



Public Works Department (Building & Roads) Punjab

OPRC for Improvement, Rehabilitation, Resurfacing & Routine Maintenance Works of Roads of Sangrur -Mansa - Batinda Contract Area



Environmental Impact Assessment Report S4: Mansa-Talwandi Sabo (up to intersection with B8:ODR9)

July 2013

PATTEL

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Private Limited
Camp: Sangrur, Punjab



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Making Infrastructure Happen

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Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

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ABBREVIATIONS

Abbreviations	Full Form	Abbreviations	Full Form
AAQ	Ambient Air Quality	NGO	Non Governmental Organisations
AAQMS	Ambient Air Quality Monitoring Station	NH	National Highway
AIDS	Acquired Immuno Deficiency Syndrome	NOC	No-objection Certificate
BOQ	Bill of Quantities	NO _x	Oxides of Nitrogen
BPL	Below Poverty Line	ODR	Other District Roads
CF	Conservator of Forest	PAF	Project Affected Family
CO	Carbon Monoxide	PAH	Project Affected Household
CoI	Corridor of Impact	PAP	Project Affected Person
CPCB	Central Pollution Control Board	PD	Project Director
DFO	Divisional Forest Officer	PF	Protected Forest
EIA	Environmental Impact Assessment	PIU	Project Implementation Unit
EMP	Environmental Management Plan	PPP	Public Private Partnership
FGD	Focus Group Discussions	PRBDB	Punjab Roads & Bridges Development Board
GO	Government Order	PWD	Public Works Department
Gol	Government of India	R&R	Resettlement and Rehabilitation
GoP	Government of Punjab	RAP	Resettlement Action Plan
GWQMS	Ground Water Quality Monitoring Station	RF	Reserved Forest
IMO	Indian Meteorological Organization	RHS	Right Hand Side
IRC	Indian Roads Congress	ROW	Right of Way
IS	Indian Standard	SH	State Highways
LHS	Left Hand Side	SO ₂	Sulphur Dioxide
MDR	Major District Roads	SPCB	State Pollution Control Board
MoEF	Ministry of Environment and Forests	PM	Particulate Matter
NAAQS	National Ambient Air Quality Standards	SWQMS	Surface Water Quality Monitoring Station
NBWL	National Board of Wildlife	TDS	Total Dissolved Solids



0 EXECUTIVE SUMMARY

0.1 PROJECT BACKGROUND

Output and Performance based Road Contract is designed to increase the efficiency and effectiveness of road asset management and maintenance. It ensures that the physical condition of the roads under contract is adequate for the needs of road users, over the entire period of the contract which is normally several years. The OPRC as a model for road asset management is similar to Design, Build, Maintain, Operate and Transfer (DBMOT) model of contracts which addresses the issue of inadequate incentives. Minimum road conditions and Service Levels are defined through output and performance measures, and these are used under the OPRC to define and measure the desired performance of the Contractor. In the OPRC, the defined performance measures are thus the accepted minimum thresholds for the quality levels of the roads for which the Contractor is responsible and covers all aspects of the contract. Patel Infra has been appointed as the Contractor for the project by the project proponent

0.2 NEED OF THE PROJECT

- Provide easy access to commuters from Mansa to Talwandi Sabo
- The road links SH-17 (between Bhatinda -Rori section) with SH13 (Barnal - Sirsa section)
- Caters to the traffic growth pegged at 7.20% for Car, 4.00% for 2W, 3.20% for Bus, 5.77% for LCV, 2.61% for 2AT, 5.90 for MAV Beyond 2022.

0.3 PROJECT ROAD

The project road Mansa-Talwandi Sabo (up to intersection with B8) section of ODR 9 is 24.970 Km long and starts from Km. 0.000 at Mansa at Junction with SH13 and ends at Talwandi Sabo at intersection with SH 17 at Km 24.970. The proposed length of the project road is also 24.970 Km.

0.4 PROJECT INFLUENCE AREA

The project districts are Bhatinda & Mansa districts in Punjab State. The districts are bounded by Haryana in the South, Muktasar district in the west, Sangrur district in east & Moga, Barnala and Faridkot districts in north. The average existing Right of Way (RoW) is 25.15 m as per records and Specifications of the contract. The proposed RoW is also 25.15 m and the average Corridor of Impact (CoI) is thus approx. 30 m. The project area as per MoEF guidelines is 500 m on either side of the project corridor i.e., a total of 1 Km.

0.5 PROJECT PROPONENT

The project proponent is PWD R&B, Government of Punjab.

0.6 PROPOSED IMPROVEMENTS

The project highway presently is an intermediate lane carriageway for 24.970 Km. To cater to the future traffic, the project proposes to:

- 2 lane configuration of 3.50m carriage way with 1.5m hard shoulder and 1m earthen shoulder except in urban / semi urban areas where covered drains & footpath are proposed
- 2 Typical Cross Sections (E1 & E2) for improvement works with widening of 2 lane with paved shoulder status of the project road has been proposed as per Specifications and Contract Works of the project
- Both side minimum directional cross-fall of 0.5% proposed for the pavement, 1% for paved shoulders & 1% for earthen shoulders.

0.7 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) STUDY IN THE PROJECT

The study methodology for the EIA employs a simplistic approach in which the important environmental issues have been identified during the Environmental Screening phase. Based on the identification baseline data was generated and then analysed to predict the impacts and quantify them.

0.8 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

0.8.1 Institutional Setting

The responsibility of implementing the mitigation measures lies with Patel Infra and all the construction activities being taken up by M/s Patel Infra. The PMC M/s Feedback Infra shall monitor the implementation of the work on behalf of Patel Infra, who will be responsible for planning all Environmental

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Management Plan (EMP) activities in the construction phase of the Project.

0.8.2 Clearances

As part of the project preparations, the Project Proponent shall take the following clearances and NOCs:

- Tree felling permission from Divisional Forest Officer / District Administration
- Forest Clearance as per Forest Conservation Act, 1980 as Diversion of Protected forest land

Apart from the clearances Patel Infra shall also obtain the required clearances NOCs & licenses from the various agencies & authorities prior to his work initiation. These are:

- NOC and Consents under Air, Water, EP Acts & Noise rules of SPCB for establishing and operating plants from Punjab SPCB. The NOC shall be made available after the SPCB completes the process of conducting Public Hearing of the project (which shall be carried out as per the Prior Environmental Clearance process)
- NOC under Hazardous Waste (Management and Handling) Rules, 1989 from SPCB
- PUC certificate for use of vehicles for construction from Department of Transport
- Quarry lease deeds and license and Explosive license from Dept. of Geology and Mines & Chief controller of explosives
- NOC for ground water extraction for construction and allied works from Ground Water Authority

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

- Clearance of Engineer for location and layout of Worker's Camp, Equipment yard and Storage yard.
- Clearance of Engineer for Traffic Management Plan for each section of the route after it has been handed over for construction.
- An Emergency Action Plan should be prepared by Patel Infra and approved by the Engineer for accidents responding to involving fuel & lubricants before the construction starts.
- Submit a Quarry Management Plan to the Engineer along with the Quarry lease deeds

0.9 BASELINE ENVIRONMENTAL PROFILE

0.9.1 Physical Environment

Climate

The climate of the project districts are on the whole dry and are characterized by a short monsoon, a hot summer and a bracing cold winter. The year may be divided into four seasons. The cold season from November to March is followed by the hot season lasting up to the end of June. The period from July to mid-September constitutes the rainy season, of south-west monsoon, the second half of September and October may be termed the post-monsoon or transition period.

Geology

Geologically the project districts Mansa & Bhatinda are occupied by Indo-gangetic alluvial plain of Quaternary age. The geological formations met within the districts comprise Alluvium of Quaternary age. It consists of alternating beds of sand, silt and clay

Soil

The district Bathinda has two types of soils, the arid brown soils and siezoram soils. The arid brown soils are found in mostly eastern parts of the district and siezoram soils are found in the western part of the district. The major soil types in Mansa district is Clayey Loam Sandy Loam. The district Mansa mainly consists of flat and level plains interrupted by sand dunes in south-western part.

Ambient Air Quality

The air quality in the project area is moderately polluted. The concentrations of all pollutants except PM₁₀ are well within the prescribed limits of the National Ambient Air Quality Standards. This may be due to the dust generated from thrashing of Wheat crop in the agricultural field in addition to plying of heavy traffic such as trucks and other combustion engine vehicles in nearby roads.

Noise Quality

The noise monitoring survey reveals noise levels are well within the limit as stipulated by CPCB. Noise, though is a major area of concern, at locations of sensitive receptors (educational establishments like



schools and colleges, health units etc.) identified quite close to the road.

Water Hydrology and Drainage

All the blocks in the project area falls under over exploited zones as per Ground Water Information Booklet, CGWB. The post monsoon ground water table varies from 3.89 to 12.36 mbgl in Mansa & 4.17m-16.76mbgl in Bathinda. Various nallahs and canals at different locations have intersected the project corridor. All along the project road, within the ROW some hand pumps are present. These community owned resources are the major sources of potable water. Water samples from ground water resources were collected to assess ground water quality impacts. These samples were analysed for various physical parameters and chemical parameters to know the contamination level and have been found to be within limits set by the Bureau of Indian Standards for drinking water and surface water quality for bathing.

0.9.2 Biological Environment

Forest Resources

The plantation along highways within ROW is notified as protected forest in the state of Punjab. Hence the status of plantation area along both side of the project road within ROW of the existing project section is protected forest. The project road section is existing highway and the widening and upgrading will be performed on land adjoining to the existing alignment only. Road side plantations along the project road will be impacted due to the proposed widening work. However, no other forest land shall be diverted for the project. There are though some forest areas within the project area but are quite away from the project road.

Protected Areas / Eco-sensitive Zones/ Animal Corridor

The project road doesn't falls within 10 Km radius of any Protected Natural Habitats (Biosphere Reserves, National Parks and Sanctuaries).

Further there are no Wildlife Habitats (outside designated protected areas) including bird habitats, aquatic habitats, as relevant in the project area.

Trees within ROW

There are number of trees within the proposed ROW are likely to be affected.

