross roads are constructed in such a sequence that construction work over the adjacent cross roads are taken up one after one so that traffic movement in any given area not get affected much.
C.5.4	Personal Safety Measures for Labour	Contractor will provide: ➢ Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc. ➢ Welder's protective eye-shields to workers who are engaged in welding works

S.No.	Environmental Aspect/Issue	Management Measure/s
		➢ Protective goggles and clothing to workers engaged in Factories Act, 1948 stone breaking activities and workers will be seated at sufficiently safe intervals ➢ Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. ➢ Adequate safety measures for workers during handling of materials at site are taken up. ➢ The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance. These will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and will be approved by Authority Engineer and PIU.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.5.5	First Aid	The contractor will arrange for - ➢ a readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone ➢ availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital equipment and trained nursing staff at construction camp.
C.5.6	Risk from Electrical Equipment(s)	The Contractor will take all required precautions to prevent danger from electrical equipment and ensure that - ➢ No material 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 in construction zones. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Environmental Expert of the Authority Engineer.
C.5.7	Risk Force Measure	The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities. The contractor will make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. Construction Safety Plan prepared by the Contractor will identify necessary actions in the event of an emergency.
C.5.8	Informatory Signs and Hoardings	The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and local language, as required in line with IRC:55 or as suggested by the Environmental Expert of the Authority Engineer.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.3	**Management of Water**	
C.3.1	Loss of Community Water Resources	Pond enhancement measures shall be provided for community ponds getting impacted to slight degree and falling within the right of way as per the design provided in annexure of specific EMP. The enhancement measures shall include provision for stepped access to the edge of water, providing flat boulders for washing, stone pitching for slope stabilisation etc. Roadside wells shall also be enhanced as per the design general EMP.
C.3.2	Drainage and Flood Control	Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed off so as not to block the flow of water of any water course and cross drainage channels. Contractor will take all necessary measures to prevent the blockage of water flow. In addition to the design requirements, the contractor will take all required measures as directed by the Environmental Expert of the Authority Engineer to prevent temporary or permanent flooding of the site or any adjacent area.
	Water logging	Adequate water-harvesting structures shall be made part of the project design, all along the storm water drains, at appropriate intervals. The contractor shall provide RCC covered drains in urban locations in areas with high water table for storm water runoff management. The drains shall be connected to proximal culverts.
C.3.3	River Training and Disruption to Other Users of Water	While working across or close to any perennial water bodies, contractor will not obstruct/ prevent the flow of water. Construction over and close to the non-perennial streams shall be undertaken in the dry season. If construction work is expected to disrupt users of community water bodies, notice shall be served well in advance to the affected community.

S.No.	Environmental Aspect/Issue	Management Measure/s
		The contractor will serve notice to the downstream users well in advance to divert the flow of water of any surface water body. Wherever excavation for diverting water flow will take place, contractor will ensure that the slopes are not steeper than 1:2 (vertical: horizontal) otherwise proper slope protection measures will be taken as approved by the Environmental Expert of the Authority Engineer. The contractor will take prior approval of the River Authority or Irrigation Department or Authority Engineer for any such activity. The PIU will ensure that contractor has served the notice to the downstream users of water well in advance.
C.3.4	Disruption to other users	While working across or close to the Rivers, the contractor shall not prevent the flow of water. If for any bridgework, etc., closure of flow is required, the contractor shall seek approval of the Engineer. The engineer shall have the right to ask the contractor to serve notice on the downstream users of water sufficiently in advance. Construction work expected to disrupt users and impacting community water bodies shall be taken up after serving notice on the local community.
C.4	**Pollution**	
C.4.1	**Water Pollution**	
C.4.1.1	Water Pollution from Construction Wastes	The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. Contractor will avoid construction works close to the streams or water bodies during monsoon. All waste arising from the project is to be disposed off in the manner that is acceptable to the State Pollution Control Board or as directed by Environmental Expert of the Authority Engineer. The Environmental Expert of the Authority Engineer will certify that all liquid wastes disposed off from the sites meet the discharge standards.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.4.1.2	Siltation of Water Bodies and Degradation of Water Quality	The Contractor will not excavate beds of any stream/canals/ any other water body for borrowing earth for embankment construction. Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including wells) adjacent to the RoW and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthwork and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. The contractor will also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay byes and bus bays which are ultimately entering into any surface water bodies / water channels with a fall exceeding 1.5 m. Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water course.
C.4.1.3	Slope Protection and Control of Soil Erosion	Slope protection shall be provided on embankments abutting water bodies by providing stone pitching for slopes b/w 1:4 (V:H) to 1:2 (V:H). Retaining walls shall be provided at high embankments. In borrow pits, the depth shall be so regulated that the sides of the excavation will have a slope not steeper than 1 vertical to 2 horizontal, from the edge of the final section of the bank. The contractor will take slope protection measures as per design, or as directed by the Environmental Expert of the Authority Engineer to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fibber mats, mulches, grasses, slope, drains and other devices. All temporary sedimentation, pollution control works and maintenance thereof will be deemed as incidental to the earth work or other items of work and as such as no separate payment will be made for them.

S.No.	Environmental Aspect/Issue	Management Measure/s
		Contractor will ensure the following aspects: ➢ During construction activities on road embankment, the side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. ➢ Turfing works will be taken up as soon as possible provided the season is favorable for the establishment of grass sods. Other measures of slope stabilization will include mulching netting and seeding of batters and drains immediately on completion of earthworks. ➢ In borrow pits, the depth shall be so regulated that the sides of the excavation will have a slope not steeper than 1 vertical to 2 horizontal, from the edge of the final section of the bank. Along sections abutting water bodies, stone pitching as per design specification will protect slopes. Soil shall be monitored for erosion at select locations as per the monitoring plan mentioned in General EMP.
C.4.1.4	Water Pollution from Fuel and Lubricants	The contractor will ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from rivers and irrigation canal/ponds. All location and lay-out plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the Environmental Expert of the Authority Engineer and PIU. Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refueling areas as per the design provided. In all, fuel storage and refueling areas, if located on agricultural land or areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage.

S.No.	Environmental Aspect/Issue	Management Measure/s
		Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Authority Engineer and PIU) and approved by the Environmental Expert of the Authority Engineer. All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines. Environmental Expert of the Authority Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.
C.4.1.5	Contamination of Water Resources	Silt fencing shall be provided along ponds within the direct impact zone intercepting highway to prevent siltation in water body. Such ponds shall not be getting impacted during construction. Temporary drains shall be prepared to dispose off the eroded sediments and to prevent them from entering the surface water bodies. To prevent contamination of water resources due to contaminants from construction camps, adequate sewage disposal measures shall be taken care of at construction camps. Contaminated discharges containing oil/grease contributed by vehicle parking/repair areas and workshops and construction sites shall be collected and treated using oil interceptors. Construction work close to water bodies shall be avoided during monsoon. The contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites shall be located at least 1000 m from rivers and irrigation canal/ponds or as directed by the Engineer. Both ground and surface water quality shall be monitored as per the monitoring plan at select locations.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.4.2	**Air Pollution**	
C.4.2.1	Dust Pollution	The contractor will take every precaution to reduce the level of dust from crushers/hot mix plants, construction sites involving earthwork by sprinkling of water, encapsulation of dust source and by erection of screen/barriers. All the plants will be sited at least 1 km in the downwind direction from the nearest human settlement. The contractor will provide necessary certificates to confirm that all crushers used in construction conform to relevant dust emission control legislation. The suspended particulate matter value at a distance of 40m from a unit located in a cluster should be less than 500 g/m3. The pollution monitoring is to be conducted as per the monitoring plan. Alternatively, only crushers licensed by the PCB shall be used. Required certificates and consents shall be submitted by the Contractor in such a case. Dust screening vegetation will be planted on the edge of the RoW for all existing roadside crushers. Hot mix plant will be fitted with dust extraction units. All crushers identified to be used in construction shall conform to relevant dust emission control legislation of the respective SPCB. Clearance for siting shall be obtained from the respective SPCB. Alternatively, only those crushers that are already licensed by the SPCB shall be used. All Hot mix plants shall be fitted with dust extraction systems SPM value at a distance of 40 m from a unit located in a cluster should be less than 600 microgram/m3. The monitoring is to be conducted as per the monitoring plan. Excavation and transport of earth shall be done during the daytime only to minimize risks of the spills etc. from the earthwork on the community.

S.No.	Environmental Aspect/Issue	Management Measure/s
		Transport of the soil/earth shall be done by covering the haulage vehicles with tarpaulin or any other good quality material. Dust suppression measures in the form of water sprinkling on the lime / cement and earth mixing sites, asphalt mixing site and temporary service and access roads. Traffic detours shall not be located on areas with loose soils. Temporary pavement shall be made by using dismantled pavement material from existing roads. All construction workers shall be provided with pollution masks to mitigate the effect of dust generation on the health of workers. Fly ash shall be transported in covered dump trucks to the project site and shall be directly dumped on the embankment. This shall not be stock piled at the project site.
C.4.2.2	Emission from Construction Vehicles, Equipment and Machineries (Generation of Exhaust Gases)	All vehicles, plants and machinery used during construction shall conform to the emission standards promulgated under the Environment (Protection) Act, 1986. Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of PCB. The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Monitoring results will also be submitted to Authority Engineer and PIU as per the monitoring plan. Traffic detours and diversions shall be designed such as to minimize bottlenecks and ensure smooth traffic. Air pollution monitoring shall be carried out at specified locations as described in the monitoring plan to verify that air pollution norms are being followed by the contractor and the air quality at the construction site does not exceed the prescribed limits. Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of PCB.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.4.3	**Noise Pollution**	
C.4.3.1	Noise Pollution: Noise from Vehicles, Plants and Equipment	The Contractor will confirm the following: ➢ All plants and equipment used in construction (including the and PIU, NHAI aggregate crushing plant) shall strictly conform to the MoEF/CPCB noise standards. ➢ All vehicles and equipment used in construction will be fitted with exhaust silencers. ➢ Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. ➢ Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. ➢ Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Environmental Expert of the Authority Engineer to keep noise levels at the minimum. At the construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, concrete mixing, batching will be stopped during the night time between 9.00 pm to 6.00 am. No noisy construction activities will be permitted around educational institutes/health centers (silence zones) up to a distance of 100 m from the sensitive receptors i.e., school, health centers and hospitals between 9.00 am to 6.0 pm. Contractor will provide noise barriers (Design of Noise Barrier Provided) to the suggested locations of select schools/ health centers. List of locations for noise barriers is given in specific EMP. 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).

S.No.	Environmental Aspect/Issue	Management Measure/s
		Blasting operations shall be undertaken so as to produce minimum vibrations in sensitive areas. Traffic management plans prepared during construction mobilization period shall also be implemented during construction stage. Effective traffic management shall especially be taken care of in sensitive locations, major built-up areas and along important highway junctions. Asphalt mixing sites and the batching plants should be at a distance of at least 200 m from sensitive receptor locations. Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to Authority Engineer and PIU. Environmental Expert of the Authority Engineer will be required to inspect regularly to ensure the compliance of EMP.
C.4.3	**Land/Soil Pollution**	
C.4.3.1	Contamination of Soil	Fuel shall be stored in proper bounded and covered areas. All spills and collected petroleum products shall be disposed off in accordance with the guidelines framed by Ministry of Environment, Forests &, Climate Change and State Pollution Control Board. Maintenance and refuelling of vehicles, machinery and other construction equipment shall be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. An “Oil Interceptor” shall be provided for wash down and refuelling areas. Debris generated due to the dismantling of the existing road shall be suitably reused in the proposed construction, subject to the suitability of the materials and approval of the Engineer as follows: The sub-grade of the existing pavement shall be used as embankment fill materials The existing base and sub- base material shall be recycled as sub-base of the haul road or access roads

S.No.	Environmental Aspect/Issue	Management Measure/s
		The existing bitumen surface may be utilized for the paving of cross roads, access roads and paving works in construction sites, temporary traffic diversions, haulage routes etc. The contractor shall suitably dispose off un-utilized debris materials including spoils of material unsuitable for embankment; either through filling up of borrow area located in wasteland or at pre-designated dump locations, subject to the approval of the Engineer. At locations identified for dumping of residual bituminous wastes, the dumping shall be carried out over a 60 mm thick layer of rammed clay so as to eliminate the possibility of leaching of wastes into the ground water. The contractor shall ensure that the surface area of such dumping pits is covered with a layer of preserved topsoil. All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary shall be considered incidental to the work and shall be planned and implemented by the contractor as approved and directed by the Engineer. The pre-designed dump locations shall be a part of comprehensive solid waste management plan to be prepared by Contractor in consultation with Engineer. Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area. The contractor shall identify dumping sites. The identified locations shall be reported to the Engineer. Location of dump sites shall be finalised prior to earthworks on any particular section of the road. No fly ash shall be disposed in any disposal site. Care shall be taken to return the remaining fly ash after construction work to the source or to use it in construction of embankment elsewhere with proper construction measures. IE shall keep strict vigil on this aspect.

S.No.	Environmental Aspect/Issue	Management Measure/s
		Non-bituminous wastes other than fly ash may be dumped in borrow areas covered with a layer of the conserved topsoil. No new disposal sites shall be created as part of the project, except with prior approval of the Engineer. All waste materials shall be completely disposed and the site shall be fully cleaned before handing over. Soil shall be monitored for contamination as per the monitoring plan at locations to be identified by the Engineer. The Engineer shall certify the site after approval. The contractor at his cost shall resolve any claim arising out of waste disposal.
C.6	**Flora and Fauna: Plantation/Preservation/Conservation Measures**	
C.6.1	Road side Plantation Strategy	The contractor will do the plantation at median and/or turfing at embankment slopes as per the tree plantation strategy prepared for the project. Minimum 80 percent survival rate of the saplings will be acceptable otherwise the contractor will replace dead plants at his own cost. The contractor will maintain the plantation till they handover the project site to Project Authority. The Environmental Expert of the Authority Engineer will inspect regularly the survival rate of the plants and compliance of tree plantation guidelines.
C.6.2	Flora and Chance found Fauna	The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Environmental Expert of the Authority Engineer and carry out the Authority

S.No.	Environmental Aspect/Issue	Management Measure/s
		Engineer's instructions for dealing with the same. IE shall be responsible to intimate the wildlife protection authorities in the area. The Environmental Expert of the Authority Engineer will report to the nearby forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.
C.7	**Archeological Resources and Cultural Properties**	
C.7.1	Chance Found Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Environmental Expert of the Authority Engineer of such discovery and carry out the Authority Engineer's instructions for dealing with the same, waiting which all work shall be stopped. The Authority Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.
C.7.2	Impact/s on Cultural/Religious Properties	All necessary and adequate care shall be taken to minimize impact on cultural properties which includes cultural sites and remains, places of worship including temples and shrines, etc., graveyards, monuments and any other important structures as identified during design. All conservation and protection measures shall be taken up as per design. Access to such properties from the road shall be maintained clear and clean.