Flora & Fauna

The dominant flora along the project road are *Albizzia procera*, *Prosopis julifera*, *Dalbergia sissoo*, *Terminalia arjuna*, *Eucalyptus* sp., *Azadirachta indica*, *Pongomia pinnata*, *Acacia nilotica*, *Ficus bengalensis*, & A number of giant trees (mainly *Ficus* species) are present along the corridor. These trees are though present mainly near the settlements. Some trees might become potential traffic safety hazard since the road is proposed for widening. Care though shall be taken during the construction to avoid felling of these giant trees and mitigation measures shall be devised.

Avenue plantation is present almost all throughout the road and the presence of green tunnel is quite common for quite a length. The green tunnels are caused mainly by tree species such as *Acacia nilotica*, *Eucalyptus* sp, & *Prosopis julifera*. **No vulnerable, threatened, endangered species of flora and fauna are reported**

0.9.3 Social Environment

Census Profile

The project highway passes through the district of Mansa & Bhatinda in Punjab. As per the 2011 census, Punjab has a total population of 2, 77, 04,236 and the total male and female population in the state is 1, 46, 34,819 and 1, 30, 69,417 respectively. The population density per sq km is 550. The literacy rate of the state is 76.7 % while the sex ratio is 893. The sex ratio, literacy rate and density of the project districts are less than the state level.

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

Workforce in Project area

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

Linguistic Distribution



Punjabi is the major language spoken by the majority of the people in the project corridor.

Settlement

There are a total of 7 major settlements varying in size and populations along the project corridor.

Educational Institutes

Some of the couple of educational institutions are located on the edge of the road and is a serious concern from the point of safety. Signage and Safety measures need to be built in the proposed road design at these locations.

Places of Historical Importance / Cultural Heritage

There are no Historical Importance / Cultural Heritage structures on the project road, though a number of such locations are present in the project districts.

Cultural Properties

The project highway traverses through a number of settlements and there are some religious and cultural properties which though not of archaeological significance are nevertheless, significant to the community.

Agriculture Pattern

The major occupation of the project districts is agriculture. Major crops are maize, wheat, barley, etc.

Highway Amenities

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

Land Use / Acquisition of the Proposed Corridor

No land acquisition has been proposed as the developmental activity will take place within available ROW.

0.10 PUBLIC INTERACTIONS & CONSULTATION

Public Interactions & consultations were conducted during the project preparations. The main purpose of these consultations was to know the community's reaction to the perceived impact of proposed project on the people at individual and settlement level. The issues of the most concern were related to rehabilitation and resettlements and have been dealt in social assessment report. It was also felt during the public consultation process that most of the people are aware about the project but they did not appreciate environmental problems associated with road projects. However, some people were concerned about environmental issues, mainly air and noise pollution. The issues raised by the public shall be duly incorporated in project design.

0.11 POTENTIAL ENVIRONMENTAL IMPACTS

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

0.11.1 Impacts on Climate

Impact on the climate conditions from the proposed road project widening will not be significant as no major deforestation and / or removal of vegetation is involved for the project.

0.11.2 Impact on Air Quality

There will be rise in PM levels during the construction activities, which shall again be within prescribed limit after the construction activities are over. CO level shall remain within prescribed standards.

0.11.3 Impact on Noise Levels

The impact of noise levels from the proposed project on the neighbouring communities is addressed. It has been concluded that both day and nighttimes equivalent noise levels are within the permissible limits

right from start of project life. Noise sensitive receptors have been identified along the project road.

0.11.4 Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area. Contamination to water bodies may result due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants. This will be more prominent in case of locations where the project road crosses rivers, canals distributaries, etc. Mitigation measures have been planned to avoid contamination of these water bodies.

0.11.5 Impact on Ecological Resources

There is no major loss of vegetation hence adverse impact in terms of availability of nesting sites for the bird doesn't arise. But on the long run the project shall have a positive impact due to the compensatory forestation and avenue plantation.

0.11.6 Impact on Land

During the construction of the proposed project, the topography will change due to excavation of borrow areas, stone quarrying, cuts and fills for project road and construction of project related structures etc. Provision of construction yard for material handling will also alter the existing topography. The change in topography will also be due to the probable induced developments of the project. Benefits in the form of land levelling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

0.11.7 Impact on Human Use Values

The PAPs shall be compensated as per the RAP. Accidents are bound to increase coupled with ribbon development. There shall also be some impacts on cultural or religious properties along the corridor.

0.12 ANALYSIS OF ALTERNATIVES

Detailed analyses of the alternatives have been conducted taking into account both with and without project

0.13 MITIGATION AVOIDANCE AND ENHANCEMENT MEASURES

Both generic and site specific mitigation and enhancement measures have been planned for identified adverse environmental impacts. The construction workers camp will be located at least 500m away from habitations. The construction yard, hot mix plants, crushers etc. will be located at 500m away from habitations and in downwind directions. Adequate cross drainage structures have been planned to maintain proper cross drainage. In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:2 i.e. for every tree to be cut, two trees will be planted. The project shall also witness the plantation of trees for providing aesthetic beauty and shade. As the space for compensatory afforestation might not be adequate along the project road, this plantation shall be taken up by the forest department, after payment of the cost for raising and maintaining the saplings for three years. The project will take an opportunity to provide environmental enhancement measures to improve aesthetics in the project area. The planned environmental enhancement measures include plantation in available clear space in ROW, enhancement of water bodies etc. In order to avoid contamination of water bodies during construction sedimentation chambers, oils and grease separators, oil interceptors at storage areas and at construction yard have been planned.

0.14 INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

The responsibility of implementing the mitigation measures lies with Patel Infra and all the construction activities being taken up by M/s Patel Infra. The PMC M/s Feedback Infra shall monitor the implementation of the work on behalf of Patel Infra, who will be responsible for planning all Environmental Management Plan (EMP) activities in the construction phase of the Project.

To mitigate the potential negative impacts of OPRC Link road, an Environmental Monitoring Plan is developed typically to identify the mitigation measures to be undertaken during construction, and operation stages. The formulation of an appropriate environmental monitoring plan and its diligent implementation is the key to overall success for the project.

0.15 ENVIRONMENTAL MANAGEMENT PLAN

Project specific environmental management plan have been prepared for ensuring the implementation of the proposed measures during construction phase of the project, implementation and supervision responsibilities The cost for environmental management during construction is INR 0.227crores.

0.16 CONCLUSIONS

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

1 INTRODUCTION

1.1 INTRODUCTION

Output and Performance based Road Contract is designed to increase the efficiency and effectiveness of road asset management and maintenance. It ensures that the physical condition of the roads under contract is adequate for the needs of road users, over the entire period of the contract which is normally several years. The OPRC as a model for road asset management is similar to Design, Build, Maintain, Operate and Transfer (DBMOT) model of contracts which addresses the issue of inadequate incentives. Minimum road conditions and Service Levels are defined through output and performance measures, and these are used under the OPRC to define and measure the desired performance of the Contractor. In the OPRC, the defined performance measures are thus the accepted minimum thresholds for the quality levels of the roads for which the Contractor is responsible and covers all aspects of the contract.

1.2 NEED OF THE PROJECT

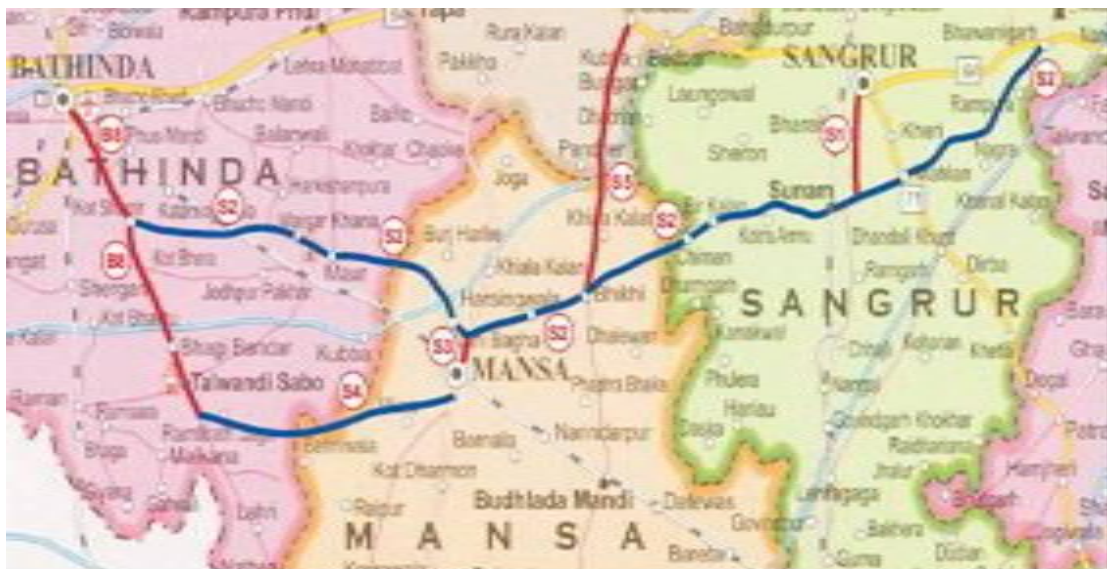
- Provide easy access to commuters from Mansa to Talwandi Sabo
- The road links SH-17 (between Bhatinda -Rori section) with SH13 (Barnal - Sirsa section)
- Caters to the traffic growth pegged at 7.20% for Car, 4.00% for 2W, 3.20% for Bus, 5.77% for LCV, 2.61% for 2AT and 5.90 for MAV Beyond 2022.

1.3 PROJECT ROAD

The project road Mansa-Talwandi Sabo (up to intersection with B8) section of ODR 9 is 24.970 Km long and starts from Km. 0.000 at Mansa at Junction with SH13 and ends at Talwandi Sabo at intersection with SH 17 at Km 24.970. The proposed length of the project road is also 24.970 Km.

The location of the project road is presented in Figure 1.1.

Figure 1-1: Location of Project Road



1.4 PROJECT INFLUENCE AREA

The project districts are Bhatinda & Mansa districts in Punjab State. The districts are bounded by Haryana in the South, Muktasar district in the west, Sangrur district in east & Moga, Barnala and Faridkot districts in north. The average existing Right of Way (RoW) is 25.15 m as per records and Specifications of the contract. The proposed RoW is also 25.15 m and the average Corridor of Impact (CoI) is thus approx. 30 m. The project area as per MoEF guidelines is 500 m on either side of the project corridor i.e., a total of 1 Km.

1.5 PROJECT PROPONENT

The project proponent is PWD R&B, Government of Punjab.