S.No.	Environmental Aspect/Issue	Management Measure/s
C.8	**Labor Camp Management**	
C.8.1	Accommodation	Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. The location, layout and basic facility provision of each labour camp will be submitted to Authority Engineer and PIU prior to their construction. The construction will commence only upon the written approval of the Environmental Expert of the Authority Engineer. The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Authority Engineer.
C.8.2	Potable Water	The Contractor will construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. The Contractor will also provide potable water facilities within the precincts of every workplace in an accessible place, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. The contractor will also guarantee the following: a) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities. b) If any water storage tank is provided that will be kept such that the bottom of the tank at least 1mt. from the surrounding ground level.

S.No.	Environmental Aspect/Issue	Management Measure/s
		c) If water is drawn from any existing well, which is within 30mt. proximity of any toilet, drain or other source of pollution, the well will be disinfected before water is used for drinking. d) All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. e) A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. f) Testing of water will be done every month as per parameters prescribed in IS 10500:1991. Environmental Expert of the Authority Engineer will be required to inspect the labour camp once in a week to ensure the compliance of the EMP.
C.8.3	Sanitation and Sewage System	The contractor will ensure that - ➢ the sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place ➢ separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women ➢ adequate water supply is to be provided in all toilets and urinals ➢ all toilets in workplaces are with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition night soil is to be disposed off by putting layer of it at the bottom of a permanent tank prepared for the purpose and covered with 15 cm. layer of waste or refuse and then covered with a layer of earth for a fortnight.
C.8.4	Waste Disposal	The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of the Authority Engineer.

S.No.	Environmental Aspect/Issue	Management Measure/s
		Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert of the Authority Engineer will have to be provided by the contractor.
C.8.5	Health and Hygiene Impacts on Construction Camps	The contractor shall provide erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour up to living standards and scales approved by the IE at the locations identified foe such facilities in pre-construction phase. Guidelines for provision of these facilities shall be followed as provided in Annexure II. The contractor shall also guarantee the following: Supply of sufficient quantity of potable water (as per IS) in every work place/labour campsite at suitable and easily accessible places and regular maintenance of such facilities. If any water storage tank is provided it shall be kept at a distance of not less than 15m from any latrine drain or other sources of pollution. If water is drawn from any existing well which is within close proximity of any latrine, drain or other source of pollution the well shall be disinfected before water is used for drinking. All such wells shall be entirely covered and provided with a trap door, which shall be dust proof and waterproof. A reliable pump shall be fitted to each covered well. The trap door shall be kept locked and opened only for cleaning or inspection, which shall be done at least once a month. Testing of water shall be done every month as per parameters prescribed in IS 10500:1991. Engineer shall be required to inspect the labour camp once in a week to ensure the compliance of the EMP. Contractor shall be responsible for proper functioning and management of sanitation and sewage system as per the guidelines provided in Annexure II.

S.No.	Environmental Aspect/Issue	Management Measure/s
		All latrines shall be provided with dry-earth system (receptacles), which shall be cleaned at least four times daily, and at least twice during working hours and kept in a strict sanitary condition. Receptacles shall be tarred inside and outside at least once a year. Adequate health care is to be provided for the work force. On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, excreta tank and other disposal pits or trenches filled in and effectively sealed off and the outline site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the engineer.
C.8.6	Deterioration of indoor air quality and risk of water borne diseases	It shall be the responsibility of the contractor to make adequate provisions for workers at labour camps under the Factories Act, 1948. Dwelling units shall be supplied with clean fuel for domestic purpose. Generation of carbon monoxide under any circumstance shall not be allowed. Contractor shall make sure that no water stagnation happens in the vicinity of construction camp as well as anywhere along the project stretch to prevent spread of malaria & other water borne diseases
C.9	**Contractor's Demobilization**	
C.9.1	Clean-up Operations, Restoration and Rehabilitation	Contractor will prepare site restoration plans, which will be approved by the Environmental Expert of the Authority Engineer. The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL waste as per Comprehensive Waste Management Plan and as approved by Authority Engineer. All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by Environmental Expert of the Authority Engineer in a layer of thickness of 75 mm-l50 mm.

S.No.	Environmental Aspect/Issue	Management Measure/s
		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 entire satisfaction to the Environmental Expert of the Authority Engineer.

The Environment Management Plan would be included as part of the Bidding document and shall be used by the Contractor for developing the Contractor's EMP. The contractor's environment management plan should be in accordance with the EIA (this report).

8.3 Environmental Monitoring Program

The Environmental Monitoring Program is aimed at essentially monitoring the day to day activities in order to ensure that the environmental quality is not adversely affected during the implementation. The monitoring programme consists of Performance Indicators and Process Indicators.

8.3.1 Monitoring Indicators

Monitoring indicators have been identified to objectively identify and assess a particular environmental component which is expected to be affected due to particular activities at a particular time of the project lifecycle. These indicators would be a mix of both objective as well as subjective. The performance indicators shall be evaluated under three heads as;

- Environmental condition indicators to determine efficacy of environmental management with respect to 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 proposed mitigation measures

The performance indicators includes the components which have to be identified and reported during the stage of the implementation. These would help identify the level of environmental performance of the project. In addition, there would be Process Indicators which would help in assessing the effectiveness of the system which has been instituted. The process and performance indicators for different stages are presented in Table 8-2.

Table 8-2:Process and Performance Indicators in Baner- Bopalgarh -Kuchera

Sl. No	Indicator	Description	Type of Indicator
1.	Sourcing of Water	Has the Contractor applied for permit for groundwater abstraction	Performance Indicator
2.	Rainwater Harvesting	Has the Contractor initiated the process of rainwater harvesting	Performance Indicator
3.	Siting of Contractors Camp	Have the PIU intimated the Contractor the guidelines for siting of the Camp	Process Indicator
4	Facilities in Contractors Camp	Has the Authority Engineer/PIU verified the design /Plan of the Contractor's Camp for adequacy of the Facility	Process Indicator
5	Encroachment on Surface water resources	Review of Detailed Design and analyse whether any surface water body or it catchments is getting	Performance Indicator

Sl. No	Indicator	Description	Type of Indicator
		impacted hydrologically (the embankment of the road should not disturb the hydrological profile of the area).Check should also be carried out to ascertain whether the development of the road has potential to pollute the water body.	
6	Potential to pollute surface water bodies	The design of longitudinal drainage should ensure that the runoff from the road should not drain into the catchment or water body used for drinking. In case of draining of embankment the hydraulic design of the culvert should be checked so that flooding or water logging do not take place due to the raised embankment	Performance. Indicator
7	Adequacy of cross drainage structures	The adequacy of cross drainage structure should be checked not only from the hydraulic perspective but also whether the location and number of culverts are sufficient for efficiently removing water from the different micro-catchment along the alignment so that the embankment does not impede on the movement of water or there is no back flow.	Performance Indicator
8	Extent of Impact Water Harvesting Structure	The alignment should not encroach upon any water harvesting structure or its catchment. The run-off from the pavement should not drain into the catchment of such areas	Performance Indicator
9	Number of Trees which could be saved	Possibility of preventing felling of trees especially mature trees by modification of design. The Feasibility of transplantation of trees should also be checked	Performance Indicator
10	Prevention of Wildlife collision	The design should consider measures to avoid wildlife collisions in areas wher wildlife movement is predominant e..g Jajiwal. The existence of wildlife in the area should be authenticated from the Divisional Forest office including areas where animal crossing happens.	Performance Indicator
11	Disturbance and Safety at Schools and Hospitals:	The design should include mitigation measures for noise and safety of children in front of the school. The	Performance Indicator

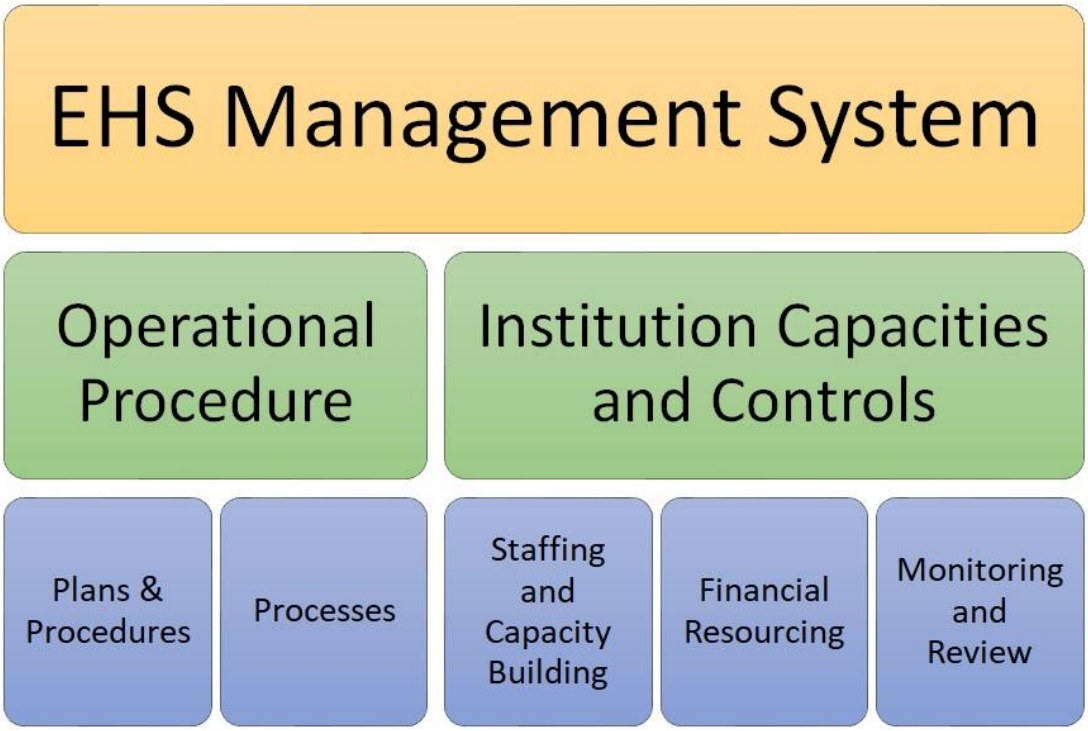
Sl. No	Indicator	Description	Type of Indicator
		design should include traffic calming measures and also measure for ensuring noise attenuation	
12	Review of Design	Has the design been reviewed and observations sent	Process Indicator

9 IMPLEMENTATION ARRANGEMENT

9.1 Environmental Health Safety Management System

The environmental health safety management system developed in RHSDP II would be also be used for the monitoring of the Baner- Kuchera Road Project. The system essentially consists of plans and procedures, processes, institutions and responsibilities, capacity building, monitoring and review. The components of the EHS Management System is presented in

Figure 9-1: EHS Management System for RHSDP II



The Individual components of the system are described in the sections below.

9.1.1 Operational Procedures

The Environment Management Plan for the Baner-Kuchera Road is presented in the Section 8.2. The process and procedures which have to be adopted are described in the Operational manual prepared for the project.

9.1.2 Institutions Capacities and Controls

The section details out the staffing for the entire implementation and oversight of the EMP implementation during the construction and operation of the project. It would also present the environmental management plan budget which would be required for the execution of the plan and also a mechanism for the monitoring and review of the implementation

Institutional Arrangements

The institutional arrangement for the implementation of the EMP in the project road has been designed in conformity with the institutions considered under the RHSDP II.

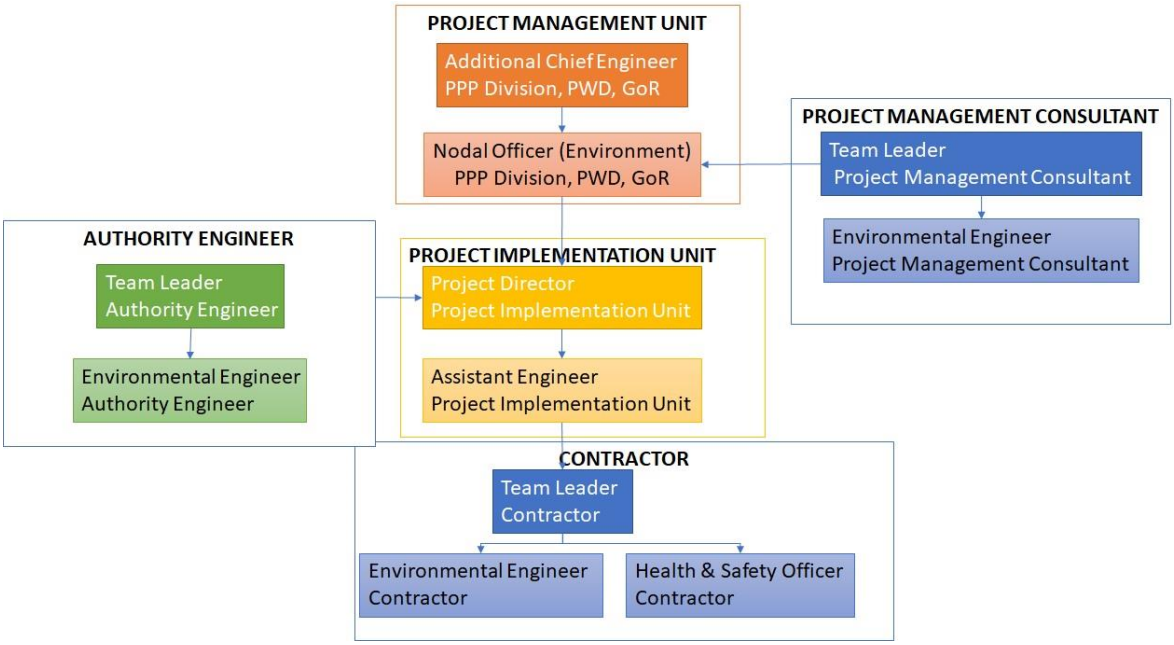
Institutional arrangements are intended to help the PPP division achieve the desired level of environmental performance during implementation of various project components as specified by the various conditions of EMP. These would not only help the project attain the compliance with the statutory requirement and World Bank Safeguard requirement but also ensure protection of environment, health and safety to be integrated into the program.

RHSDP II is headed by the Chief Engineer of the PPP cell who will be responsible for the successful implementation of the Project. The Chief Engineer is also responsible for the Environment Health Safety performance of the project. The Chief Engineer would be assisted by an Nodal Environmental Officer and Health Safety officer equivalent to the rank of an Executive Engineer and form the Project management Unit. The team at the PMU would be assisted by the Project Management Consultant (PMC). The PMC also would have a Environmental Officer as team leader who would assist the Nodal Environmental Officer at the PMU in ensuring environmental safeguards are implemented

An officer of the rank of Executive Engineer who is the Project Director of the Project implementation unit((PIU) under the PMU will be implementing the project He heads the PIU and responsible for the environmental health safety performance of the project road. He would be assisted by an EHS Engineer of the rank of Assistant Engineer who would be responsible for ensuring that the provisions of the environmental management plan are implemented. The Authority Engineer associated with the PIU would also have an Environmental Engineer along with him. His task is to assist the PIU in ensuring that the provisions in the EMP are implemented.