1.6 CONTRACTOR

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
Consultant: Feedback Infra Pvt. Ltd

The Contractor for the project is Patel Infrastructure Pvt. Ltd. (Patel Infra)

1.7 SCOPE OF WORK

The objectives of the EIA include:

- Collection and analysis of baseline environmental data on various components of the environment
- Identification of impacts and determination of the magnitude of environmental impacts so that due consideration is given to them during design, construction & operational phases of the road project.
- Identification of areas and aspects, which are environmentally or socio-economically insignificant.
- Suggestion of mitigation measures and preparation of Environmental Management Plans for enhancing and mitigating the negative impacts and strengthening the beneficial impacts.
- Economical assessment of project from the environmental point of view and preparation of environmental budget for implementation of mitigation measures.
- Development of the road alignment in such a way that the environment and settlements are affected the least.
- Presentation of public consultation and public view on various aspects of environment and the project.

1.8 PROPOSED IMPROVEMENTS

The project highway presently is an intermediate lane carriageway for 24.970 Km. To cater to the future traffic, the project proposes to:

- 2 lane configuration of 3.50m carriage way with 1.5m hard shoulder and 1m earthen shoulder except in urban / semi urban areas where covered drains & footpath are proposed
- 2 Typical Cross Sections (E1 & E2) for improvement works with widening of 2 lane with paved shoulder status of the project road has been proposed as per Specifications and Contract Works of the project
- Both side minimum directional cross-fall of 0.5% proposed for the pavement, 1% for paved shoulders & 1% for earthen shoulders.

1.9 APPROACH TO EIA

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

1.9.1 Preliminary Environmental Screening

A Rapid Assessment Survey (RAS) was undertaken to identify the Valued Ecosystem Components (VECs) and were categorised into various environmental components for screening and to assess their subsequent impacts due to the project as per the table below.

Table 1-1: Valued Ecosystem Components

Sl. No.	Environmental Attributes	Valued Ecosystem Components
1	Topography	Terrain (Hilly to Rolling to Plain)
2	Land use	Agriculture: (Irrigated, Un-irrigated); Settlements; Forest; Notified Industrial Area / Estate; Grazing; Fallow; No Development zone etc.
3	Water resources	Water bodies like rivers, canals, reservoirs, lakes and ponds – Crossings as well as water bodies within 100 m on either side of the existing Centre line
4	Forests & Wild Life	<ul style="list-style-type: none"> • Designated Protected Areas like Biosphere Reserves, Terrestrial or Marine National Parks, Sanctuaries, Tiger / Elephant Reserves, Coastal Regulation Zone etc.) within 15 Km (aerial distances) from the proposed project location boundary • Migratory route / crossing of wild animals and birds crossing project road • Presence of RF, PF other forests within 100m on either side of the existing Centre line
	Road side Plantations	Green Tunnels, Strip Plantation
5	Settlements	Towns and villages abutting the road corridor
6	Sensitive Receptors	Sensitive receptors such as educational and health facilities within COI
7	Drinking water	Total number of drinking water sources (wells, hand pumps, community water points /

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Sl. No.	Environmental Attributes	Valued Ecosystem Components
	sources	taps etc.) within COI
8	Religious Structures	Temples, shrines, mosque, church, gurudwara etc. within COI
10	Cultural Properties	Number (total) of cultural properties (protected/ unprotected archaeological monuments) within 500m from the road
11	Market Places	Number (total) of weekly market places / haats; grain / fruit / vegetable / fish market; cattle market within COI
12	Common Property Resources	CPRs such as pastures / grazing lands; seating areas of the community; cremation/burial grounds etc. within / along the RoW (All CPRs other than religious structures, drinking water sources and bus stops) within COI
13	Other features	Flood Plains; Soil Erosion; stone quarries etc.

1.9.2 Review of Applicable Environmental Regulations

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

1.9.3 Assessment of Baseline Environmental Profile

The baseline conditions of the project area were studied. Data pertaining to all facets of environment which include physical, ecological, and socioeconomic environment both through primary and secondary sources were collected. Key relevant information sources has been summarised in table below. Ambient air & noise, ground and surface water samples were monitored at various locations identified along the corridor. The monitoring and analysis for each component were carried out as per MoEF and CPCB guidelines. The results of the monitoring were compared with the relevant national standards.

As part of the baseline environmental profile, a detailed tree inventory along the RoW was carried out earlier based on their chainage, species, girth and distance from the carriageway. All trees with a girths size more than 30cm that are falling within the proposed ROW were and marked on the ground. Based on the survey a tree schedule was prepared for submission to the authorities.

In order to quantify the impacts of the project road on various receptors a survey was carried out. The receptors included educational institutes, hospitals, cultural & religious properties and community properties.

Table 1-2: Primary and Secondary Information Sources

Environmental Parameters	Information Sources
Project objectives, Technical information on existing road features	Design Report
Inventory of road features like water Bodies, Community structures, environmentally sensitive locations areas, congested locations etc.	Ground Physical surveys
Climatic Condition & Meteorological data	SPCB, Envis and other Websites, District Groundwater Brochure of CGWB, Feasibility report, primary data collection
Geology, Seismicity, Soil and Topography	State of Environment report published by SPCB, government websites, District Groundwater Brochure of CGWB & primary data collection
Land Use / Land Cover	Survey of India (Sol) Toposheet, Satellite maps and Observation during surveys
Drainage Pattern	Survey of India Toposheet, District Groundwater Brochure of CGWB, field observation and local people
Status of forest areas, Compensatory afforestation norms etc.	Divisional Forest Office
Air quality Noise, Soil and Water	Onsite monitoring and Analysis of Field samples
Borrow Areas, Quarries and other construction material source	Material Surveys and public consultations
River geo-morphology, hydrology, drainage, flood patterns	Feasibility report and information from local people, field observations
Socioeconomic Environment	Official websites maintained by state Govt., Census of India 2001 & 2011 and Public Consultation during the Field survey

1.9.4 Consultations

Consultations with community members, PAPs Focus Group Discussions with teachers, women groups

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and others and stakeholder meetings were carried out. The feedback generated through these meetings has been incorporated as far as possible in the design and construction of the road. The consultation process shall continue even during the implementation stage to gauge the general opinion. The details are elaborated in chapter 5.

1.9.5 Assessment of Impacts

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

1.9.6 Assessment of Alternatives

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

1.9.7 Mitigations and Enhancement Measures

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

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

1.9.8 Environmental Management Action Plans

The EMP shall detail out the implementation of the proposed mitigation and enhancement measures. A detailed study of the following has been carried out:

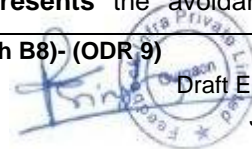
- Prediction and addressal of impacts on the various environmental components;
- Site specific designs for the mitigation measures provided;
- Site specific enhancement designs for water bodies, seating places etc.;
- Traffic management plans during construction; and
- Monitoring mechanisms and indicators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

1.10 STRUCTURE OF THE REPORT

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

- Chapter - 2 Project Description** describes the existing features and also discusses the various proposed improvement programmes along the corridor;
- Chapter - 3 Policy, Legal and Administrative Framework** reviews the existing set-ups relevant to the project, at the National and the State levels;
- Chapter - 4 Baseline Environmental Profile** describes the entire picture of the existing environmental set up of the project;
- Chapter - 5 Public Interactions, Consultations** describes consultations carried out and people's perceptions of the project benefits and the potential impacts;
- Chapter - 6 Impacts Assessment** identifies and assesses the potential impacts on each of the environmental components due to the proposed project development;
- Chapter - 7 Analysis of Alternatives** discusses the various alternatives for the project stretch along with the criteria for analysis and evaluation;
- Chapter - 8 Mitigation, Avoidance and Enhancement Measures** presents the avoidance and

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)



mitigation and enhancement measures suggested on each of the environmental components;

Chapter - 9 Implementation Arrangements gives a brief about the present implementation arrangements for environmental components of the **project**

Chapter - 10 Environmental Management Plan & Monitoring Schedule details both the generic and specific EMPs for the project road, compliance monitoring; This chapter also includes the Environmental Budget

Chapter - 11 Borrow Areas Study provides the details of the borrow areas required for mining of soil / earth for the project

Chapter - 12 Disclosure of the Consultant provides the details of the consultants engaged along with their capabilities and experiences.



2 PROJECT DESCRIPTION

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

2.1 EXISTING ROAD FEATURES

2.1.1 Alignment

- The project highway presently is an intermediate lane carriageway for 24.970 Km
- Earthen shoulder of 0.5 to 1.0m width is observed on both sides along the project, paved shoulder is non-existent
- The entire project road is Flexible pavement.
- Average embankment height varies from 0.3 m to 1.0 m
- There are approximately 7 left hand and 4 right hand Horizontal curves

Table 2-1: Existing Cross Section details

Carriageway Width (m)	Earthen Shoulder Width (m)	Embankment Height (m)
5.5	1.0	0.3 – 1.0

Figure 2-1: Photographs of Project Road



2.1.2 Right of way

- The present right of way along the project stretch is in general 25.15 m (average).

2.1.3 Road inventory

- The road has 33 minor intersections. The road inventory details are given in Engineering Report.

Table 2-2: Existing Road Inventory

Major Intersection	Minor intersection	Major bridges	Minor bridges	PUP	Level Crossing	Flyovers	Culverts		ROB / RUB	
							Box / slab	Pipe	RO B	RU B
-	33	-	-	-	-	-	7	94	-	1

Source: Primary Road Inventory Survey

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2.1.4 Traffic

The project road section had been divided into 1 homogenous section. The traffic was counted in 1 location all along the project road. The average daily traffic along the project road is 2241 PCUs. The traffic is mainly mixed traffic.