The actual responsibility of implementation of the EMP would be with the Contractor. An Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards. The organisation structure for environmental safeguards is presented in Figure 9-2

Figure 9-2: Implementation Arrangement



Roles and Responsibilities

The roles and responsibilities of the different officers and professionals involved in the implementation of the environmental safeguards are presented in Table 9-1.

Table 9-1:Roles and Responsibilities for implementation of Environmental Safeguards

SL. No	Position	Responsibilities
1.	Chief Engineer (PMU)	• Overview of the RHSDP II's compliance to Bank's and national laws and regulations • Oversight of the EHS requirements to be integrated in the Project formulation, implementation and formulation e.g. bid documents and contract of all involved in the planning, construction, and operations of the roads • Ensure that sufficient funds are available for implementation of all agreed Environmental safeguards measures. • Review of environment monitoring and audit findings, grievance associated with environment during each of the project review • Submit annual safeguards monitoring reports to the Bank and its closure. • Review of the annual environmental audit and approve of the mitigation of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • In case of significant new or unforeseen impacts, immediately inform Bank to make a decision on the same besides updating relevant project reports.
	Environmental Officer (PMU)	• Ensure that RHSDP II meets the statutory requirement and Bank's requirement; • Recommend for approval to PMU all document and ensure that design and documents include all relevant EHS Safeguards; • Recommend for approval to PMU the Contractor's Implementation Plan after approval of the Environmental Engineer of the PMC; • Review the environmental performance of the project through Monthly Reports and Monthly Environmental Audits reports submitted by the Project Management Consultants and report to the Management; • Carry out quarterly environmental audits and report back to the management • Review Corrective Action Plan for closure of the Environmental Audit Findings

SL. No	Position	Responsibilities
		• Overall coordination and management through PIU supported by PMC and Authority Engineer for implementation of Environment Safeguards. • Review and action on all grievance related to environment through the Grievance Redress Mechanism. • Prepare the Annual Safeguards Monitoring & closure Reports to the Management for review and onwards submission to the Bank and its closure; • Review of all the finding in the monitoring and auditing report and ensuring corrective action are implemented so that it does not reoccur; • Updating of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • Organise training for Capacity building of the PMU and the PIU for effective implementation of safeguard requirements
	Environmental Engineer (PMC)	• Preparation of all application including documentation required for statutory clearance. Assisting PWD in obtaining requisite clearances. • Review of all document and ensure that design and documents include all relevant EHS Safeguards; • Compile and analyse all Fortnightly and Monthly Audits reports submitted by the Authority Engineer for review by the Environmental Officer; • Review the Contractor's Implementation Plan after approval of the Authority Engineer for the environmental measures as per the EMP; • Carry out monthly environmental audits of all the project roads; • Preparation of the Corrective Action Plan for closure of the Environmental Audit Findings along with the PIU the Authority Engineer and the Contractor; • Assisting the Environment Officer of the PMU in the discharge of their duties; • Carry out any specialised studies which would be required for the environmental safeguards e.g. rainwater harvesting, environmental enhancements • Assist the PMU to implement the process and procedures described in the Project Management Manual; • Capacity building of PIUs for effective implementation of EMP; • Updating of checklists and reporting formats prepared by Authority Engineer for EMP implementation.

SL. No	Position	Responsibilities
	Project Director: PIU	• Overview of that the Project Road is in compliance to Bank's and national laws and regulations • Oversight of the EHS requirements are integrated in the Project design and documents e.g. detailed drawing • Ensure that sufficient funds are available for implementation of all agreed Environmental safeguards measures. • Review of environment monitoring and audit findings, grievance associated with environment during each of the project review • Ensure timely submission of the reports to Nodal Officer of PMU. • Review of the annual environmental audit and approve of the mitigation of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • In case of significant new or unforeseen impacts, immediately inform Nodal Officer and make modification in the EMP.
	Assistant Engineer: PIU	• Review the Contractor compliance with all the statutory requirement and the Safeguard requirement mentioned in the EMP. • Approve the Contractor's EMP Implementation Plan after the same has been approved by the Authority Engineer; • Review the weekly environmental reports submitted by the Authority Engineer and submission to the PMU for review; • Review the grievances in the Grievance Management System and ensure its closure. If required interact with the district authorities and ensure its closure; • Coordinate with the Environmental Officer of the PMU for the Implementation of the EMP and environmental Safeguards • Oversight of the package specific EMP's and make necessary modifications if required. • Review the Environmental Performance during the project review meeting. • Ensure monthly, quarterly and annual environmental monitoring reports are prepared by Authority Engineer and submitted to PMU . • Review the Corrective Action Plan for closure of the Environmental Audit findings

SL. No	Position	Responsibilities
	Environmental Expert (Authority Engineer)	• Ensure that Contractor is in compliance with all the statutory requirement and the Safeguard requirement mentioned in the EMP. • Review and approve the Contractor's EMP Implementation Plan; • Ensure that the weekly environmental reports are compiled by Contractor, reviewed and submitted to PMC; • Carry out any specialised designs which would be required for the environmental safeguards; • Facilitating the Contractor to obtain necessary permissions/ approvals and its submission to PMC • Directly interact with aggrieved persons and record their views and grievances in the Grievance Management System. • Work with the contractor to ensure grievances if any at field level is resolved • Review and approve the package specific EMP's and make necessary modifications if required. • Ensure that all mitigation measures as given in the EMP are implemented properly by the Contractor during the study. • Conduct weekly environmental monitoring of all project during pre-construction, construction and operation phases. • Ensure monthly, quarterly and annual environmental monitoring reports are prepared and submitted to PMC . • Work with the Contractor PIU and PMC for preparation of the environmental corrective actions on audit observations
	Environmental Engineer (Contractor)	• Responsible for ensuring integration of the mitigation measures proposed in the Environmental Management Plans (EMP) associated with the construction activities into the construction processes. • Responsible for daily monitoring of the environmental compliance and submission of the information to the Authority Engineer.. • Preparation of Contract Specific management and submission of the same to the Authority Engineer for approval. • Ensure that adequate budget provisions are made for implementing all mitigation measures specified in the Contract specific EMP. • Participate in induction training on EMP provisions and requirements delivered by the PMU and carry out the same for all contract staff.

SL. No	Position	Responsibilities
		• Carry out liasoning with the regulatory agencies for necessary environmental license(s), permits etc. • Assist the PIU with support required for obtaining necessary environmental permits • Participate in resolving issues as a member of the Grievance Redressal Cell. • Respond promptly to grievances raised by the local community or and implement corrective actions.
	Health and Safety Office (Contractor)	• Responsible for ensure integration of the health and safety in the work processes associated with the construction activities ;. • Responsible for day -to day monitoring of the occupational health and safety performance and submission of the information to the Authority Engineer.. • Preparation of a Safety Plan and submission of the same to the Authority Engineer for approval. • Participate in induction training on EMP provisions and requirements delivered by the PMU and carry out the same for all contract staff. • Carry out Construction safety Audits and report it to the Team Leader of the Contractor. • Assist the PIU with the health safety performance of the project • Respond promptly to grievances raised by the local community for the safety and implement corrective actions.

9.1.3 Training and Capacity Building

Training and capacity building would be required especially for the PMU and PIU staff associated with the project as the Environmental Safeguards would be a relatively new area which the staff are required to handle. The training and capacity building would not only be project specific but would also target and develop long term capacities in the PPP Division. The training program would include:

Sensitisation Training: primarily aimed at introducing the EHS safeguards to the officers and also make them aware of the responsibilities.

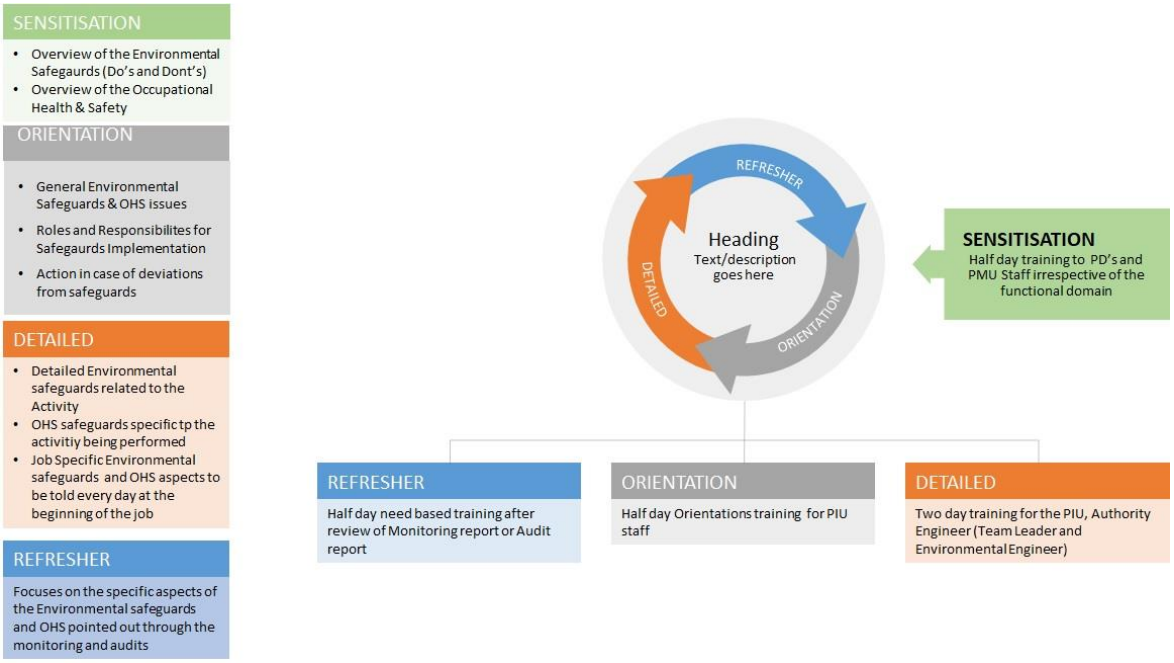
Orientation Training : introducing the Environmental safeguards to the PIU staff and making them aware of the key principles of environmental safeguards

Detailed Training : aimed at the PIU staff and the Authority Engineer to make them aware of the detailed activities which needs to be implemented and enforced during he EMP Implementations

Refresher Training: this would be a need based training organised to rectify the shortcomings identified during the Monitoring and Auditing.

The modalities of the training are presented in Figure 9-3.

Figure 9-3: The training to be carried out as part of Capacity Building



9.2 Monitoring & Auditing Plan

Suggested monitoring and auditing plan along with detailed reporting system, which will be operating at two levels are as follows:

- Reporting for environmental management (EM) indicators to assess the progress of the EMP Implementations
- Auditing of the Environmental management implementation to assess the effectiveness of the implementation

The monitoring and auditing responsibilities and their reporting authority over the period of one year is presented in

Figure 9-4. This cycle would be replicated over the tenure of the project

Figure 9-4: Monitoring and Auditing Protocol

9.2.1 Monitoring

Periodic Monitoring of the EMP is required for assessing the progress of the implementation of the EMP. The monitoring would include regular activities related to the activities proposed in the EMP. The following Monitoring reports would be submitted as per the protocol described earlier:

- **Daily Monitoring Report**: by the Contractor to the Authority Engineer on a daily basis regarding the environmental actions which has been implemented on site. The complains received from the community, observations at site for EHS issues, daily site audit, unsafe acts etc would also recorded ;
- **Fortnightly Monitoring Report**: by the Authority Engineer to the PIU and PMC . This would review the Action Taken Report submitted by the Contractor and certify for the completion. In addition, an independent monitoring would be carried out by the Authority Engineer and observations would be included in the report. The Action Plan agreed with the Contractor shall also be appended to the report.
- **Monthly Monitoring**: by the PMC for reporting to the PMU, would include a monitoring of all the packages and report the observations. The Completed Action would also be assessed for its effectiveness and sustainability.

9.2.2 Auditing

The Internal Audit will be conducted once every quarter by the Nodal Officer of the PMU and annually by an External Agency. The audit team would conduct document review of earlier issues and their closure and also make visits for verification and auditing of the works being carried out.

It has been envisaged that auditing shall be carried out for:

- Assessing the process and the effectiveness of the measures suggested.
- In addition, a external compliance audit shall be conducted every before the annual review to assess the effectiveness of the management system and compliance of the environmental safeguards.

9.2.3 Monitoring Indicators

The Performance and Process Monitoring Indicators have been discussed in Section 8.3.1. The Performance Indicators would be primarily used for monitoring of the performance of the Environmental Management Plan . The Process Indicators would be used for assessing the effectiveness of the Environment management System.

9.2.4 Records

All monitoring and auditing records would be transmitted and maintained electronically . No hard copies of the documents would be used for circulation. Each of the documents would be uniquely numbered by the Package, Project Corridor Nomenclature of the Report and Date. The records of the project would be stored in a Central repository at the PMU.

9.2.5 Review and Corrective Action

An annual review shall be conducted by Additional Chief Engineer at the time of the Project Review meeting and after the completion of the Quarterly and Annual audit. The Project Directors and the Assistant Engineer of the respective projects shall deliberate on the findings and recommendation of Environment Audit and agree on a Corrective Action Plan including budgetary support if required. The Corrective Action Plan shall be implemented in a time bound manner and reported back to the PMU. The PMU would prepare a closure report which would form a part of the Annual Report submitted to the Bank

9.3 Environment Management Budget

The budget for implementing the Environmental management Plan is presented in Table 9-2. This budget would not be part of the Contract and would be used by the PMU/PIU to implement the Environmental Safeguards. The budget should not form a part of the Bid Document.