2.2 PROPOSED ROAD FEATURES

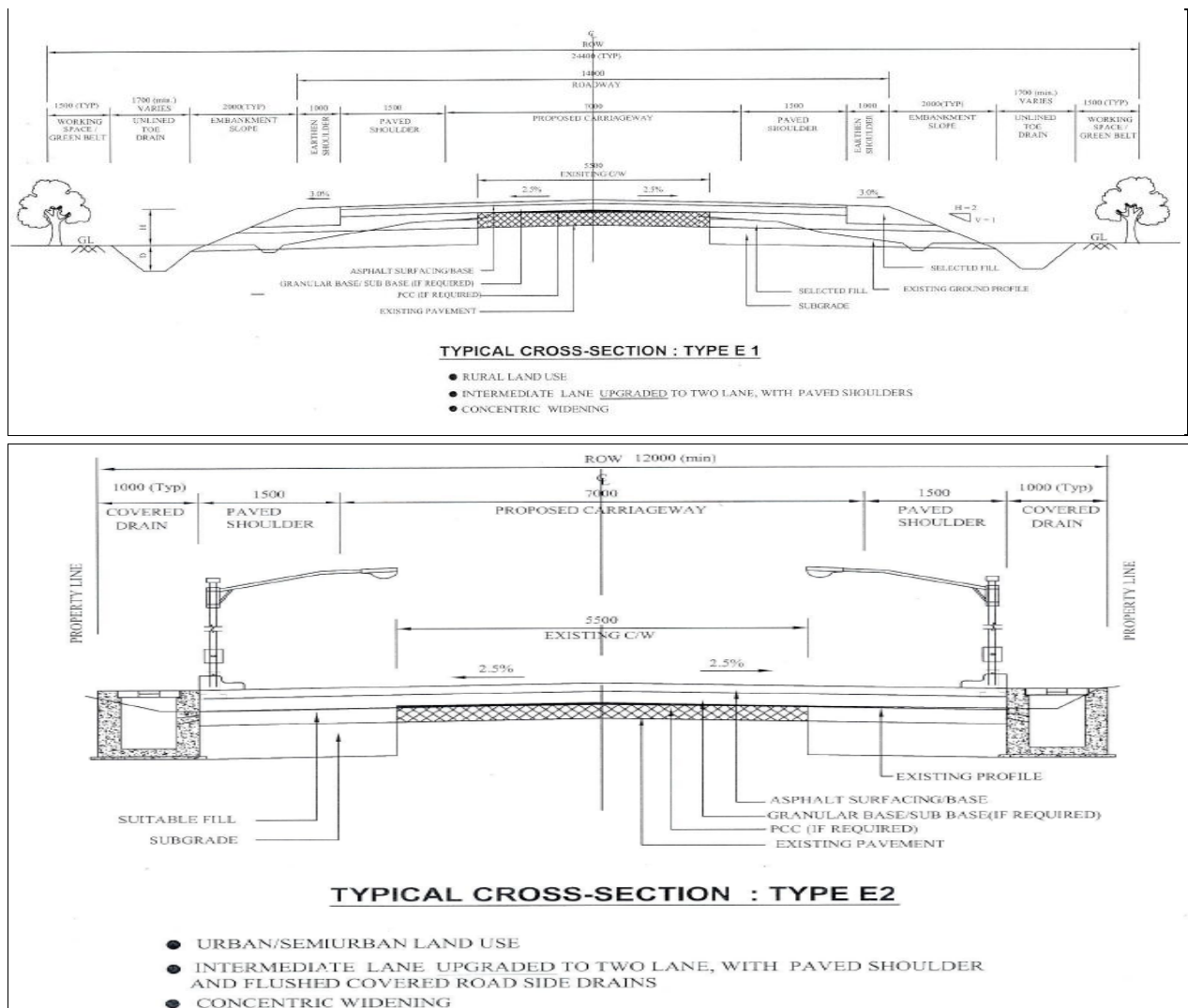
2.2.1 Alignment

- The length of the project road is 24.97 Km.
- 2 lane configuration of 3.50m carriage way with 1.5m hard shoulder and 1m earthen shoulder except in urban / semi urban areas where covered drains & footpath are proposed
- 2 Typical Cross Sections (E1 & E2) for improvement works with widening of 2 lane with paved shoulder status of the project road has been proposed as per Specifications and Contract Works of the project
- Both side minimum directional cross-fall of 0.5% proposed for the pavement, 1% for paved shoulders & 1% for earthen shoulders.

2.2.2 Geometric Design Aspects

- Minor improvements in geometrics is proposed along with widening of the existing road to 2 lane with paved shoulder status
- Design speed at urban is minimum 60kmph and in rural is minimum 80 & maximum 100 Kmph

Figure 2-2: Typical Cross Sections



Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

2.2.3 Right of Way

- Proposed RoW is in general 25.15 m (average).
- No Land acquisition is proposed.

2.2.4 Pavement

- Flexible pavements are proposed for all throughout the road

2.2.5 Bypasses and Realignment

- The project doesn't propose any bypasses and rehabilitations

2.2.6 Service roads

- No Service roads are proposed in the project road

2.2.7 Cross Drainage Structures

- The project road shall have the same CD structures as per existing which is given below

Table 2-3: Proposed Structures

Major bridges	Minor bridges	Box / Slab Culverts	Pipe Culverts	Total
-	-	7	94	101

2.2.8 Other Structures including Underpasses

- No underpasses, overpasses & flyovers proposed

2.2.9 Drainage

- Drains have been provided on both the sides for the entire length of the road
- The length of unlined drains is 2.800 Km while lined drains is 1.750 Km

2.2.10 Design of Intersections

All junctions have been studied thoroughly with respect to traffic volume and geometric design. The important junctions leading to settlements have been identified and proper junction layouts (including road marking, and traffic signs) shall be applied as per IRC-SP: 41-1994.

2.2.11 Traffic Control and Road Safety Features

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



3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This chapter reviews the existing institutional and legislative set-up pertaining to the project at the National and state levels. The chapter also elaborates on the various clearances and permissions required for the project from Government of Punjab, Ministry of Environment and forests, Government of India. This section elaborates on the various clearance requirements for the project from the State Government and MoEF, GoI.

3.1 ENVIRONMENTAL LEGISLATIONS AND THEIR IMPLICATIONS / APPLICATION

The Government of India has formulated various policy guidelines; acts and regulations aimed at protection and enhancement of environmental resources. The following table surmise the existing legislations pertaining to the project, the various clearances required for the project and the status as on date.

Table 3-1: Relevant Environmental Laws & Regulations

Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for Application	Implementing / Responsible Agency
1	The Environmental (Protection) Act, 1986, and the Environmental (Protection) Rules, 1987-2002 (various amendments)	Umbrella Act. Protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere.	Yes	All environmental notifications, rules and schedules are issued under the act	MoEF, State Department of Environment & Forest, CPCB and SPCB
2	The EIA Notification, 14th September 2006 & subsequent amendments	Identifies expansion of National highways greater than 30 Km involving additional ROW greater than 20m involving Land Acquisition and all new state highway projects & SH expansion projects in hilly terrain (above 1000 MSL) and or ecological sensitive areas (item 7 (f) of schedule) as one of the projects requiring prior clearance.	No	Project road is an ODR and neither a new state highway nor a SH expansion projects in hilly terrain (above 1000 MSL) and or ecological sensitive areas	MoEF / SEIAA
3	Notification for use of Fly ash, 3rd November 2009	Reuse fly ash discharged from Thermal Power Station to minimise land use for dispersal and minimise borrow area material. The onus shall lie with the implementing authority to use fly ash unless it is not feasible as per IRC	Yes	Thermal Power Station located in 100 Km radius of road	MoEF, SPCB
4	The Water (Prevention and Control of Pollution) Act, 1974	Central and State Pollution Control Board to establish/enforce water quality and effluent standards, monitor water quality, prosecute offenders, and issue licenses for construction/operation of certain facilities.	Yes	Consent required for not polluting ground and surface water during construction	State Pollution Control Board
5	The Air (Prevention and Control of Pollution) Act, 1981	Empowers SPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission.	Yes	Consent required for establishing and operation of plants	State Pollution Control Board
6	Noise Pollution (Regulation And Control) Act, 1990	Standards for noise emission for various land uses	Yes	Construction machineries and vehicles to conform to the standards for construction	State Pollution Control Board

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Sl. No.	Law / Regulation / Guidelines	Relevance	Applicable Yes / No	Reason for Application	Implementing / Responsible Agency
7	Forest (Conservation) Act, 1980	Conservation and definition of forest areas. Diversion of forest land follows the process as laid by the act	Yes	Diversion of Protected forest land	State Forest Department, MoEF
8	Coastal Regulatory Zone Notification, 1991	Protect and manage coastal areas	No	The project area is not within designated coastal zone	MoEF, State Department of Environment
9	Wild Life Protection Act, 1972	Protection of wild life in sanctuaries and National Park	No	No sanctuaries / national park along the project road	State Forest Department, MoEF
10	Ancient Monuments and Archaeological sites and Remains Act 1958	To protect and conserve cultural and historical remains found.	No	No Archaeological monument along the project road	Archaeological Survey of India, State Dept. of Archaeology
11	The Motor Vehicle Act. 1988	Empowers State Transport Authority to enforce standards for vehicular pollution. From August 1997 the "Pollution Under Control Certificate is issued to reduce vehicular emissions.	Yes	All vehicles used for construction will need to comply with the provisions of this act.	State Motor Vehicles Department
12	The Explosives Act (& Rules) 1884 (1983)	Sets out the regulations as to regards the use of explosives and precautionary measures while blasting & quarrying.	No	No new quarrying operation to be started by the concessionaire / contractor	Chief Controller of Explosives
13	Public Liability And Insurance Act, 1991	Protection to the general public from accidents due to hazardous materials	Yes	Hazardous materials like Bitumen shall be used for road construction	State Pollution Control Board
14	Hazardous Wastes (Management and Handling) Rules, 1989	Protection to the general public against improper handling and disposal of hazardous wastes	Yes	Hazardous wastes shall be generated due to activities like of maintenance and repair work on vehicles	State Pollution Control Board
15	Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996	Protection against chemical accident while handling any hazardous chemicals resulting	Yes	Handling of hazardous (flammable, toxic and explosive) chemicals during road construction	District & Local Crisis Group headed by the DM and SDM
16	Mines and Minerals (Regulation and Development) Act, 1957 as amended in 1972	Permission of Mining of aggregates and sand from river bed & aggregates	No	No mining of sand or aggregates. These materials shall be procured from approved agencies	State Department of Mining
17	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) BOCW Act, 1996	Employing Labour / workers	Yes	Employment of labourers	District Labour Commissioner

3.2 ENVIRONMENTAL CATEGORIZATION

This project doesn't falls either under Category 'A' or 'B' project as far Prior Environmental Clearance is



concerned, as this project doesn't satisfies all the criteria laid under the purview of the EIA Notification of September 2006 and its subsequent amendments. The project road is neither a new state highway nor a SH expansion projects in hilly terrain (above 1000 MSL).