Table 9-2:Environmental Management Budget for Baner- Bopalgarh Kuchera Road

Sl. No	Budget head	Description	Unit	Quantity	Rate (in INR)	Amount (in INR)
1	Dust Suppression	Regular Water Sprinkling (at least 2 to 3 times) a day at all construction sites for dust suppression.	Covered under Civil Works BOQ			0.00
2		Use of Dust Suppressant (35% calcium lignosulphonate solution to be sprayed once every week on stretches where earthwork is carried out)	Per km/week	16 week & 128 km	8374[16]	1,71,50,000.00
3a	Rainwater Harvesting	Study to identify micro water catchment within the Corridor of Direct Impact and identify rain water harvesting potential	L.S			25,00,000.00
3b		Execution of works of works for rain water harvesting ponds	L.S			1,00,00,000.00
4a	Wildlife Management	Barricading of excavations with wire mesh fencing (3 m high PVC coated wire mesh)	R mt	20 m per excavation) 10 excavation (to be reused)	5500	11,00,000.00
4b		Wildlife warning Reflectors	Nos			10,00,000.00

[16] http://www.geltechsolutions.com/soil2o/dust-control-uses.aspx

Sl. No	Budget head	Description	Unit	Quantity	Rate (in INR)	Amount (in INR)
5a	Training Cost	Sensitisation training (30 participants Material @1000, Rent and Refreshment @150000)	L.S			1,75,000.00
5b		Orientation Training (70 persons PMU and PIU, Material @1000, Rent and Refreshment INR 150000)				2,70,000.00
5c		Detailed training (25 Persons :only to PIU staff and Authority Engineer)Material 500 and Rent and Refreshment 75000)				1,00,000.00
5d		Refresher Training : 6 training one in every quarter; 50 persons (PIU , Authority Engineer and Contractor) Material 500 per person , Rent and refreshment INR 25000 pre training)				3,00,000.00
6a	Monitoring Expenses	Monitoring Expenses for PMU (travel Expenses 1250km @10 km +Incidental Expensies 5000 @5 days)	18	month (for covering atleat 3 packages in a month)	38000	6,84,000.00
6b.	Ambient Environmental Monitoring	Air, Water And Noise Quality Monitoring (once every quarter depending on need)	6	L.S every quarter	500000	30,00,000.00
7a	Enhancement	Ponds Along the Alignment	8	LS	500000	40,00,000.00
7b		Schools along the Alignment	20	LS	5,00,000	1,00,00,000.00

Sl. No	Budget head	Description	Unit	Quantity	Rate (in INR)	Amount (in INR)
8	Road Safety Measures		To be budgeted separately			0
,9.	External Auditing	Annual External Auditing (involving auditing both at the PIU and the site)	2	LS	5,00,000	10,00,000
	TOTAL ENVIRONMENT MANAGEMENT BUDGET					**5,52,79,000.00**

10 Summary and Conclusion

The Baner- Bopalgarh Kuchera (SH 63) road would be developed in PPP Mode with Financial assistance of The World Bank. This stretch of the road (129.5 km) presently is a two to single land road and would be upgraded to four-lane for the first 10 kms approximately and two laning with granular shoulder for the remaining stretch.

The alignment primarily passes through Jodhpur district though some part also falls in Nagaur District. Development of this connectivity would not only provide an alternative connection between Jodhpur and Nagaur but also help economic development of the mining and industrial areas near Bopalgarh. It would also provide connectivity to several settlements along the highway notably Jhajhirwal Kalan, Thabukada, Daikra, Bucheti, Bopalgarh, Asop, Kankarai, Sankhwas and Khajwana. Commuting to either Jodhpur and Nagaur for work or other purposes would be easier.

The EIA was focused on interactions between the Project activities and various resources/receptors that could result in significant impacts. To understand the baseline environmental condition of the resources and receptors along the project corridor primary baseline environmental monitoring and studies were carried out. In addition, desktop studies were carried out for the project influence areas of 10 km on either side of the corridor through review of secondary literature. The paragraph below gives a description of the significant impact which were identified during the EIA studies and the and mitigations which have been adopted in the project.

The project road primarily passes through the arid region west of the Aravalli Mountain through the dry desert region. The region faces severe shortage of water and people along the alignment are still dependent on rainwater collected in surface water bodies for drinking water. Even though, the alignment does not encroach on any of these water bodies, at Kankarai Bypass the new alignment would severe the waterbody from its catchment (approx. 22 sq. km). A culvert has been provided in the preliminary design but it may not be adequate. The detailed design thus needs to look into this carefully so that the road does not impact the flow of water from the catchment into the pond.

The runoff from the carriageways also should not enter these drinking water ponds. Presently to prevent such intrusion of run-off from the road earthen bunds have been created by Government of Rajasthan or Community. The alignment would not disturb these bunds except at two locations where the toe of the embankment of the road touches the toe of the bund. Protection measures and enhancement has been suggested but the details would be worked out during the Detailed Design. Also, during the design it has to be ensured that longitudinal drains carrying water should not discharge the runoff at locations where it can enter these ponds an pollute the drinking water sources.

It is estimated that approximately an average of 150- 175 KLD of water would be required during the peak construction period for construction purpose and 10 KLD for domestic purpose. Usage of surface water for drinking would have a very severe impact on the people and thus has been totally prohibited under this project. The sourcing of water for construction from ground water would also stress on the ground water resource. Being located on the western side of the Aravalli the area receives very less rainfall. The lack of surface water resource has put stress on the Ground water resources, as a result most of the blocks in these two districts are declared “overexploited” In fact CGWA has declared

Bhopalgarh block in Jodhpur District as a “notified Block” thus restricting use of groundwater. Thus, for sourcing construction water the Contractor has to either undertake rainwater harvesting or abstract saline ground water treat it and use it for construction. To develop a sustainable source of water resources in the area and also augment the surface water resources in the area rain water harvesting has been planned as part of the Environment Management Plan. The surface water collected in these new/renovated surface water bodies developed by the contractor with permission from the Panchayat can be used for construction purpose and later handed over to the community as an asset.

There are no National Park, Wild Life Sanctuaries within 10 km of the site. There is one small patch of protected forest along the alignment, but the alignment would not encroach on it. However, it is estimated 761 trees need to be felled for this project. Even though there are no Wildlife sanctuaries there is a large population of Chinkaras and Blackbucks in the area. Both these animals are protected species under The Wildlife Act 1972. Wildlife collisions have also been reported by the local people. To prevent such collision mitigation measure e.g. traffic calming, wildlife reflectors and signages, have been proposed. Additionally the veterinary facility of the Forest Department would be strengthened to cater to any untoward incident..

In addition to the above specific measures to mitigate construction related impact the Environmental Management Plan has suggested measures and also developed a management system to ensure that they are effectively implemented.

However, in spite of the earnest attempt of PPP division to implement the EMP in its full earnest and develop the project in a sustainable manner some issues would remain especially during the construction period. However, these environmental issues would be short term i.e. during the construction period and would not cause any permanent change in the receiving environment. The benefits accruing to the local people would far outweigh the inconvenience faced during the construction.

ANNEXURES

ANNEXURE: 2.1: CARRIAGEWAY DETAILS

Existing Chainage		Length (km)	Surface Type	Configuration	Existing Carriageway Width (m)
From	To				
0+000	0+100	0.100	Rigid Pavement	Two Lane	7.3
0+100	12+000	11.900	Flexible Pavement	Two Lane	6.9-7.3
12+000	13+000	1.000	Flexible Pavement	Intermediate lane	5.0
13+000	44+000	31.000	Flexible Pavement	Two Lane	6.9-7.2
44+000	48+000	4.000	Flexible Pavement	Two Lane	6.6-6.9
48+000	58+000	10.000	Flexible Pavement	Two Lane	7.0-7.2
58+000	59+000	1.000	Rigid Pavement	Two Lane	7.0
59+000	60+000	1.000	Rigid Pavement	Two Lane	8.5
60+000	61+000	1.000	Rigid Pavement	Two Lane	10.2
61+000	72+000	11.000	Flexible Pavement	Two Lane	7.0-7.2
72+000	78+000	6.000	Flexible Pavement	Single Lane	3.7-4.1
78+000	79+000	1.000	Flexible Pavement	Intermediate lane	5.00
79+000	80+000	1.000	Rigid Pavement	Intermediate lane	5.00
80+000	80+400	0.400	Flexible Pavement	Single Lane	3.80
80+400	80+600	0.200	Rigid Pavement	Two Lane	10.00
80+600	92+600	12.000	Flexible Pavement	Single Lane	3.4-3.7
92+600	93+400	0.800	Flexible Pavement	Two Lane	7.50
93+400	95+000	1.600	Flexible Pavement	Single Lane	3.5-3.6
95+000	97+000	2.000	Flexible Pavement	Two Lane	7.00-7.15
97+000	98+000	1.000	Rigid Pavement	Two Lane	7.00
98+000	99+000	1.000	Flexible Pavement	Two Lane	7.00
99+000	105+000	6.000	Flexible Pavement	Single Lane	3.5-3.65
105+000	107+000	2.000	Flexible Pavement	Single Lane	4.00-4.10
107+000	114+000	7.000	Flexible Pavement	Single Lane	3.50-3.80
114+000	115+000	1.000	Flexible Pavement	Two Lane	7.00

Existing Chainage		Length (km)	Surface Type	Configuration	Existing Carriageway Width (m)
From	To				
115+000	128+000	13.000	Flexible Pavement	Single Lane	3.50-3.70
128+000	129+300	1.500	Flexible Pavement	Intermediate lane	5.00-5.20

ANNEXURE 2.2: EXISTING CROSS-DRAINAGE STRUCTURELIST OF CULVERTS

Sr. No.	Chainage (Km)	Structure Type	Span/ Opening with Span Length (m)	Width (m)
1	12+667	Slab	3x0.6	8.81
2	18+760	Pipe	1x1.2	11.22
3	33+383	Slab	1x4.64	8.22
4	45+959	Slab	1x3.67	8.24
5	45+971	Slab	1x2.48	8.33
6	47+730	Slab	1x2.5	8.09
7	48+543	Slab	1x1.72	8.2
8	49+022	Slab	1x1.68	8.15
9	50+371	Slab	1x1.84	8.09
10	53+815	Slab	1x1.68	8.02
11	53+698	Slab	1x1.68	8.02
12	60+751	Pipe	2x0.6	12.61
13	78+846	Slab	1x2.72	8.02
14	91+428	Slab	1x0.94	8.46
15	95+996	Pipe	2x0.6	6.62
16	128+241	Slab	1x1.0	11.92

List of Minor Bridges

Sr. No.	Chainage (Km)	Type of Structure)	No. of Spans with span Length (m)
1	46+315	Minor Bridge	4 x 8.0
2	48+709	Minor Bridge	5 x 2.62
3	50+185	Minor Bridge	1 x 6.89

List of Causeways

Sr. No.	Chainage (Km)	Structure Type
1	41+593	Causeway
2	44+083	Causeway
3	51+141	Causeway
4	55+429	Causeway
5	59+341	Causeway

ANNEXURE 2.3: MAJOR AND MINOR JUNCTIONS

LIST OF MAJOR JUNCTIONS

Sr. No.	Location (Existing)	Type		Village
		Junction Type	Cross Road	
1	0+000	Y	NH-112	Banar
2	12+580	Y	SH-58	Thabukra
3	18+600	T	SH-58	Daikra
4	59+650	X	MDR-90	Bhopalgarh
5	77+550	T	MDR-58	Asop
6	78+200	T	MDR-58	Asop
7	96+100	X	MDR-37B	Sankhwas
8	114+360	X	SH-39	Khajwana
9	129+450	Y	NH-89	Kuchera

List of Minor Junctions

Sr. No.	Location (Existing)	Type	Road
1	0+082	T	L (Banar railway station)
2	0+780	T	R (Village Road)
3	1+200	T	R (Jajiwal village)
4	1+474	T	L (Village Road)
5	4+300	T	R (Village Road)
6	4+371	Y	R (Salvakua)
7	5+072	T	L (Aagpawa)
8	9+059	T	R (Batewas)
9	10+171	T	L (Sursagar)
10	16+170	Y	R (Salwa)
11	20+875	T	R (Salwakalan)
12	23+560	T	L (Lunawas)

Sr. No.	Location (Existing)	Type	Road
13	29+230	T	L (Castee)
14	29+943	T	L (Ram Chowki)
15	29+980	Y	L (Bandra)
16	34+230	T	R (Mandiya Prabhawa)
17	36+971	T	R (Salwa kalan)
18	39+534	T	L (Godaro)
19	44+610	T	R (Artiya Kalan)
20	44+650	T	R (Artiya Kalan)
21	47+040	T	L (Sopada)
22	50+473	X	L (Chopda) R (Kurdi)
23	52+220	T	R (Joru)
24	55+850	Y	R (bagoriya)
25	56+200	T	L (Cholawata)
26	57+417	T	PCC Road
27	60+268	X	(Medata)
28	60+740	T	Bhopalgarh
29	77+860	T	R (Warandi)
30	78+170	T	R (Gotan)
31	78+238	T	R (Gotan)
32	80+500	Y	L (Asop)
33	86+630	T	L (Khishar)
34	96+441	T	L (Village Road)
35	96+600	T	R (Village Road)
36	97+000	T	R (Village Road)
37	96+900	T	L (Village Road)
38	103+470	T	R (Village Road)
39	103+800	Y	L (Village Road)
40	104+600	Y	L (Mandua)

Sr. No.	Location (Existing)	Type	Road
41	107+450	T	L (Village Road)
42	108+870	T	L (Village Road)
43	109+530	T	L (Village Road)
44	110+740	T	L (Village Road)
45	113+420	T	L (Village Road)
46	113+442	T	L (Village Road)
47	113+590	T	L (Village Road)
48	113+725	T	R (Village Road)
49	113+750	T	R (Village Road)
50	113+800	T	R (Village Road)
51	114+030	T	R (Village Road)
52	114+054	T	L (Village Road)
53	114+124	T	R (Village Road)
54	114+231	T	R (Village Road)
55	114+370	X	L (Village Road
56	118+670	X	L (Paldijhadha) R (Chlara)
57	120+238	T	L (Gaju village)
58	121+400	Y	R (Dhadhriya)
59	122+460	T	L (Village Road)
60	128+626	T	R (Village Road)
61	128+649	T	R (Village Road)

ANNEXURE 2.4: WIDENNING SCHEDULE

Widening Schedule

SL.No	Location		Length (km)	TCS Type	Settlement
	From	To			
1	0.000	0.100	0.100	TCS-6	Banar
2	0.100	1.200	1.100	TCS-4	Banar
3	1.200	4.250	3.050	TCS-10	
4	4.250	4.430	0.180	TCS-8	Jhajhirwal Kalan
5	4.430	5.430	1.000	TCS-10	
6	5.430	7.050	1.620	TCS-8	
7	7.050	8.250	1.200	TCS-10	
8	8.250	8.750	0.500	TCS-8	Jhajhiwal Ghelotan
9	8.750	12.150	3.400	TCS-10	
10	12.150	12.570	0.420	TCS-8	Thabukda Village
11	12.570	17.765	5.195	TCS-3	
12	17.765	19.270	1.505	TCS-5	Realignment at Daikra
13	19.270	21.000	1.730	TCS-3	
14	21.000	28.480	7.480	TCS-1	
15	28.480	28.690	0.210	TCS-5	Curve Improvement at Bucheti
16	28.690	30.950	2.260	TCS-1	
17	30.950	32.220	1.270	TCS-3	
18	32.220	32.370	0.150	TCS-5	
19	32.370	32.980	0.610	TCS-3	
20	32.980	33.450	0.470	TCS-5	
21	33.450	33.660	0.210	TCS-1	
22	33.660	33.900	0.240	TCS-5	
23	33.900	35.660	1.760	TCS-1	

SL.No	Location		Length (km)	TCS Type	Settlement
	From	To			
24	35.660	37.050	1.390	TCS-7	Budkiya
25	37.050	38.720	1.670	TCS-1	
26	38.720	39.050	0.330	TCS-7	Dewatra
27	39.050	40.200	1.150	TCS-1	
28	40.200	40.600	0.400	TCS-7	Godawas
29	40.600	42.000	1.400	TCS-1	
30	42.000	43.150	1.150	TCS-3	
31	43.150	44.100	0.950	TCS-7	Artiya Kalan
32	44.100	56.000	11.900	TCS-3	
33	56.000	56.340	0.340	TCS-1	
34	56.340	56.650	0.310	TCS-7	Bhadua Ki Dhani
35	56.650	57.720	1.070	TCS-1	
36	57.720	59.500	1.780	TCS-7	Bhopalgarh
37	59.500	61.200	1.700	TCS-3	
38	61.200	62.034	0.834	TCS-1	
39	62.034	71.034	9.000	TCS-3	
40	71.034	72.034	1.000	TCS-1	
41	72.034	73.034	1.000	TCS-3	
42	73.034	75.034	2.000	TCS-2	
43	75.034	76.634	1.600	TCS-3	
44	76.634	76.804	0.170	TCS-5	
45	76.804	78.584	1.780	TCS-7	Asop
46	78.584	78.784	0.200	TCS-5	
47	78.784	79.034	0.250	TCS-3	
48	79.034	80.034	1.000	TCS-9	
49	80.034	80.434	0.400	TCS-3	
50	80.434	80.634	0.200	TCS-9	

SL.No	Location		Length (km)	TCS Type	Settlement
	From	To			
51	80.634	85.434	4.800	TCS-3	
52	85.434	86.034	0.600	TCS-2	
53	86.034	86.809	0.775	TCS-3	
54	86.809	88.204	1.395	TCS-5	Kankrai Bypass
55	88.204	94.134	5.930	TCS-3	
56	94.134	96.534	2.400	TCS-5	Sankhwas Bypass
57	96.534	97.034	0.500	TCS-3	
58	97.034	98.034	1.000	TCS-9	
59	98.034	99.034	1.000	TCS-3	
60	99.034	101.034	2.000	TCS-1	
61	101.034	101.464	0.430	TCS-2	
62	101.464	102.894	1.430	TCS-5	Realignment at Gawaloo
63	102.894	105.034	2.140	TCS-2	
64	105.034	105.200	0.166	TCS-1	
65	105.200	107.034	1.834	TCS-2	
66	107.034	108.034	1.000	TCS-1	
67	108.034	111.084	3.050	TCS-1	
68	111.084	113.484	2.400	TCS-7	Khajwana Village
69	113.484	114.034	0.550	TCS-2	
70	114.034	115.034	1.000	TCS-1	
71	115.034	116.034	1.000	TCS-2	
72	116.034	118.034	2.000	TCS-1	
73	118.034	120.034	2.000	TCS-2	
74	120.034	126.033	6.000	TCS-3	

ANNEXURE6.1: GUIDANCE NOTE ON BORROW AREA MANAGEMENT

PRECONSTRUCTION STAGE

The contractor shall identify the borrow area locations in consultation with the individual owners in case of private lands and the concerned department in case of government lands, after assessing suitability of material. The contractor shall submit an application to the District Level Environmental Assessment Committee for Environmental Clearance with the required details. The Environmental clearance shall be submitted to the Employer before the borrowing operations can begin.

Borrowing are to be avoided in the following areas:

- Lands close to toe line of the existing or proposed road.
- Irrigated agricultural lands shall be avoided. (In case of necessity for borrowing from agricultural land, the topsoil shall be preserved in stockpiles. The subsequent Guidelines detail the conservation of topsoil.
- Grazing land or any community property e.g. Orans, Gochars etc.
- Lands within 0.8km of settlements.
- Environmental sensitive areas such as Reserve Forests, Protected Forests, Sanctuary, wetlands. distance of 1000 m should be maintained from such areas.
- Eco-sensitive areas around Mount Abu and Eco-Sensitive Zones of the Wild Life Sanctuaries
- Unstable side-hills.
- Water-bodies.
- Streams and seepage areas.
- Areas supporting rare plant/ animal species;

The Employer/Authority Engineer will have the right to stop work at any borrow location even after the required environmental clearance is received if it violates any of the above.

The Contractor shall ensure soft rock is not prominent within the proposed depth of excavation as it will render rehabilitation difficult. The following options for redevelopment of Borrow area might be considered in compliance to with MoRTH, clause 305.2.2.2.

Box 1:Options for Borrow Area redevelopment

- Borrow areas can be developed as:
- Ponds (various types) (e.g.: Drinking Water only; Washing and for other Domestic Chores; Only for Cattle; Mixed Uses etc.) (a large pond can be divided into two parts - each having a defined use)
- Agricultural land
- Water Recharging Zones (depending on the geology of the area)
- Pastureland
- Fish Ponds (pisciculture)
- Plantation Zones
- Recreational Zones (depending upon location, size, potential of the site, willingness of the local bodies to develop it)

- Wildlife Refuge and Drinking Area (applicable only in case of sensitive environs with appropriate planning and understanding including regulation of depth for safety of animals etc.)
- Waste disposal Sites (depending upon the location, distance from settlements, pollution risks, safety, associated environmental risks and hazards, regulations/ permissions of appropriate authority and other precautions e.g. HDPE Lining to prevent contamination of soil and groundwater)

The rehabilitation measures for the borrow areas shall be dependent on the following factors:

- Land use objectives and agreed post-borrowing activities with the owner of the land as per the agreement;
- Physical aspects (landform stability, erosion, re-establishment of drainage, geological profile);
- Biological aspects (species richness, plant density,) for areas of native re vegetation;
- Water quality and soil standards; and
- Public safety issues.

The method statement which can be adopted for different options is presented in the **Appendix 1**: Options for Rehabilitation of Borrow areas to the Guidance Notes

Operation of the Borrow Areas during the Construction Period

The Contractor will work out statutory requirement for borrowing with the land from the Department of Mining and Geology, Govt. of Rajasthan. The Contractor must also obtain the necessary environmental clearance as per the EIA Notification 2006.

The Contractor shall also work out an agreement for the borrowing of soil with the concerned land owner. The arrangements will include:

- commitment not to use the topsoil;
- redevelopment after completion of borrowing;
- Commercial terms and conditions as may be agreed between the two parties;

The contractor shall submit to the Employer/Engineer the following before beginning work on the borrow areas.

- Environmental Clearance Certificate of the borrow area
- Written No-objection certificate of the owner;
- Estimate extent of earth requires;
- Extent of land required and duration of the agreement;
- Photograph of the site in original condition; and
- Site redevelopment plan after completion.

The arrangements (except for the commercial terms and conditions) will be verified by the Employer/Engineer to enable redressal of grievances at a later stage of the project. The Employer/Engineer shall approve the borrow area with or without inspection of the site to verify the reclamation plan and its suitability with the contractor and landowner. The contractor shall commence borrowing soil only after the approval by the Employer/Engineer.

The depth of excavation should be decided based on natural ground level of the land and its surroundings, as well as based on the rehabilitation plan. In case of highland larger depths may be allowed but the final level of the borrowed land shall in no case be lower than the adjoining plots so that it gets water logged. In case higher depth of excavation is agreed by backfilling using unsuitable excavated soil (from roadway), in those cases filling should be adequately compacted except for topsoil, which must be spread on the top most layer (for at least 20m thick).

In case the borrow pit is on agricultural land, the depth of borrow pits shall not exceed 45 cm and may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside. In case of stripping and stockpiling of topsoil, provisions of Appendix 2: Topsoil Salvage, Storage and Replacement need to be followed.

The guidelines for location, depth, size and shape of the borrow areas are available in the following:

- Clause 305.2.2.2 of MoRTH specification for roads and bridge works of IRC;
- Guidelines for environmental impact assessment of highway projects, Indian Roads Congress, 1989: IRC: 104-1988);
- IRC: 10-1961-Recommended practice for borrow pits for road embankments constructed by manual operations, as revised in 1989;
- IRC SP: 58-2001 guideline for use of fly ash in road construction;
- Highways Sector EIA manual of MoEFCC, 2010 (http://envfor.nic.in/sites/default/files/highways-10_may_0.pdf);
- MoEFCC notification on utilisation of fly ash dated 25th March 2015 vide S.O. 1396 (E) mandating all road projects within a radial distance of 500 km to mandatorily use fly ash.

During the excavation the contractor must ensure that following database must be documented for each identified borrow areas that provide the basis of the redevelopment plan.

- Chainage along with offset distance;
- Area of the plot (Sq.);
- Geo-tagged Photograph of the borrow pit from all sides;
- Type of access/width/kutcha/pucca etc from the carriageway;
- Soil type;
- Slope/drainage characteristics;
- Water table of the area or identify from the nearest well, etc;
- Existing landuse, for example barren/agricultural/grazing land;
- Location/name/population of the nearest settlement from borrow area;
- Present usage of borrow area; and
- Community facility near borrow pit.

During the excavation of the borrow areas the Contractor should maintain the following precautions

Table 1:Mitigation Measures to be adopted in case of the Borrow Area excavation

Activity	*Mitigation Measures*
Access Road to Site	• Access road shall be used for hauling only after it is approved. In case of any of the infrastructure i.e. road or culvert is in poor conditions they may either be strengthened so that the conditions do not deteriorate after the activity is over • In case of Sensitive receptors on the access road e.g. school, hospitals flagman should be posted to control the traffic. These areas should also be maintained as a no-horn zone. The traffic movement should be planned to avoid the movement during the School timings.
Removal of natural vegetation	• The natural vegetation from the plot may be removed and stored separately. This may be used as a mulch to protect the topsoil heaps from wind erosion

	• No tree would be felled without the permission of the forest Department
Top Soil Preservation	Before any excavation is carried out: • In case of agricultural land, the topsoil (30 cm) shall be stripped and stored at corners of the plot. The topsoil shall be stored at location so that it is not disturbed during the process of excavation of the borrow area. Top soil should be reused / re-laid as per agreed plan.; • In case of riverside, borrow pit should be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood. In no case shall borrow pit be within 1.5m from the Toe line of the proposed embankment. The topsoil shall however be stripped as indicated above Subsoils and overburden may also need to be kept on site for future use in building final landforms or providing additional rooting medium over hard rock areas. However, subsoils and overburden materials are of lower value for revegetation than topsoil, and contamination of topsoil with these materials can reduce its value.
Depth of Excavation	• For agricultural land, the total depth of excavation should be limited to 150cm including top 30 cm for top soil preservation; • For river side borrow area, the depth of excavation shall be regulated so that the inner edge of any borrow pit, should not be less than 15m from the toe of the bank and bottom of the pit should not cut the imaginary line of 1:4 projected from the edge of the final section of the embankment. The distance may be increased depending on the magnitude and duration of flood to be withstood. In no case shall borrow pit be within 1.5m from the Toe line of the proposed embankment. To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Engineer. • For highland areas the depth of excavations may be increased but the final levels of the borrow area shall not be lower than the adjoining land top prevent the land from becoming a water-logged area
Damage to Surrounding land and properties	Movement of man and machinery should be regulated to avoid damage to surrounding land. To prevent damages to adjacent properties, To prevent damages to adjacent properties, the Contractor shall ensure that an undisturbed buffer zone exists between the distributed borrow areas and adjacent land. Buffer zone shall be 3 m wide or equal to the depth of excavation whichever is greater.
Drainage Control	Most of the borrow work is likely to the carried out during the dry season. The contractor should ensure that the rehabilitation works is initiated at the onset of the monsoon. However, the Contractor shall maintain erosion and drainage control in the vicinity of all borrow pits and make sure that surface drains do not affect the adjacent land/ water body or future reclamation. In no case shall the topsoil be allowed to be washed away by the runoff. The protection measures mentioned in the “Guidance Notes 2: Slope Stability and Erosion Control” may be adopted. This needs to be rechecked by the Employer/Engineer.
Dust Suppression	• Water should be sprayed on kutcha haul road twice a day or as may be required to avoid dust generation during transportation of

	material; Depending on moisture content, 0.5 to 1.5% water may be added to excavated soil before loading during dry weather to avoid fugitive dust emission. • However, in dry areas i.e. areas facing water scarcity the speed of the vehicle on Kutcha road may controlled to 15 kmph to prevent re-entrainment of dust. • Consider the direction of prevailing winds when designing the work area, work faces and stockpile layouts to minimise dust nuisance • Loading of the excavated earth on to the tippers shall be done to minimise the dust • In case of extreme windy condition leading to dust emission stoppage of work may be considered.
Material transport	Material transport shall only be provided with tarpaulin cover
Decommissioning of Equipment	All site should be cleaned of all contamination e.g. contamination from oil spillage. These contaminated areas should be scrapped and sent with the excavated material for use in embankment. In case any adjoining area or property or area has become unstable the same shall be repaired before the decommissioning of the machinery Any damage to road, culverts or any other common property shall be repaired immediately

Redevelopment of Borrow Areas

All reclamation shall begin within one month of decommissioning of borrow area, in accordance with the redevelopment plan. The site shall be inspected by the Employer/Engineer after implementation of the reclamation plan. Certificate of Completion of Reclamation is to be obtained by the Contractor from the landowner that ―the land is restored to his satisfaction.

Inspection of the Redevelopment Works

Inspection needs to be carried out by the Employer/Engineer for overseeing the redevelopment of borrow areas as per the plan. The checklist for the inspection by the Employer/Engineer is given below (Box 10-2).

Box 10-2:Inspection Checkpoints for Borrow Area Operations

- Compliance of post-borrowing activities and land use with the restoration plan;
- Drainage measures taken for inflow and outflow in case borrow pit is developed as a detention pond;
- Levelling off the bottom of the borrow areas;
- In case the borrow area is on private property, the contractor shall procure written letter from landowner for satisfaction on rehabilitation. In case of no rehabilitation is desired by the landowner, the letter should include statement ― "no responsibility of PWD or the contractor in the event of accident".
- Condition of the reclaimed area in comparison with the pre-borrowing conditions.

Appendix 1: Options for Rehabilitation of Borrow Areas

Option I: Suitable in locations with high rainfall and productive areas

The sites which have relatively better rainfall is well suited for conversion to agricultural fields. The following process can be used for the rehabilitation of the borrow area into agricultural field:

- After the decommissioning of the machinery the entire area shall be graded so that the plot is level. A grader or even a Dozer may be used for the purpose.
- The subsoil soil if any which has been scrapped shall also be re-laid. Once the site is levelled no heavy machinery would enter the plot of land. To remove any compaction of the soil the deep ploughing would be applied;
- Once the site ash been levelled at the deep ploughed the topsoil shall be evenly re-laid. Topsoil must be placed, seeded, and mulched within 30 days of final grading if it is within a current growing season or within 30 days of the start of the next growing season.
- Vegetative material used in reclamation must consist of grasses, legumes, herbaceous, or woody plants or a combination thereof, useful to the community for the fuel and fodder needs.
- Plants must be planted during the first growing season following the reclamation phase. Selection and use of vegetative cover must consider soil and site characteristics such as drainage, pH, nutrient availability, and climate to ensure permanent growth. The vegetative cover is acceptable if within one growing season of seeding, the planting of trees and shrubs results in a permanent stand, or regeneration and succession rate, sufficient to assure a 75% survival rate.

Option II: In barren land, the borrow areas can be redeveloped into detention ponds.