Hence Prior Environmental Clearance is not required from State Environmental Impact Assessment Authority or MoEF. Thus a formal EIA is also not required as per the EIA Notification of September 2006 and its subsequent amendments.

3.3 WORLD BANK OPERATIONAL POLICIES

The Operational Policies of the Bank, both triggered and not triggered, the details and the applicability to the project road are provided in the table below. The World Bank environment assessment (EA) requirements are based on a three-part classification system such as Category A, Category B and Category C as defined by the World Bank OP 4.01. A project designated as 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 However, emphasis of the World Bank is in the integration of mitigation measures into the project design and mainstreaming environment in all stages of project planning, implementation and operation. **The project diverts protected forest land & shall have some environmental impacts as per screening. The project can be classified as Category B project and hence requires environmental analysis.**

Table 3-2: World Bank Safeguard Policies

Sl. No.	Safeguard Policy	Subject Category	Triggered	Triggered By	Mitigation Measures	Documentation
1.	OP 4.01	Environment Assessment	No	Some impacts on environmental and social components	Mitigation measures to be incorporated	EMP shall be prepared
2.	OP 4.04	Natural Habitats	No	No sanctuaries / national parks within the project area	Not Applicable	Not Applicable
3.	OP 4.09	Pest Management	No	Not applicable	Not applicable	Not Applicable
4.	OP 4.11	Physical Cultural Resources	No	Risk to cultural properties	Not Applicable	Not Applicable
5.	OP 4.36	Forestry	Yes	Diversion of forest land	To be carried out as per Forest (conservation) Act, 1980	Not Applicable
6.	OP 4.37	Safety of Dams	No	Not Applicable	Not Applicable	Not Applicable
7.	OP 7.50	International Waterways	No	Not Applicable	Not Applicable	Not Applicable
8.	OP 7.60	Disputed Area	No	Not Applicable	Not Applicable	Not Applicable

3.4 ENVIRONMENTAL PERMITS / APPROVALS REQUIRED

The summary table showing time requirements for agency responsible for obtaining clearance, and a stage at which clearance will be required is given below:

Table 3-3: Summary of Clearances & NOCs Applicable

Sl. No	Type of clearance	Statutory Authority	Applicability	Project stage	Time required
1	Forest Clearance	State Department of Environment and Forest and MoEF	Diversion of Protected Forest land	Pre-construction	6-9 months
2	Tree felling permission	State Department of Environment and Forest	Felling of trees	Pre-construction	1-2 months
3	NOC And Consents Under Air, Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For establishing plants	Construction (Prior to work initiation)	2-3 months

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Sl. No	Type of clearance	Statutory Authority	Applicability	Project stage	Time required
4	NOC And Consents Under Air, Water, EP Acts & Noise rules of SPCB	State Pollution Control Board	For operating Hot mix plants, Crushers and batching plants	Construction (Prior to work initiation)	1-2 months
5	Permission to store Hazardous Materials	State Pollution Control Board	Storage and Transportation of Hazardous Materials and Explosives	Construction (Prior to work initiation)	2-3 months
6	PUC certificate for use of vehicles for construction	Department of Transport	For all construction vehicles	Construction (Prior to work initiation)	1-2 months
7	NOC for water extraction for construction and allied works	Ground Water Authority	Ground water extraction	Construction (Prior to work initiation)	2-3 months

Table 3-4: Summary of Clearances & NOCs Not Applicable

Sl. No	Type of clearance	Statutory Authority	Reason
1	Prior Environmental Clearance	MoEF / SEIAA	Not a category A / B project
2	Permission for Activities near archaeological protected area	Archaeological survey of India / the state department of Archaeology	No Archaeological structures in the project road
3	Diversion of Sanctuary land	NBWL/Chief Wild Life Warden	Project road doesn't cross any sanctuary
4	Wild Life Clearance	NBWL/SBWL	No sanctuaries / national parks within the project area



4 BASELINE ENVIRONMENTAL PROFILE

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

4.1 PROJECT AREA

The project districts are Bhatinda & Mansa districts in Punjab State. The districts are bounded by Haryana in the South, Muktasar district in the west, Sangrur district in east & Moga, Barnala and Faridkot districts in north. The average existing Right of Way (RoW) is 25.15 m as per records and Specifications of the contract. The proposed RoW is also 25.15 m and the average Corridor of Impact (CoI) is thus approx. 30 m. The project area as per MoEF guidelines is 500 m on either side of the project corridor i.e., a total of 1 Km.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Climate and Meteorology

The climate of the project districts are on the whole dry and are characterized by a short monsoon, a hot summer and a bracing cold winter. The year may be divided into four seasons. The cold season from November to March is followed by the hot season lasting up to the end of June. The period from July to mid-September constitutes the rainy season, of south-west monsoon, the second half of September and October may be termed the post-monsoon or transition period.

➤ Temperature

Temperature starts rising from middle of February and from about the beginning of March increase rapidly till June which is generally the hottest month. The mean daily maximums temperature during June is around 40°C and the mean daily minimum is around 27°C. The heat is intense in summer. On individual days, the day temperature may occasionally exceed 47°C - 48°C. Scorching dust laden winds which blow during the hot season. Afternoon thunder showers also occur occasionally. With the onset of monsoon by the end of or the beginning of July, there is a drop in the day temperatures but nights continue to be as warm as in June. Due to increased humidity in the monsoon the weather is oppressive in between the rains. At the end of rainy season, by the middle of September, there is a decrease in temperature, the drop in the night temperatures being more rapid. After October, both day and night temperatures decrease rapidly. January is usually the coldest month with the mean daily maximum temperature at about 20°C and the mean daily minimum at about 7°C. In winter, particularly in January and February, cold waves in the wake of passing western disturbances affect the districts and the minimum temperature occasionally drops down below the freezing point of water. On such occasions frosts are likely in the districts.

➤ Humidity

During the south-west monsoon, season July to September the relative humidity is high, being 75 to 80 per cent in the mornings and about 55 to 65 per cent in the afternoons. High humidity of more than 70 per cent also prevails during the winter months, December to February. It is comparatively drier during rest of the year. April and May are the driest period of the year when in the afternoons the relative humidity is 25 per cent or less.

➤ Rainfall

Situated far away from the Himalayas, the districts get meagre rainfall. The average rainfall is 410mm in Bathinda district, the maximum (about 73%) falling in the months of July to September, July being the wettest month. The rainfall in the district increases from south-west towards the northeast and varies from about 490mm to 670mm. There is some rain, mostly in the form of thundershowers, during the pre-monsoon month of June. Some rain is also received with passing western disturbances during winter. The variation in the annual rainfall from year to year is large. On an average, there are 27 rainy days (i.e. days with rainfall of 2.5 mm or more) in a year in the district.

➤ Winds

Winds are generally light but do gain some strength during the late summer and early part of the monsoon season. In the south-west monsoon season winds from easterly and south-easterly directions are more

common with north-westerly blowing on some days. In the post-monsoon and winter seasons, the predominant wind direction is north-westerly. In the summer, winds are generally from north-westerly direction but on some day they blow from south-east.

4.2.2 Land

Terrain

Terrain is classified by general slope of the country across the highway alignment. Based on these criteria the project highway passes through plain terrain along the entire stretch. The project road is situated in Malwa region which is the area south of River Sutlej. The topography of Punjab can be divided into the upper portion of the sub-Shivalik area and the rest of Punjab (where the project road is located).

Geology

Geologically the project districts Mansa & Bhatinda are occupied by Indo-gangetic alluvial plain of Quaternary age. The geological formations met within the districts comprise Alluvium of Quaternary age. It consists of alternating beds of sand, silt and clay

Land Use

The highway passes through plain terrain along the entire stretch. The abutting land uses along the project road are barren & revenue, agricultural and settlement lands.

Figure 4-1: Photographs showing Land Use in Project area



Soil

The district Bathinda has two types of soils, the arid brown soils and siezoram soils. The arid brown soils are found in mostly eastern parts of the district and siezoram soils are found in the western part of the district. The major soil types in Mansa district is Clayey Loam Sandy Loam. The district Mansa mainly consists of flat and level plains interrupted by sand dunes in south-western part.

Samples of soil have been collected and are tested for the physical and chemical properties. The sampling and analysis of soil along the project corridor was carried out once during the month of May 2013 by **Envirotech East Pvt. Limited, Kolkata** on behalf of Feedback Infra Pvt. Ltd. The samples were collected by ramming a core-cutter into the soil up to 90-cm depth. Two locations are selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and homogenized. The homogenized samples were analysed for physical and chemical characteristics. The sealed samples were sent to laboratory for analysis. They were stored in air tight Polythene Bags and analysed at the laboratory as per standard procedure provided in IS: 2720.

Table 4-1: Details of Monitoring Station for Soil

Sl. No.	Monitoring Station Code	Road Section No.	Location	Land Use	Sampling Date
1	S7	S4- ODR9: Mansa – Talwandi Sabo(up to intersection with B8)	Talwandi Akali	Agricultural	24.05.2013
2	S8	B8- SH17: Bathinda-Kotsamir-Talwandi Sabo (Up to intersection with S4)	Talwandi saboo	Agricultural	24.05.2013

Results & Analysis of Soil Quality

The texture of the soil is sandy clay. Bulk density of soil in the study area varied between 1.35 - 1.38 gm. / cm³. The moisture content was moderate. The soil samples were slightly alkaline with the pH range varying between 8.30 to 9.10. The soil samples were poor in Organic Carbon content, with the values

ranging within 1.01% to 1.06%.