The plots of land which cannot be put into agricultural or other productive use may be considered for such rehabilitation. These detention tanks will be doubled up as water bodies for rain-water harvesting and for removal of sediment from runoff flowing through the ponds. Design of the detention basin depends upon the particle size, settling characteristics, residence time and land area. A minimum of 0.02 mm size particle with a settling velocity of 0.02 cm/sec (assuming specific gravity of solids 2.65) can be settled in the detention basin.

The parameters are to be observed while setting up a detention pond:

Box 3:Design Parameters for the Detention Tank

- The plot in which the pond is being created should be located at the lowest point in the catchment area.
- Care should be taken that the horizontal velocity should be less then settling velocity to prevent suspension or erosion of deposited materials.
- Minimum Effective Flow Path: 5 times the effective width
- Minimum Free Board: 0.15 m
- Minimum Free Settling Depth: 0.5 m
- Minimum Sediments Storage Depth: 0.5 m
- Maximum interior slope: 2H: 1V
- Maximum exterior slope: 3H: 1V

The inlet structure should be such that incoming flow should be distributed across the width of the pond. A pre-treatment sump with a screen should be provided to remove detritus/debris. The settled sediments should get settled in the sedimentation tank.

Appendix 2: Topsoil Salvage, Storage and Replacement

Poor handling and stockpiling practices will result in a significant loss of viable seed and topsoil quality. Quality control procedures should be applied for the movement and handling, storage and re-spread of soil layers for use in revegetation

In case of hilly and desert areas, topsoil with humus wherever encountered while opening the site for construction shall be stripped and stockpiled (Refer MoRTH- Technical Specification no. 301.3.2 and 305.3.3[17] and for measurement for payment 301.8).

Location of Stockpile

The Topsoil stockpile shall be located within the agricultural plot. In case two or more plots are adjacent to each other the topsoil of the plots should not be mixed and stored separately. The location for storage of the topsoil shall have the following consideration (Box -4)

Box -4:Considerations for Storage of Topsoil

- The surface topsoil layer and the subsoil should not be mixed during the stripping and stockpiling process.
- A secure area away from:
- Grade, Subsoil & Overburden materials;
- Pit activities and Day-to-day operations.
- Areas that do not interfere with future pit expansion
- Areas away from drainage paths and uphill of sediment barriers
- Areas away from the access roads
- Scalp good quality topsoil in windrow to each side of the earthworks to prevent erosion by wind.
- The stripping and handling of topsoil should occur when the field soil moisture content is optimum i.e. early morning for the soil texture class

Specifications for Stockpiles

The stockpiles for storing the topsoil shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile is restricted to 2m. A minimum distance of 1m is required between stockpiles of different materials.

Preservation of Stockpile

In cases where the topsoil must be preserved for more than a month, the stockpile is to be stabilized within 7 days. The stabilisation shall be carried out through temporary seeding. It consists of planting rapid-growing annual grasses or small grains, to provide initial, temporary cover for erosion control.

Box -5: Vegetative material for stockpile stabilisation

- Must consist of grasses, legumes, herbaceous, or woody plants or a mixture thereof
- Selection & use of vegetative cover to take into account soil and site characteristics such as drainage, pH, nutrient availability, and climate to ensure permanent growth
- The following precautions shall be considered for stockpile stabilisations:
- Stockpiles will not be surcharged, or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur.

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- Divert runoff around stockpiles unavoidably located in drainage paths using a perimeter bank uphill.
- The stockpiles shall be covered with gunny bags or tarpaulin immediately in case they are not stored for periods longer than one month.

Annexure 6.2: Guidelines for Storage , Handling and Disposal of Hazardous Waste Municipal Solid Waste And Construction and Demolition Waste

zardous Waste

- For storing of hazardous waste (Used oil and waste oil, Empty barrels/containers of oil, lubricant and grease, Contaminated cotton rags or other cleaning materials), the Contractor shall follow the guidelines while planning and designing the hazardous waste storage areas:
    - The storage area should be provided with concrete floor;
    - The storage area floor should be provided with secondary containment;
    - Proper slopes as well as collection pit to be provided in the storage area to collect wash water and the leakages/spills etc.;
    - Storage area should be provided with the flameproof electrical fittings;
    - Automatic smoke, heat detection system should be provided in the sheds;
    - Adequate firefighting systems (ABC type fire extinguisher) should be provided for the storage area; and
    - The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

Municipal Solid Waste

- The Contractor shall segregate and store bio-degradable and non-biodegradable municipal solid waste in two separate bins (primary collection point). The storage area should be provided with concrete floor;
- The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.
- The storage area shall be enclosed, or the storage containers shall be covered to prevent vermis and scavengers from littering

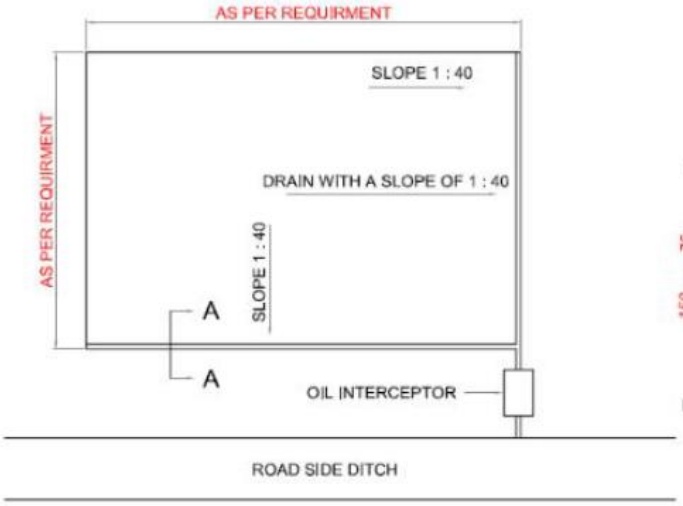
Construction and Demolition Waste

- The Contractor shall keep the construction and demolition waste within the premise or at a designated place for the collection of the C&D waste. The designated place shall be decided in consultation with the local body. The agreement with the local body shall essentially mention the end-use of the designated location. The designated site shall be away from:
    - Located at least 1000 m away from sensitive locations;
    - do not contaminate any water sources, rivers etc; and
    - Lotal site has 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;
    - Productive lands are avoided; and available waste lands shall be given preference;
    - Forest land shall be avoided.
- During the site clearance and disposal of debris, the contractor will take full care to ensure that the public or private properties are not damaged/affected and that the traffic is not interrupted.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Authority Engineer.
- The contractor will at all times ensure that the existing water bodies and drains within and adjacent to the site are kept safe and free from any debris.
- In case the dumping operations are carried out in dry and windy condition Contractor will regulate the dumping operations so that the dust generation is minimised, or preferably carry

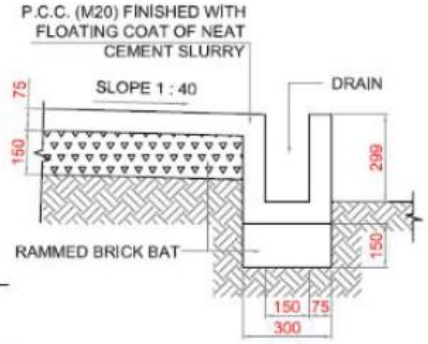
out the operations in early morning when the environment is moist. The contractor may utilize effective water sprays during the delivery and handling of materials.

- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- 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 Authority Engineer.
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the contractor will take into account the wind direction and location of settlements to ensure against any dust problems. The contractor can also consider the use of dust screens to prevent dust pollution.

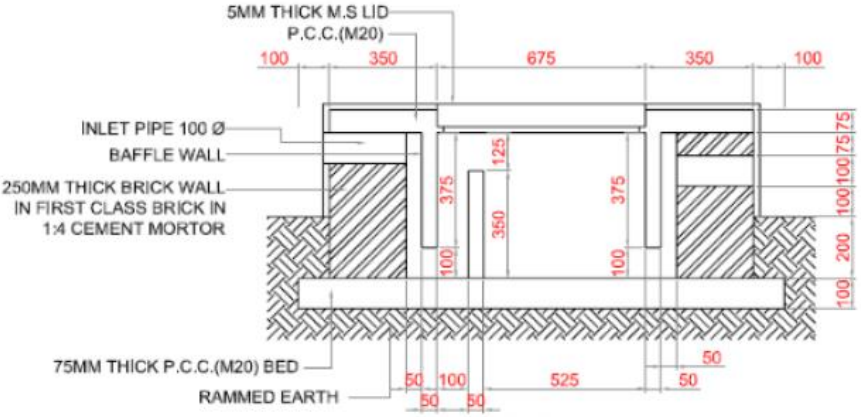
ANNEXURE6.3: SCHEMATIC DIAGRAM FOR OIL-WATER SEPERATOR



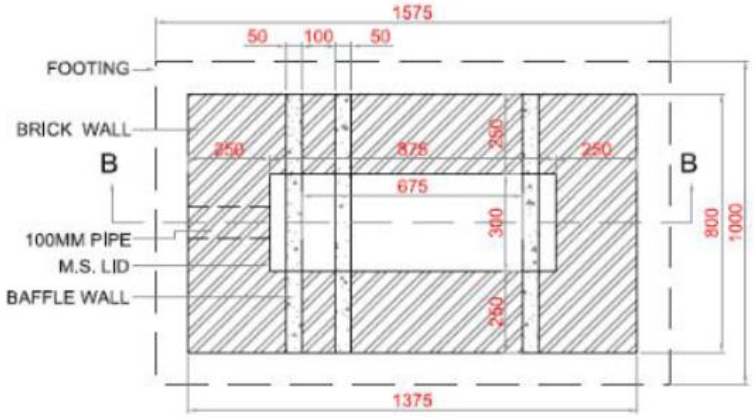
KEY PLAN



SECTION A - A



SECTION B - B



PLAN OF OIL INTERCEPTOR

ANNEXURE 6.4: EMERGENCY SPILL CONTROL PROCEDURE

Emergency Spill Procedure

Should a spill occur, either though spillage or equipment failure, the applicable emergency spill procedure outlined below must followed.

Spill Procedure

In the case of a spill, overflow or release fluid into the stream waterway (whether water is flowing during the spill or not), any actions that is practical and safely possible to control the situation, shall be implemented.

- Stop the flow
    - Stop the release into the stream waterway
    - Shutdown equipment
    - Close valves and pumps
    - Plug hoses
- Remove Ignition Sources
    - Shut off vehicles and other engines
- Do not allow torches, mobile phone, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible).
- Contact the environmental Officer and initiate Emergency Response
- Notify the site supervisor and the Contractor's Environmental Engineer and Health and Safety Officer as soon as possible
- The Environmental Engineer of the Contractor will review the situation and decide if Emergency Services like Fire Brigade are required
- Appropriate parties to be notified of the spill are The contractor's Project Manager, The Authority Engineer through his designated Environmental Officer, The PIU, Regulatory Agencies like Pollution Control Board, Municipal Authorities, as applicable,

Clean-up and Disposal

- Identify nature and type of chemical/fuel spilled through information available onsite or from first responder.
- Refer to the MSDS for any special instruction
- Wear personal protective equipment (PPEs) viz. chemical resistant gloves, safety boots, safety glasses etc. Reach for the spill kit placed at the Contractor Camp.
- In case of spill on land create a dyke on the spill and use readily available sand, saw dust to contain the spill. Use absorbent pads, to clean up the spill. In case of spill in a water channel which is dry use the above method.
- In case the spill occurs within a waterbody stop any agitation to the waterbody and place absorbent material to remove the spill.
- Recover the spill contaminated absorbent materials and use pads and store the same in "Hazardous Waste" containers and store it in the waste storage area for disposal.
- For spill on unpaved areas such as soil, remove the upper layer of soil in the contaminated area with a shovel and transfer it to the hazardous waste containers using a bucket.
- If any of your PPEs have been exposed to spill material dispose it off safely in hazardous waste containers.

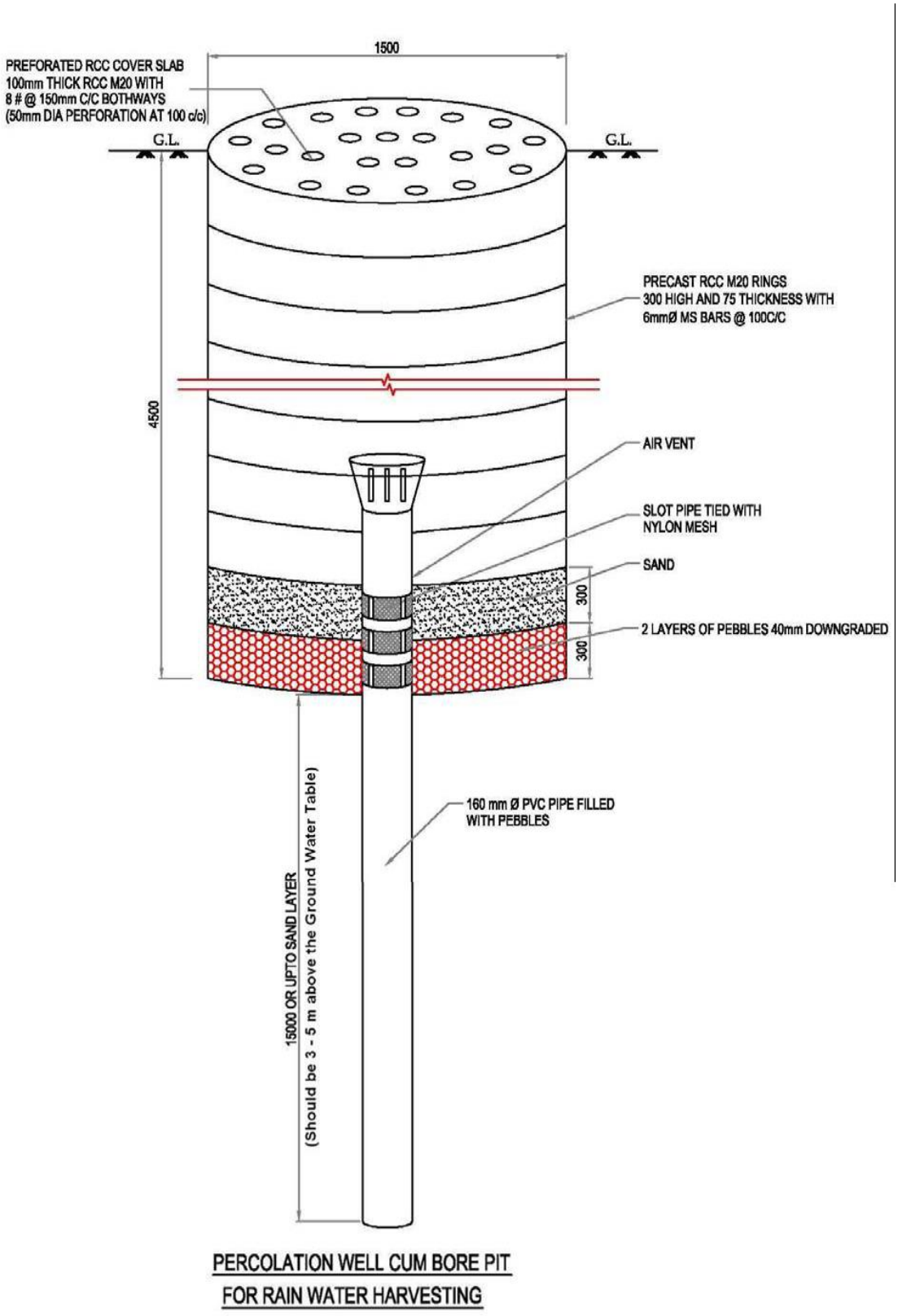
Reporting

- The Contractor's Environmental Officer will document the event and submit reports to the Authority Engineer. The Authority Engineer would send a report of the incident immediately with its observations to the PIU, PMC and Environmental Officer at the PMU.
- If required the Client would direct the Contractor to iniate the process of reporting to the regulatory agencies. like the Pollution Control Board.

Procedure Review

The Environmental Office will review the report, determine if changes are required to procedures and recommend implementation of all required changes. He would also intimate the management of such incident.

ANNEXURE6.5: SCHEMATIC DIAGRAM FOR RAINWATER HARVESTING PIT



PERCOLATION WELL CUM BORE PIT
FOR RAIN WATER HARVESTING

ANNEXURE 6.6: GUIDANCE NOTE ON SITE CLEARANCE

Vegetation Clearance

- Vegetation clearance shall comprise uprooting of vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth upto 30 cm. measured at a height of one meter above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately. The procedure/ steps involved for uprooting, skating and felling trees are described below.

Uprooting of Vegetation

- The roots of trees and saplings shall be removed to a depth of 60 cm. below ground level or 30 cm. below formation level or 15 cm below sub grade level, whichever is lower.
- All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled .
- Trees, shrubs, poles, fences, signs, monuments, pipe lines, cables etc. within or adjacent to the area, which are not required to be disturbed during vegetation clearance shall be properly protected by the contractor at his own cost.

Staking and Disposal

- All useful materials obtained from clearing and grubbing operation shall be staked in the manner as directed by the Consultant.
- Trunks and branches of trees shall be cleared of limbs and tops stacked properly at the places indicated by the Consultant. These materials shall be the property of the Government.
- All unserviceable materials are disposed off in such a manner that there is no livelihood of getting mixed up with the materials meant for construction.

Felling Trees

- Marking of tress: Trees, above 30 cm girth (measured at a height of one meter above ground level) to be cut, shall be approved by the Consultant and then marked at the site.
- Felling of trees: Felling of trees shall include taking out roots up to 60 cm. below ground level or 30 cm. below formation level or 15 cm. below sub-grade level, whichever is lower.
- Filling: All excavations below general ground level arising out of removal of trees, stumps etc. shall be filled with suitable material in 20 cm. layers and compacted thoroughly so that the surface at these points conform to the surrounding area.
- Sizing: The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Consultant.
- Staking: The serviceable materials shall be staked in the manner as directed by the Environmental specialist of Supervision Consultant.

Disposal: The material, which cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Consultant. Unsuitable waste materials should not get mixed with construction material during disposal

ANNEXURE 6.7: GUIDANCE NOTE ON OCCUPATIONAL HEALTH & SAFETY

GUIDANCE ON GENERAL OHS APPLICATIONS

General Safety procedure

All workers entering the site should be trained and made aware of the environmental and safety practices. They should be made aware of the safety signages at the site;

Housekeeping

Improper housekeeping is the primary hazard in any construction site. The Contractor shall ensure that a high degree of housekeeping is always maintained at the work sites. All site personnel, and line management shall demonstrate committed and continued efforts towards housekeeping.

General Housekeeping shall be carried out by the contractor and ensured at all times at Work Site, Construction Depot, Batching Plant, Labour camp, Stores, Offices and toilets/urinals. In case public areas adjoining the worksites are soiled by construction debris, soil either spilled from worksite or carried by the vehicle moving out of the worksite it shall be the Contractor's responsibility to clean-up. Toward general house keeping the Contractor shall constitute a special group of housekeeping personnel. This group shall ensure daily cleaning at work site & surrounding areas and maintain a register.

The contractor shall be responsible to provide segregated containers for disposal of debris at required places and regular cleaning of the same.

Safety During Clearing and grubbing

If a tractor dozer is employed on clearing scrub or felling trees, it shall be provided with adequate driver protection.

When two or more scrapers are working on the same job, a minimum distance of at least 25m or adequate shall be kept between them.

In case of hydraulic breakers, hydraulic rams and hoses shall be in good working condition.

During the clearing operations no material shall be dumped on public land so as to reduce the width of the carriageway;

The stumps of trees shall not be dumped on the public land nor shall it encroach on the right of way.;

Construction within Settlements

Full height fence, barriers, barricades, etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. In the same way barricades protect the road users from the danger due to construction equipment and other temporary structures.

Specific walkways should be demarcated by barricade for use by pedestrians;

Cross-over sites would be provided at all worksites within settlements. At all cross over points flagman shall be posted to control the traffic and facilitate movement of the pedestrians,

At night the worksite and adjoining areas within the settlement shall be well lit so that the people are not inconvenienced;

Flasher should be provided at all cross over points to warn vehicular traffic of impending movement of pedestrians

Safety Measures for Vehicles

Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.

No passengers shall be carried, on any vehicle unless specific seating has been provided in accordance with the manufacturers recommendations;

All Vehicles procured for the project shall be fitted with audible reverse alarms and maintained in good working conditions. Reversing shall be done only when there is adequate rear view visibility or under the directions of a Flagman.

All vehicle drivers including Hydra operators shall be trained on defensive driving at recognized Institute for Driver Training. All vehicle drivers shall also undergo refresher training on defensive driving provided by recognized institutes for the purpose once in 6 months.

No vehicle shall travel through the settlement at speed of more than 15 kmph

Flagman shall be placed at the both ends of the settlement and at the cross-over point to facilitate movement of vehicle;

Safety measures at slopes

Working on gradients beyond any equipment capability shall not be allowed. Prevention of dumper and dump truck accidents should be managed by providing wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, etc.

The manufacturer's recommended bucket size must not be exceeded in excavators.

If excavators operating on a gradient, which cannot be avoided, it must be ensured that the working cycle is slowed down, that the bucket is not extended too far in the downhill direction, and that travel is undertaken with extreme caution. A large excavator must never be permitted to travel in a confined area, or around people, without a flagman to guide the driver, who should have the excavator attachment close in to the machine, with the bucket just clear of the ground. On wheeled excavators, it is essential that the tyres are in good condition and correctly inflated. If stabilizing devices are fitted, they should be employed when the machine is excavating.

When the front shovel of the 180° backhoe loaders is being employed, the backhoe attachment shall be in its "travel" position, with the safety locking device in place.

When operating the backhoe in poor ground conditions, the stabilizers tend to sink into the surface of the ground, reducing stability. Therefore, frequent checks shall be made for the stability of the machine. The loading shovel should always be lowered to the ground to stabilize the machine when the backhoe is employed.

Safety Measures During Bitumen Construction Work…

The Contractor shall ensure that bitumen storing, handling as well as mixing shall be done at hot-mix plant or designated areas5 to prevent contamination of soil and ground water.

Skilled labour shall be used while hand placing the pre-mixed bitumen material.

The hand placing of pre-mixed bituminous material shall be done only in following circumstances:

- For laying profile corrective courses of irregular shape and varying thickness
- In confined spaces where it is impracticable for a paver to operate and

o For filling potholes

The Contractor shall provide safety equipment i.e. gumboots and gloves to the workers while handling bitumen.

While applying Tack Coat, spraying of bitumen shall be done in the wind direction. The labour shall wear jacket while spraying the bitumen.

All the bituminous work shall be done as per IRC's Manual for Construction and Supervision of Bituminous Works.

Dangerous Work Environment

As per BOCWR:

When an internal combustion engine/s is/are used in a confined space or excavation or tunnel or any other workplace where either natural or artificial ventilation system is inadequate to keep carbon monoxide below 50ppm, exposure of workers shall be avoided unless suitable measures are taken and provided by the contractor.

No worker shall be allowed into any confined space or tank or trench or excavation wherein there is given off any dust, fumes/vapours or other impurities which is likely to be injurious or offensive, explosive or poisonous or noxious or gaseous material or other harmful articles unless steps are carried out by the contractor and certified by the responsible person to be safe.

Danger areas

The Contractor shall carry out a workplace safety assessment (not limited to the requirement of the any legislation) where a workplace contains an area in which, owing to the nature of the work, there is a risk of any person at work

o falling a distance; or

o being struck by a falling object or moving vehicle and equipment which is liable to cause personal injury, and;

Such area may be clearly indicated as a Danger area. The area shall be clearly demarcated by precautionary signages indicated in both pictorial and local language.

In case of active worksite which are also dangerous, or dangerous worksite where there is heavy traffic or pedestrian movement flagman shall

Excavation

In case of excavation the safety plan should safeguard against the following::

- Collapse of the sides,
- Material falling on the people working in the excavation,
- People and vehicles falling into the excavation,
- People being stuck by plant and machinery,
- Access of both workers and local people to the excavation,
- Fumes/gas
- Underground utilities
- Accidents to members of the public.

Make sure the necessary equipment needed such as trench sheets, props, etc. is available on site before work starts.

The following precautionary measures need to be considered:

Before starting excavation; it shall be checked whether there are any underground utilities present like electrical power cables, pipe line or any other service line.

- If the excavation is deep more than 1.2 meters worker shall wear full body harness.
- For deep excavations appropriate preventive measure to be taken to avoid earth collapse like slope or bench providing to the walls of the pit or sheet piling etc. as per norms and design. The slope of excavation would not be steeper than the angle of repose of the particular soil. When the slope is less than the angle of repose, which cannot be achieved because of limited place or if it is uneconomical to provide such a slope then shoring should support the earth.
- Excavation area would be barricaded 1-meter away from the edge of excavation pit. Tube & coupler type hard barricades shall be used for the barricading.
- No materials would be stacked at edge of the excavation pit.
- There would not be any vehicle movement close to the edge of the excavation pit.
- Proper access would be made for workers, either by providing Stairways or cutting steps on the wall of the pit or by any appropriate means
- Proper ramp to be made if the excavated earth is to be moved by vehicles.
- Proper lighting shall be provided for working at night. Reflectors & caution boards are to be fixed to caution outsiders.
- Electrical cable routing would be laid such that it does not cause tripping hazard.
- Care would be taken that the persons working near by the excavation may not be hit by moving part of the machine.
- The Dump Truck that shifts the excavated material shall move only after lowering the hull to original position; after completion of dumping the material.
- Well trained two person are deployed for locking and unlocking backdoor of dumper.

Hand Tools & Power Tools

- Proper hand tools with insulated body shall be used.
- If duct dismantling is done at site, then the sheet handling shall be done carefully as it may cause cut injury. Proper gloves shall be used to prevent any injury.
- When not in use, sharp edged hand tools shall be provided with proper protection for the edges, Hand tools shall not be left unattended in the passageways, suitable cabinets or covers shall be provided for hand tools. (Especially metal bending and cutting tools).
- Power tools shall be connected through ELCB (Earth Leakage Circuit Breaker).
- Plug-top shall be provided with all power tools.

Temporary Electrical Supply Installation

- In case of layout of temporary cable and distribution board the layout shall displayed at the office and the main DB room.
- Cable markers shall be fixed to identify the route of the cables.
- The electrical installations shall be done in accordance with the regulation of the country
- All temporary electrical connection shall be done by authorized electrician, so deployed shall necessarily have the electrical license from the concerned Government authority.
- Earth Leakage Circuit Breaker (ELCB) shall be provided to all portable equipment supplies and a register to be maintained for its weekly check.

Setting up of Temporary Diesel Generator Set

- DG set shall be installed as per the electrical regulations;

- Fuel shall be stored away from the D.G Set and the area to be cordoned;
- CO2 fire extinguisher and two sand buckets shall be provided;
- All rotating parts of the equipment shall be adequately guarded;
- Fuelling shall be avoided while D.G is in operation;
- All cables shall be double insulated / armoured;
- Routing of cables shall be proper;
- Proper earthlings shall be provided. Earth resistance shall be maintained as per norms in the Indian Electricity Act;
- Only authorized personnel shall be allowed to operate the generator;
- Smoking shall be strictly prohibited in the area around the generator and fuel storage area;
- The designated operator shall use earmuff in addition to other common PPEs.

Hydraulic Excavators /Lifts/Cranes

- Operator should have valid license;
- The equipment should also have a valid load test certificate;
- The driver should always carry his valid license and the certificate of the equipment he operates.
- No person would enter the radius of action of Earth-moving equipment when in operation.
- No Earth-moving equipment would be started up until all workers are away from the operating radius. The Flagman/traffic marshal/Signaller should assist the operator to ensure safety in operation. Similar precautions should be taken during lifting operations of cranes. The precautions mentioned in IS 13367: (Part 1): 1992 should be followed.
- The person directing the movement of the earth moving equipment/mobile crane (signaller) should be easily identifiable by the driver and should be wearing high visibility clothing. The Driver and the signaller should be providing with appropriate personnel protective equipment such as safety boots googles gloves safety harness, safety spectacles and ear plugs as applicable.
- Earth-moving equipment would not travel on bridges, viaducts, embankments, etc. unless it has been found safe for it to do so.
- Adequate precautions shall be taken to prevent Earth-moving equipment being operated in dangerous proximity to live electrical conductors.
- On Earth-moving equipment motors, brakes, steering gear, chassis, blades, blade-holders, tracks, wire ropes, sheaves, hydraulic mechanisms, transmissions, bolts and other parts on which safety depends shall be inspected daily.
- Earth-moving equipment shall not be left on a slope with the engine running.
- No adjustments, maintenance work or repairs would be made on equipment in motion.
- Deck plates and steps shall be kept free from oil, grease, mud or other slippery substances.
- Permit to Work Procedures should ideally be followed.

Working at Night

- Arrangement shall be made for adequate lighting of the work area. Precautions for electrical safety should be considered during lighting
- Illumination shall be provided at working locations and passages the workers may use; Workers shall be instructed to use the passage;
- All workers would wear Hi-visibility jackets, Safety helmets with chin strip, Safety shoes and other PPEs.
- Availability of EHS person, safety personnel with beacons is essential during night work

Fall Protection

These safety precautions shall be applied when working at height especially in case of bridges or any place where the workers are working at heights more than 2m

- Employee/ worker deployed for height work shall be selected persons who are experienced and screened by the site management.
- Proper access and working platform shall be provided to reach the work spot.
- Fall protection must be provided for each employee on a walking/working surface with an unprotected side or edge at the height. One of the following measures must be used when employees are exposed to a fall of 6 feet or more:
    - Guardrail: To an extent possible guard rails would be provided along the edges
    - Safety Net Systems: Safety Nets to be provide when workers are exposed to risks of fall from height.
    - Fall Arrest Systems: Workmen shall wear full body harness with double lanyards for work above 1.2 m height. The selection of safety Belts and harness would have done in accordance to the IS 3521: 1999.
    - On horizontal movements the lanyard of fall arrestor shall be hooked to the static line.
    - Life lines shall be used for easy movement during work of standard size as specified in IS Codes.
    - Cover or guard floor holes as soon as they are created. In case holes cannot be covered the holes / opening/ vacant spaces in the floor should be guarded (with isolation tapes or guard rails) or covered as soon as they are created.
- Height work permit to be followed on daily basis.
- Tool box talk shall be conducted on daily basis for height work.