Table 4-2: Physico-chemical Analysis of Soil Quality

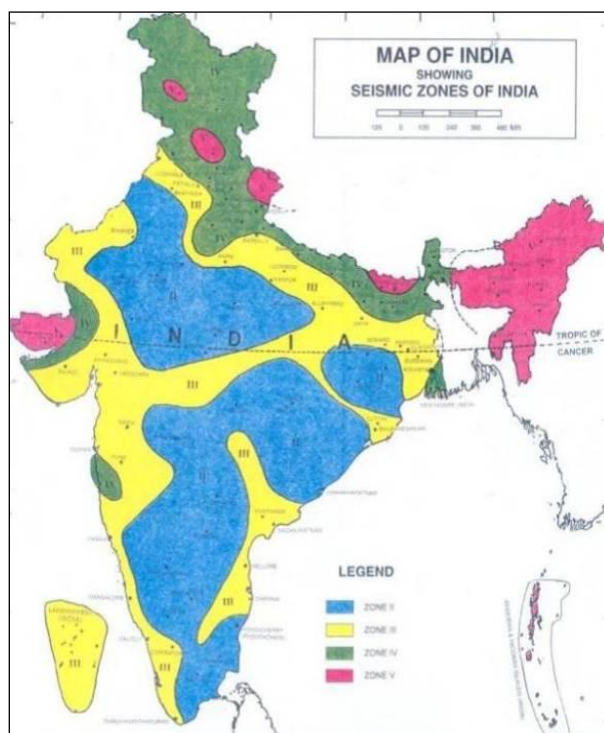
Sl. No.	Parameters	Unit	Concentration	
			Talwandi Akali	Talwandi Sabu
1	pH	-	9.10	8.30
2	Conductivity	umhos/cm	194	153
3	Bulk Density	g/cm ³	1.38	1.35
4	Porosity	%	38.56	39.20
5	Infiltration Rate	cm/hr.	1.51	1.62
6	Soil Texture	-	Sandy clay	Sandy clay
7	Clay	%	44	39
8	Silt	%	17	16
9	Sand	%	39	45
10	Soil Colour	-	Light brown	Brown
11	Organic Carbon	%	1.16	1.01
12	Organic Matter	%	2.00	1.74
13	Moisture	%	0.72	1.06

Source: Field Monitoring

Seismicity

The north-eastern part of India in Punjab State where the project road lies comes under the stable seismic zone. The entire stretch of the project highway traverses through sub category seismic zone II of seismic zoning classification system as defined by the Seismic Zoning Committee¹. Zone - II is most stable and Zone - V is considered to be least stable. In the revision of the seismic zones in year 2000, the seismic Zone - I has been merged in Zone - II by BIS. The project corridor thus is in a zone of stability.

Figure 4-2: Seismic Zones of India



Source: National Atlas Thematic Mapping Organisation, Govt. of India

¹ IS 1893 (Part 1):2002 'Criteria for Earthquake Resistant Design of Structures: Part 1 General provisions and Buildings'

4.2.3 Ambient Air Quality

The monitoring of the ambient air quality (AAQ) for the various land uses along the project corridor was carried out at a frequency of twice in a week at each station in the months of March, April & May 2013, by **Envirotech East Pvt. Limited, Kolkata on behalf** of Feedback Infra Pvt. Ltd. Monitoring was carried out by taking 24 hourly samples at each location as per guidelines of Central Pollution Control Board and the requirements of MoEF.

Baseline AAQ Monitoring

Air Pollution Monitoring Stations were selected with an idea of establishing correlation between pollution levels and road geometrics and air pollution and land use along the road. The methodology for the monitoring instruments and techniques has been in accordance to the guidelines laid by the Central Pollution Control Board (CPCB). The equipment was placed at a height of 3.5-4m above ground level at each monitoring station, for negating the effects of windblown ground dust. The equipment was placed at open space free from trees and vegetation, which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. With a view to collecting the samples for PM₁₀, So₂, NO₂ Envirotech Make Calibrated Respirable Dust Samplers (RDS-APM 460 BL) along with Gaseous attachment has been used. For collection of PM_{2.5} Fine Particulate Matter FPS-APM 550 has been used. Carbon Monoxide was collected 8 hourly and analysed by Non Dispersive Infra-Red Spectroscopy (NDIR). The APM-460 Respirable Dust Sampler has been provided with a cyclone. The cyclone has been designed to provide separation of PM₁₀ particles. Atmospheric air was drawn for ~24 hours through the cyclone and 20 X 25 cm glass fibre filter (GF/A) sheet at a flow rate of 0.8 to 1.2 m³min⁻¹ and finally the average flow rate was calculated. As the air with suspended particulate enters the cyclone, coarse non-respirable dust is separated from the air stream by centrifugal forces. The suspended particulate matter falls through the cyclone's conical hopper and gets collected in the cyclonic-cup. The fine dust comprising the respirable fraction passes through the cyclone and gets collected on GFF. The amount of respirable particulate per unit volume of air passed was calculated on the basis of the difference between initial and final weights of the filter paper, and the total volume of the air drawn during sampling. For gaseous (SO₂ and NO₂) sampling the impingers was exposed for ~24 hour at an impingement rate of 0.2 lpm. SO₂ was analysed by the West-Gaeke method on UV-Visible Spectrophotometer (Systronics) at wavelength of 560 nm. NO₂ was analysed employing the Jacob- Hochheiser modified method on spectrophotometer at wavelength of 540 nm. APM 550 Fine Particulate Sampler (Envirotech make) was used for measuring PM_{2.5}. This system is method for sampling fine particles (PM_{2.5} fraction) and is based on impactor designs standardized by USEPA for ambient air quality monitoring. Then PM_{2.5} is estimated by gravimetric method.

Although the selection of locations is not in direct connivance with the traffic locations, the total no of stations have been distributed throughout the project road so as to get representative baseline of any variation in land use as well as road geometrics and traffic conditions across the project road. The purpose is also to establish a benchmark, which can form the reference for monitoring in the construction and operation period. The following table gives the criteria for selection of the monitoring stations.

Table 4-3: Air Pollution Receptors Types Identified along the Project Road

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

Table 4-4: Details of Monitoring Station for Air Quality Monitoring

S. N	Monitoring Station Code	Location	Land use (Industrial, Residential, Rural & other Areas)	Total No of Samples in each location	Sampling Period	Height from Ground Level (m)
1	AQ6	Akali Talwandi	Industrial Area around	24	March-May 2013	4.0

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Contractor: Patel Infrastructure Pvt. Limited
Consultant: Feedback Infra Pvt. Ltd



Figure 4-3: Photograph of Air Quality Monitoring



Source: Field Monitoring

Results & Analysis of Ambient Air Quality

The air quality in the project area is moderately polluted. The AAQ of the project area is given in Table 4-5. From the table it is evident that concentrations of all pollutants except PM₁₀ are well within the prescribed limits of the National Ambient Air Quality Standards. This may be due to the dust generated from thrashing of Wheat crop in the agricultural field, presence of industrial area in addition to plying of heavy traffic such as trucks and other combustion engine vehicles in nearby roads.

Table 4-5: Ambient Air Quality within Project Corridor

Monitoring Station Code	Pollutant Concentration 98th Percentile Value				
	SO ₂ µg / m ³	NO _X µg / m ³	PM _{2.5} µg / m ³	PM ₁₀ µg / m ³	CO mg/m ³
AQ6 (Akali Talwandi)	15.85	21.00	45.34	150.24	1.18
Standards (Industrial, Residential, Rural & other Areas)	80	80	60	100	2
Standards (Ecologically Sensitive area as Notified by Central Govt.)	80	80	60	100	2

Source: Field Monitoring

4.2.4 Water

Ground Water

Ground Water resources can be categorised on basis of their occurrence as shallow aquifers such as wells, hand pumps and deep aquifers such as tube wells or bore wells. The location of these resources is the prime determinant of the impacts. Along the project road, hand pumps are present. These community owned resources are the major sources of potable water. The details of the various ground water resources are annexed in Annexure 4.1.

The occurrence of ground water in the district is mainly controlled by the topographic and structural features present in the geological formations. The principal source of ground water is precipitation. Out of the total rainfall received, a major part of it is lost as runoff and by evapotranspiration through soil and vegetation. Only a small part of rainfall infiltrates down to reach ground water body. Groundwater occurs mainly under water table conditions in all formations. The important water bearing formation besides alluvium is the gneisses granites, schists, limestone and phyllites. In the hard rocks the occurrence and movement of ground water is controlled through the foliation/bedding planes, fissures, joints, solution cavities and other structural weak planes. The weathered mantle of the hard rocks yields good discharge of water. In alluvium ground water occurs in the interstices of unconsolidated sand and gravel, locally semi confined conditions are encountered both in hard rock and alluvium. All the blocks in the project area falls under over exploited zones as per Ground Water Information Booklet, CGWB. The post monsoon ground water table varies from 3.89 to 12.36 mbgl in Mansa & 4.17m-16.76mbgl in Bathinda.

Surface Water

Surface Water includes drainage channels (rivers, streams, and canals) and stagnant water bodies (lakes,

ponds, tanks and other impounded water bodies). A highway project can significantly alter the hydrological setting of the project area by acting as an impediment to the natural drainage system of the region. It is therefore essential that all surface water resources and ground water resources and their characteristics has been identified and examined along the project road. The details of the various surface water resources are annexed in Annexure 4.2.

Figure 4-4: Water Resources along Project Road



Figure 4-5: Photographs of Surface Water Bodies



Water Quality

⊙ Selection of Sampling Location

One representative surface water and 2 ground water monitoring stations were selected based on their importance as source of irrigation and water supply, size, future impacts and quantum of water available. The samples were collected once in the month of May 2013, by **Envirotech East Pvt. Limited, Kolkata** for testing on behalf of Feedback Infra. All the basic precautions were taken care to avoid any contamination during the sampling. Water samples were collected from sampling locations in plastic jerry can and 500 ml sterilized clean glass bottles for complete physico-chemical and bacteriological tests respectively. Sample for DO was collected in a pre-cleaned BOD bottle. The water samples were preserved and stored in polythene bottles. Sampling bottles were kept in airtight large plastic ice-cold containers and were transported to laboratory for further processing. The physical and chemical parameters of the collected samples were tested as per established standard methods and procedures prescribed by CPCB and relevant IS Codes. The locations selected for water sampling are presented in Table below. The monitoring has been carried out with the following objectives:

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

Table 4-6: Details of Water Quality Monitoring Station

S. N.	Location Code	Road Section No.	Location & Type of Source	Sampling date
Ground Water				
1	GW9	S4- ODR9: Mansa – Talwandi Sabo(up to intersection with B8)	Talbandi akali- Hand Pump	24-05-2103
2	GW10	S4- ODR9: Mansa – Talwandi Sabo(up to intersection with B8)	Talbandi Sabo- Hand Pump	24-05-2103
Surface Water				
3	SW3	S4- ODR9: Mansa – Talwandi Sabo(up to intersection with B8)	Talbandi Akali- Pond	25-05-2013

⊙ Results & Analysis of Water Quality Sampling

By and large, the ground water quality is satisfactory and the major physical and chemical parameters are within permissible limits set by the Bureau of Indian Standards² for drinking water. However analysis result of Talbandi Sabo- Hand Pump water (GW 10) states that the many of the major parameters are crossing the acceptable limit. Tables below show the quality of water for various locations from where samples were collected to update the baseline on environmental quality.

Table 4-7: Physical and Chemical Results of Ground Water Samples

S. No.	Parameters	Unit	GW9	GW 10	Acceptable Limit as per IS 10500:2012	Permissible Limit as per IS 10500:2012
1	Colour	Hazan	8	10	5	15
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
3	Turbidity	NTU	0.8	4.8	1	5
4	pH	-	7.86	8.31	6.5-8.5	No Relaxation
5	Conductivity	µs/cm	660.7	814.3	-	-
6	TDS	mg/l	462	680	500	2000
7	Alkalinity as CaCO ₃	mg/l	170.9	289.9	200	600
8	Total hardness as CaCO ₃	mg/l	267.9	399.2	300	600
9	Calcium as Ca	mg/l	49.3	55.6	75	200
10	Magnesium as Mg	mg/l	35.2	63.3	30	100
11	Chloride as Cl	mg/l	38.6	15.4	250	1000
12	Sulphate as SO ₄	mg/l	82.7	98.1	200	400
13	Nitrate as NO ₃	mg/l	35.8	47.8	45	No Relaxation

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S. No.	Parameters	Unit	GW9	GW 10	Acceptable Limit as per IS 10500:2012	Permissible Limit as per IS 10500:2012
14	Sodium as Na	mg/l	12	22	-	-
15	Potassium as K	mg/l	14	10	-	-
16	Bicarbonate	mg/l	170.9	353.7	-	-
17	Fluoride as F	mg/l	0.64	1.4	1.00	1.5
18	Phenolic compound as C6H5OH	mg/l	<0.01	<0.01	0.001	0.002
19	Cyanide	mg/l	<0.01	<0.01	0.05	No Relaxation
20	Aluminum	mg/l	<0.03	<0.03	0.03	0.2
21	Arsenic	mg/l	<0.1	<0.1	0.01	0.05
22	Cadmium	mg/l	<0.01	<0.01	0.003	No Relaxation
23	Chromium as Cr+6	mg/l	<0.05	<0.05	0.05	No Relaxation
24	Iron	mg/l	0.72	0.68	0.3	No Relaxation
25	Copper	mg/l	<0.5	<0.5	0.05	1.5
26	Lead	mg/l	<0.05	<0.05	0.01	No Relaxation
27	Manganese	mg/l	<0.1	<0.1	0.1	0.3
28	Zinc	mg/l	3.6	4.3	5	15
29	Mercury	mg/l	<0.001	<0.001	0.001	No Relaxation

Source: Field Monitoring

Table 4-8: Physical and Chemical Results of Surface Water Samples

S.No.	Parameters	Unit	SW3	IS 2296 Class C Limits
1	Colour	Hazan	15	300
2	Odour	-	Agreeable	-
3	Turbidity	NTU	58	-
4	pH	-	7.43	6.5-8.5
5	Conductivity	µS/cm	440	-
6	Total Dissolve Solids	mg/l	344	1500
7	Alkalinity as CaCO3	mg/l	156.6	-
8	Total Hardness as CaCO3	mg/l	193.4	-
9	Calcium as Ca	mg/l	34.3	-
10	Magnesium as Mg	mg/l	26.2	-
11	Chloride as Cl-	mg/l	23.8	600
12	Sulphate as SO4	mg/l	50.3	400
13	Nitrates as NO3	mg/l	12.8	50
14	Sodium as Na	mg/l	6	-
15	Potassium as K	mg/l	12	-
16	Bicarbonate	mg/l	156.6	-
17	Fluorides as F	mg/l	0.42	1.5
18	Phenolic compound as C6H5OH	mg/l	<0.01	0.005
19	Cyanide	mg/l	<0.01	0.05
20	Aluminum	mg/l	<0.03	-
21	Arsenic	mg/l	<0.1	0.2
22	Cadmium	mg/l	<0.01	0.01
23	Chromium as Cr+6	mg/l	<0.05	0.05
24	Iron	mg/l	0.20	50
25	Copper	mg/l	<0.5	1.5
26	Lead	mg/l	<0.05	0.1
27	Manganese	mg/l	<0.1	-
28	Zinc	mg/l	1.8	15
29	Mercury	mg/l	<0.001	-
30	Dissolved Oxygen	mg/l	4.9	4
31	BOD, 270C - 3 days	mg/l	2.8	3
32	COD	mg/l	11.4	-

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Consultant: Feedback Infra Pvt. Ltd



S.No.	Parameters	Unit	SW3	IS 2296 Class C Limits
33	Oil and Grease	mg/l	< 5	0.1
34	Total Coliform	MPN/100 ml	56	5000

Source: Field Monitoring

4.2.5 Noise

The monitoring of the ambient noise quality along the project corridor was carried out with the help of hand held noise level meters (Model: Envirotech Make SLM 100) in the months of March, April and May 2013, by **Envirotech East Pvt. Limited, Kolkata** on behalf of Feedback Infra Pvt. Ltd.

Selection of Sampling Location

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

Baseline Noise Monitoring

In the present study, sound pressure levels (SPL) have been measured by a sound level meter. The noise levels within the study area were recorded using Sound Level Meter (Model: Envirotech Make SLM 100). Since loudness of sound is important for its effects on people, the dependence of loudness upon frequency must be taken into account in environmental noise assessment. A-weighted equivalent continuous sound pressure level (Leq) values have been computed from the values of A-weighted sound pressure level measured with the help of noise meter. At each location, noise monitoring has been carried out once during the entire study period (over a period of twenty-four hours to obtain Leq values at uniform time intervals of 1 hour. For each location, day and night time Leq values have then been computed from the hourly Leq values such that comparison could be made with the national ambient noise standards. Day & night time Leq has been computed from the hourly Leq values as per standards.

Results & Analysis of Noise Monitoring

The noise monitoring survey (in table below) shows that noise levels are well within the limit as stipulated by CPCB. Noise, though is a major area of concern, at locations of sensitive receptors (educational establishments like schools and colleges, health units etc.) identified quite close to the road.

Table 4-9: Observed Noise Levels along Road

Monitoring Station Code	Sampling period	Total No. of Samples	Location	Area Category	Observed Noise Levels in dB (A)		Noise Quality Standards in dB (A)	
					Leq Day	Leq Night	Leq Day	Leq Night
N5	March-May 2013	3	Akali Talwandi	Residential	51.9	42.7	55	45

Source: Field Monitoring;

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Forest Areas

The plantation along highways within ROW is notified as protected forest in the state of Punjab. Hence the status of plantation area along both side of the project road within ROW of the existing project section is protected forest. The project road section is existing highway and the widening and upgrading will be performed on land adjoining to the existing alignment only. Road side plantations along the project road will be impacted due to the proposed widening work. However, no other forest land shall be diverted for the project. There are though some forest areas within the project area but are quite away from the project road.

4.3.2 Protected Areas / Eco-sensitive Zones/ Animal Corridor

The project road doesn't falls within 10 Km radius of any Protected Natural Habitats (Biosphere Reserves, National Parks and Sanctuaries).

Further there are no Wildlife Habitats (outside designated protected areas) including bird habitats, aquatic

habitats, as relevant in the project area.

4.3.3 Flora & Fauna

The dominant flora along the project road are *Albizia procera*, *Prosopis julifera*, *Dalbergia sissoo*, *Terminalia arjuna*, *Pongomia pinnata*, *Acacia nilotica*, *Ficus bengalhensis* are present along the corridor. These trees are though present mainly near the settlements. Some trees might become potential traffic safety hazard since the road is proposed for widening. Care though shall be taken during the construction to avoid felling of these giant trees and mitigation measures shall be devised.

Avenue plantation is present almost all throughout the road and the presence of green tunnel is quite common for quite a length. The green tunnels are caused mainly by tree species such as *Acacia nilotica*, *Eucalyptus* sp, & *Prosopis julifera*. **No vulnerable, threatened, endangered species of flora and fauna are reported**

Figure 4-6: Flora along the Project Corridor



4.4 SOCIAL ENVIRONMENT

4.4.1 Settlement

There are a total of 7 settlements varying in size and populations along the project corridor. The main settlements are given in the following table.

Table 4-10: Major Settlements along Project Road

Chainages		Settlements
From	To	
0.000	0.370	Mansa
1.370	1.870	Ram Dittewala
3.070	4.370	Moosa
11.370	11.570	Akalia Talwandi
14.870	15.170	Banawali
18.370	19.570	Behniwal
23.770	23.970	Jaga Ram Tirath

Source: Primary Survey, 2013

4.4.2 Cultural Properties and Religious Properties

There are no archaeological heritage, local built heritage and art forms along the project road. There are 1 temple and 2 gurudwaras along the project road. The list of cultural and community properties along the project road are given in Annexure 4.3 and 4.4.

Figure 4-7: Cultural Properties along Project Road



4.4.3 Noise Sensitive Receptors

There are approximately 2 educational institutes along the project road. All structures are outside of proposed ROW. The list of noise sensitive features along the project road is given in Annexure 4.5.

Figure 4-8: Noise Sensitive Receptors along Project Road



4.4.4 Census Profile

The project highway passes through the district of Mansa & Bhatinda in Punjab. As per the 2011 census, Punjab has a total population of 2, 77, 04,236 and the total male and female population in the state is 1, 46, 34,819 and 1, 30, 69,417 respectively. The population density per sq km is 550. The literacy rate of the state is 76.7 % while the sex ratio is 893. The sex ratio, literacy rate and density of the project districts are less than the state level.

Table 4-11: Census Details

State / District	Total Population			Sex Ratio	Population density	Literacy Rate (%)		
	Persons	Males	Females			Persons	Males	Females
Punjab	2,77,04,236	1,46,34,819	1,30,69,417	893	550	76.7	81.5	71.3
Bathinda	13,88,859	7,44,875	6,43,984	865	414	69.6	75.3	62.9
Mansa	7,68,808	4,08,921	3,59,887	880	350	62.8	68.4	56.4

Source: Provisional Population Totals, Census of India 2011

4.4.5 Primary Census Profile

A primary census survey was carried out to identify and collect the details of the families and persons affected by the project. The details of all families who are losing their properties either part or full have been captured. The details of the primary census are given below.