Dropping Objects

These safety precautions shall be applied when working at height especially in case of bridges or any place where the workers are working at heights:

- Workers shall carry tools in a bag;
- No materials shall be dropped from height. The material would be lowered by a headline. A workman shall be posted at ground level to clear and caution person from coming under the lowering material;
- In case where the work is carried out at height and the area below is used as a workspace or is a passage for worker the following additional precaution shall be undertaken:
    - The entire area shall be declared as a hard hat area and it shall be strictly enforced. No personnel shall be allowed inside that area with safety helmets.
    - Safety nets shall be provided below the work area

Slips & Trips

The following are means to either prevent slips, trips, and falls or to minimize the consequences if they should happen:

- Make the workers aware of the slipping and falling hazards when working on the ground or other platforms.
- Keep all work areas clean and clear of oil, tools, and debris.
- Provide guardrails and guards around work areas that are prone to slips, trips, and falls.
- Instruct workers on proper procedures for using and installing ladders as per IS 3696-2 (1991):
- Keep all cables and hoses orderly and clear of walking spaces.

- Wear personal protective equipment (such as hard hats, work gloves, safety shoes, and eye protection).

Fire and Explosion Hazards

To prevent risks of fires from ignition of flammable or combustible materials in the space, and from leaks of flammable gas into the space, from hot work equipment during hot work such as welding, cutting, brazing, soldering, and grinding the following precautions would be undertaken:

- Perform hot work in a safe location, or with fire hazards removed or covered.
- Use guards to confine the heat, sparks, and slag, and to protect the immovable fire hazards

In addition, these basic safeguards have fire-extinguishing equipment readily available and be trained in its use. Make suitable fire-extinguishing equipment immediately available in a state or readiness.

Occupational Health and Safety Training

- The contractor shall organize quality Occupational Heath Safety training for all its employees/ contractor and sub-contractors (including managers, supervisors, works (skilled/unskilled/ both temporary and permanent) and other personnel).
- The contractor shall arrange behavioural-based training programmes for all the executives to identify, recognize and eliminate unsafe act and unsafe conditions. The contents of Occupational Health and Safety shall be discussed and assessed by Managers and Supervisors in all the regular and review meetings.
- Based on the outcomes of the review meting and the observations made during the different audits and inspections Refresher-Training programme shall be conducted once in six months.
- Every day before start of work Toolbox talk shall be conducted by the supervisor during the morning meeting highlighting the safety precautions which needs to be taken and the rectifications in safety behaviour which has been pointed out.
- In case of failure on the part of the contractor to provide all the above- mentioned training programs to all employees in time, the same shall be provided by the Employer through recognized & competent agencies if required by formulating a common scheme to all contractors. Any administrative expenses and training fee towards the same shall be at the cost of the contractor.

OHS Inspection & Audits

- The Contractor shall carry out the following OHS inspections to identify any variation in construction activities and operations, machineries, plant and equipment. The following OH inspections program shall be adopted.
    - Planned General Inspection
    - Routine Inspection
    - Specific Inspection
    - Other inspection
- In addition, the Employer/Engineer shall carry out periodic surprise inspection not less than once every month
- In addition, the Contractor shall carry out OHS Internal audit is to assess potential risk, liabilities and the degree of compliance of construction Occupational Health and Safety Plan. The Employer shall carry out annual OHS Audit of all sites every year. If required supplementary procedures and programs would be developed.

Occupational Health Safety in Plant and Machinery

Construction Machinery

Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers piling figs, vibrio hammers, mobile elevation work platforms, cranes, tipper lorries, lorry loaders, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, vibratory rollers, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.

A large number Construction machinery are deployed by the contractors for construction work, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for safety of trains as well the workforce. The following measures should invariably adopt:

- The Vehicle and equipment shall not start any work without the presence of Contractor's Supervisor at site.
- Since the vehicles and/or machinery are required to work in the close vicinity of active traffic on the highway, the work shall be so carried out is such a way that there is no infringement either to the movement of traffic or the slow-moving vehicle including pedestrian. For this purpose, the area where the vehicles and/or machinery are required to ply/operate, shall be clearly demarcated and acknowledged by the contractor. Special care shall be taken for turning / reversal of vehicles / machinery without infringing the road space available. Barricading shall be provided wherever justified and feasible as per site conditions.
- The supervisor / workmen should be counselled about safety measures.
- The Contractor shall provide a Safety Certificate to the Employer/Engineer. Every construction equipment shall be in sound mechanical working condition undertaken in the past, any accident to the equipment, visual examination details critical components safety check, devises and its working condition, manufacturer's maintenance checklist, past projects wherein the equipment were used etc as its minimum content.

Excavation & Trenching

Liaison with Utility Companies Prior to Excavation

- Prior to any excavation the contractor is responsible for notification of all applicable utility companies, reasonably expected to be encountered during excavation work, -such as sewer, telephone, fuel, electric, water lines, or any other underground installations that excavation work is being performed.
- It is expected that Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the commencement of actual excavation.
- Contractor must verify the location of any marked utility or as-built information either prior to or during excavation.

Safety of Road Users and Workers

- During excavation, the contractor shall be responsible for ensuring a safe working environment for its employees and pedestrians. When excavation operations approach the estimated location of underground installations, the exact location of the installation will be determined by safe and acceptable means.
- Maintain a physical barrier around all excavations and machinery. Often times caution tape is insufficient, and barriers like properly supported fencing or temporary chain link fencing must be installed. All excavation sites are to be secured during off work hours to prevent unauthorized access.

- The contractor is responsible for providing the proper signage necessary to direct both vehicular and pedestrian traffic safely around or through the work area.
- The contractor is responsible for routine inspections of all excavation equipment. The inspection is to include safety features like back-up warning sounds and appropriate lighting.
- The contractor is responsible to ensure that equipment operators carry the required (valid) licenses and have the necessary training to operate the equipment on site.

Safe Practices for Excavation and Trenching

The contractor shall ensure that:

- Each employee in an excavation shall be protected from cave- ins by an adequate protective system.

- All excavation which is more than one 1.5 m or above, such excavation should be protected by adequate piling and bracing against such bank or side
- Where banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank.
- Excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank
- . Metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards.
- Trench and excavation is protected against falling of a person by suitable measures if the depth of such trench or excavation exceeds 1.5 m and such protection is an improved protection in accordance with the design and drawing of a professional engineer, where such depth exceeds 4m.

Concrete and Masonry Construction

Concrete ***Construction***

- No construction loads shall be placed on portion of concrete structure unless the Supervisor determines, based on the information received from a person who is qualified in structural design, that the structures capable in supporting the loads.

- All protruding reinforced steel onto and into shall be guarded to eliminate the hazard.
- No employee shall be permitted to work under the concrete buckets while buckets are being elevated or lowered into the position. To the extent practical, elevated concrete buckets shall be routed so that no employee or the fewest number of employees are exposed to the hazards associated with buckets or concrete falling from it.

- Form work shall be designed, fabricated, erected, supported, braced and maintained so that it is capable of supporting without failure all vertical and lateral loads that may be reasonably be anticipated to be applied to form work.

- Forms (except those used for slabs on grade and slip forms) shall not be removed until it is determined that the concrete has gained sufficient strength to support its weight and superimposed loads. Such determination shall be based on one of the following:

- The concrete has been properly tested with an appropriate standard test method designed to indicate the compressive strength, and the test results indicate that it has gained sufficient strength to support its weight and superimposed loads.

Reinforced Earth (RE) I Masonry Wall

- To the practically feasible extent at site, a limited access zone will be established whenever a RE Masonry wall is under construction. It shall be established prior to the start of the construction of the wall. The zone shall conform to the following as far as practical:
- It shall be equal to the height of the wall to be constructed plus 1.2 m and shall run the entire length of the wall.
- It shall be established on the side of the wall that will be un-scaffold or free standing.
- It shall be restricted to entry by the employees actively engaged in construction of the wall. No other employee shall be permitted to enter the zone.
- It shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse.
- All masonry walls more than 2.4 m in height shall be adequately braced to prevent overturning and to prevent collapse unless wall is adequately supported so that the wall will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.

Compaction of Backfill of Material

- Tracked equipment shall not be allowed to come into direct contact with reinforced strips.
- Heavy equipment shall not be allowed to come within 1.5 m of the retaining wall. The limited access zone shall be marked with the tape "No Heavy Equipment Beyond This Point".
- Tags shall be hung from the tape every 25m.
- Compaction of backfill close to the wall shall be done only with hand operated vibrating plate compactor or light weight rollers (< 500 kg). The compactor shall move only parallel to the wall.
- Props shall be placed on two layers for preventing outward movement before compaction is started.
- To avoid kicking out, backfill shall not be placed against the initial row of panels until the first row of reinforcement has been connected.

Safety Measures for Handling Bituminous Materials

In cases of bitumen handling and application the following hazards

- Burn injuries if there is possibility of skin contact and if temperature is elevated exposure to bitumen fumes and solvent vapours
- In case of Hot-mix works and hot mix plants the hazard zones are as follows:

Box 6:Hazard Zones in Hot Mix Plant and at Worksites

- In the Hot Mix Plant:
- Around the vents of the bitumen storage tanks.
- Near the asphalt mixer, asphalt conveyor -belt, skip, hot storage bins, during loading of trucks.
- Near the crusher of old asphalt.

- In the Plant laboratory
- Exposure in and around the mixing plant is in general of short duration.
- On the Work Site
- During the application of hot asphalt, exposure to asphalt / bitumen fume: may be experienced by paver driver, screed man, rake man and roller driver since the work on and around the paving machine.
- Exposure to asphalt/ bitumen fume condensate via the skin may be considerable for people working on the paving machine.
- During spraying bitumen emulsions or cut back bitumen the sprayer may receive highest exposure to spray cloud or fume.
- During milling or crushing, annihilated of and skin contact with bitumen.

The safety measures which are essential during the process of heating of paving bitumen are:

- Mercury-in-steel dial thermometer, with long stem, should be used for recording temperature of bitumen.
- The bitumen boiler should be filled with bitumen with sufficient space left for expansion of bitumen. It should be loaded with that much quantity of bitumen so as to avoid keeping hot bitumen continuously at high temperature for long periods.
- The heating process has to be controlled depending on the quantity of bitumen in the boiler, the outlet for bitumen should be leak-proof and the boiler should be covered when not in use.
- The boiler should have a chain pulley type of loading arrangement for lifting bitumen drums.
- Hydrogen Sulphide Gas: In view of the possible presence of hazardous concentrations of hydrogen sulphide gas in the vapour space in hot bitumen storage tanks or vessels appropriate precautions must be taken when opening or entering tanks, vessels or other containers to avoid inhalation of this acutely toxic gas. Gas detectors, available for rapid monitoring of hydrogen sulphide gas, should be used for suitability of atmospheres for safe entry into such storage spaces. Personal alarms for hydrogen sulphide could be used as a further safeguard. Advice on selection of suitable respiration and other protective devices could be obtained from a health and safety specialist.
- Protective Clothing: Labourers attending to the process of heating bitumen or its application should be provided with hand gloves, gumboots, face masks and goggles to ensure adequate personal safety and as a guard against any accidental contact with any bitumen or bitumen derivatives. They should wear full sleeve shirts and full-length trousers to ensure that they have the least exposure to bitumen.
- Facilities: Workers should be provided with adequate washing facilities viz. warm water mild soap, mild skin cleanser, and clean (preferably disposals) towels.
- Awareness about thorough washing of skin after handling bitumen materials should be encouraged through various educational means.
- First Aid:
    - In case of burn injury from hot bitumen falling on the body, first-aid may be done by thorough cooling of the affected part by cold running water up to 10 minutes or longer if layer is thick or by giving an ice pack. No attempt should be made to remove firmly adhering bitumen from the skin. It should either be allowed to fall of gradually or it may be removed when necessary by warm medicinal paraffin or a blend of paraffin and kerosene oil, remembering that kerosene oil may cause skin irritation. This shall be followed by washing with soap and water and then applying a skin cleansing cream. The burnt area should not be bandaged. The casualty should be taken to hospital for treatment without delay.

    - If bitumen is splashed into the eye it should be cooled immediately under cold running water for at least 5 minutes. Medical attention should be obtained.
    - First aid treatment for inhalation is only to be required if hydrogen sulphide is involved. If this is suspected, all necessary precautions must be taken including the use of breathing apparatus to avoid exposing rescuers to a contaminated atmosphere.
- Transportation:
    - Closed systems should be used for the handling and transportation of hot and cut-back bitumen. Transfer from storage tanks to point of use should be by mechanical means in order to minimize the possibility of skin contact or fume inhalation. The bitumen boiler containing hot bitumen should be shifted from site to site carefully by towing at slow speed to avoid splashing of bitumen.
    - When hot bitumen is added in a hot mix plant for mixing with hot aggregates, care should be taken to avoid burn injuries. In the case of manual handling of hot bitumen, buckets should never be filled to the brim with hot bitumen. In mixing plants, which have no separate pug mill for mixing of aggregates and bitumen and where heating is done in the drum itself, the burner flame should be reduced after adding bitumen to avoid overheating of bituminous mix.
- Spraying: Care should be taken when spraying of bitumen from perforated can sprayer or from bar sprayer. The spraying nozzle and the hosepipe should be kept thoroughly clean for smooth and uniform spraying of hot bitumen. Under no circumstances, the hosepipe should be disconnected as any pressure developed in the pumping unit may result in hot bitumen splashing and thus injuring the operator.

Batching Plant & Casting Yard

- The batching plant/casting yard shall be effectively planned for smooth flow of unloading and stacking the aggregates reinforcements and cement, batching plant, transport of concrete, casting the segment, stacking the segment and loading the segments to the trucks. As far as possible the conflicts should be avoided.
- The batching plant / casting yard shall be barricaded and made as a compulsory PPE zone
- If in case of material unloading area is not maintainable as PPE zone, the same shall be segregated properly and made as a non-PPE zone with appropriate barricading.
- Electrical system shall also be suitably planned so that location of diesel generator, if any, location of DBs, routing of cables and positioning of area lighting poles/masts does not infringe on any other utility and pose danger.
- Drainage shall be effectively provided, and waste water shall be disposed after proper treatment
- Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation.
- Manual handling of cement shall be avoided. Whenever it is absolutely necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.
- Access roads and internal circulation roads shall be well laid paved and maintained properly at all time.