Squatters & Encroachers

There are 14 Squatters and encroachers along the project road.

Project Affected Families

A total of 14 project-affected families have been identified along the project corridor



Table 4-12: Project Affected Families

S. No.	Type of Structure	LHS	RHS	Total
1	Kachha	8	6	14
Total		8	6	14

Source: Primary survey (2013)

Vulnerable Families

There are 6 Vulnerable Affected families (BPLs) lies in the corridor. As per PB R&R policy says the income level upto 24,000 per annum shall be considered as a BPL.

Table 4-13: Vulnerable Affected Families

S.No.	Type of Structure	LHS	RHS	Total
1	Income less than Rs 24000-per annum	6	0	6
Total		6	0	6

Source: Primary survey (2013)

4.4.6 Places of Historical Importance / Cultural Heritage

There are no Historical Importance / Cultural Heritage structures on the project road.

5 PUBLIC INTERACTIONS & CONSULTATIONS

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

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

5.1 OBJECTIVES

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

- Promote public awareness and improve understanding of the potential impacts of proposed projects;
- Identify alternative sites or designs, and mitigation measures;
- Solicit the views of affected communities / individuals on environmental and social problems;
- Improve environmental and social soundness;
- Clarify values and trade-offs associated with the different alternatives;
- Identify contentious local issues which might jeopardise the implementation of the project;
- Establish transparent procedures for carrying out proposed works;
- Inform the affected populace about the entitlement framework and to settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

5.2 CONSULTATION SESSIONS

Consultations were done using various tools including, interviews with government officials, questionnaire-based information with stakeholders etc. The public consultation carried out at the Screening and Environment Assessment stages of the project has been summarised.

The extent or the likely level of adverse impacts was one of the major criteria in deciding locations for public consultation sessions. A listing of the various consultation sessions conducted at different locations along the entire project corridor is presented in Table 5-1. These community consultations were held during various times of the design period and were attended by the PWD (R&B, Government of Punjab staffs), Consultant’s Environmental and Social experts.

Table 5-1: Public Consultation held at Different Stages of Project

Level	Type	Key Participants
Individual	Local level Consultation	People along the project corridor
Individual	Door to Door Personal Contact	People along the project corridor
Village	Focus Group Discussion	Women, truckers, weaker sections, agriculturist, School teachers
Institutional	Stake holder Discussion	Line departments

5.2.1 Stake Holders Consultation

The institutional level consultations were held with representatives of institutions having stakes in implementation of the project. The institutions contacted included State Forest Department, State Pollution Control Board etc. In addition to this, officials from other departments were also contacted on several occasions. The contacted officials included revenue officers, industry department etc.



Several meetings were held with PWD Officials and their inputs have been incorporated in the Reports.

Figure 5-1: Photographs of Public Consultation



5.2.2 Consultations during Design

Consultations were carried out at the design stages to identify:

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

5.2.3 Location Specific Consultation Needs

Several project road specific consultation needs identified were:

- Where owners of property, land and building / structures or their tenants are involved, consultations are required;
- Need for improvement of intersection, curves, etc. has to be ascertained from people through consultation process;
- The noise sensitive receptors if any are to be identified through public consultation process.

5.3 IDENTIFICATION OF ISSUES

5.3.1 Issues Raised During Consultations

Based on the community consultation the key environmental, health, safety and social issues identified were:

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

5.4 CONTINUED CONSULTATION

As part of the continued consultation program, the following actions are proposed:

- Implement the suggestions / recommendations and address those grievances that are technically feasible without compromising on the quality and safety
- Continue consultations with the public and stake holders during the various stages of the construction and operation for smooth implementation of the project

Table 5-2: Addressal of General Issues and Concerns under the Project

Issue / Concern	Addressal under the project
Dust and Air Pollution	<ul style="list-style-type: none"> • Plantation of trees and shrubs along the highway and on median • Turfing on earthen slopes and earthen shoulders • Water spraying to be adopted near the crushers during construction stage.
Increased noise levels	<ul style="list-style-type: none"> • Provision of Noise attenuating wall near sensitive receptors • No-horns signage near schools, colleges and hospitals • Tree plantation and development of green belts along the project corridor abutting settlements to attenuate traffic noise
Traffic Congestion	<ul style="list-style-type: none"> • Improvement of intersections • Provision of Flyovers, bypasses, underpasses etc at suitable locations • Road widening itself will be a major factor to avoid traffic jams
Road safety	<ul style="list-style-type: none"> • Proper highway signals provided as per IRC SP:67 • Widening of bridges to avoid accidents • Grade level pedestrian , PUPs & CUPs crossing • Proper lighting at accident prone locations
Cultural properties	<ul style="list-style-type: none"> • Care has been taken to preserve sites of cultural heritage as far as possible. • Where unavoidable the religious structures within ROW to be relocated only after consultation with local community.
Fauna and flora	<ul style="list-style-type: none"> • Tree clearing within ROW has been avoided beyond what is directly required for construction activities and or to reduce accidents • Compensatory afforestation would be done as per the directives of the forest department. • Fruit bearing trees and shade trees, to be planted on the roadside.
Roadside Drainage	<ul style="list-style-type: none"> • Rising of road sections and cross drainage structures in areas facing overtopping problems. • Location of structures based on hydrological study • Provision of proper drainage scheme for the settlements
Water bodies	<ul style="list-style-type: none"> • In unavoidable cases provision for increasing depth of water bodies to increase its capacity is made.
Road side amenities	<ul style="list-style-type: none"> • Provision of facilities like Rest Areas, Truck stoppage site (lay bye) and bus stops along the highway
Loss of Livelihood and income restoration option	<ul style="list-style-type: none"> • The PAPs will be compensated as ESMP Framework prepared by the Project proponent for the project • RAP to detail out the assistance programme to the needy
Assistance to vulnerable groups	<ul style="list-style-type: none"> • Special provisions have been made in the entitlement framework for assisting vulnerable groups to improve their quality of life.
Employment of locals during construction	<ul style="list-style-type: none"> • Locals will be given preference for employment during the project implementation

5.5 KEY FINDINGS OF THE CONSULTATION

Major findings related to key issues such as general perception about the project; suggestions to mitigate hardships resulting from dislocation and loss of livelihood are presented below:

- It was observed that people are not only aware of the project but also welcomed the project in general. However, some PAPs have shown their concern due to acquisition of their properties.
- The PAPs in general were very much concerned about the mode of compensation.
- People want that their views should be taken into account in every matter where it counts for new road options
- They requested for facilities and amenities like rest areas and safer accessibility at points of habitation area.



- Affected population wanted to know about the exact period when the work will start. Sufficient time should be given before the acquisition in order to avoid any inconvenience
- People requested about creation of employment opportunities during road construction and later phases of the project
- People suggested that adequate safety measures should be provided such as speed breakers, curve improvement, signage's etc. near the In brief, it was felt during consultation that regular meeting with the local population / community could easily resolve any dispute between the community people and implementing agency settlements.
- The inhabitants requested to plant trees in the same locality where the trees will be felled.
- The RAP shall address the social issues brought to the fore during the public consultations.
- The EMP – both generic and specific has been designed to address environmental related issues



6 IMPACT ASSESSMENT

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

The project road S4 is a section of ODR 9. The project road section involves widening to 2 lanes with paved shoulder and the impacts are expected to be mostly direct and confined to the ROW. No land acquisition has been proposed and the proposed development will be accommodated within existing RoW. However, the impacts on the various environmental components can occur at any of the following stages of the project planning and implementation:

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

6.1 GENERAL ENVIRONMENTAL IMPACTS

Table 6-1 presents the general environmental impacts expected due to the proposed up gradation of the project road. Impacts have been assessed based on the information collected from the screening & scoping of environmental attributes at feasibility stage.

Table 6-1: General Impacts on Environment

Env. Component Affected	Planning and Design / Pre construction Phase	Construction Phase							Road Operation	Indirect effects of Operation or Induced Development
	Project Activity									
	Land acquisition	Removal of structures	Removal of trees and Vegetation	Earth works including quarrying	Laying of Pavement	Vehicle & Machine Operation & maintenance	Asphalt & Crusher plants	Sanitation & waste (labour campus)	Vehicle operation	-
Land	Loss of Productive Land	Generation of Debris	Erosion and loss of top soil	Erosion and loss of top soil	Reduction of ground water recharge area	Contamination by fuel & lubricants compaction	Contamination compaction of soil	Contamination from wastes	Spill from accidents Deposition of lead	Change in cropping pattern
Air	-	Dust generation during dismantling	Reduced buffering of air & noise pollution, Hotter, drier microclimate	Dust generation	Asphalt odour	Noise, dust pollution	Noise, soot, odour, dust pollution	odour/Smoke	Noise, dust pollution	Other pollution
Water	Loss of water resources	Siltation due to loose earth	Siltation due to loose earth	Alteration of drainage, break in continuity of ditches Siltation, Stagnant water pools in quarries	-	Contamination by fuel & lubricants compaction	Contamination by asphalt leakage or fuel	Contamination from wastes Overuse	Spill Contamination by fuel, lubricants & washing of vehicles	Increased Contamination of ground water
Noise	-	Noise pollution	Noise pollution due to machinery	Noise pollution	-	Noise pollution	Noise pollution	-	Noise pollution	Noise Pollution
Flora	-	Loss of Biomass	-	Lowered productivity loss of ground for vegetation	-	Removal of Vegetation	Lower productivity Use as fuel wood	Felling trees for fuel	Impact of pollution on vegetation Lowered productivity Toxicity of vegetation	-
Fauna	-	-	Disturbance habitat loss	Disturbance	-	Disturbance	Disturbance	Poaching	Collision with traffic	Distorted habitat

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)



Env. Component Affected	Planning and Design / Pre construction Phase	Construction Phase							Road Operation	Indirect effects of Operation or Induced Development
		Project Activity								
Agricultural land	-	Change in land use	Loss of land economic value	Loss of standing crops	Loss of productive land	-	-	-	-	Conversion of agricultural land
Buildings and built-up structures	-	-	Loss of structures, Debris generation, noise and air pollution	-	Noise vibration may cause damage to structures	-	Noise vibration - damage to structures	-	Vibration and Noise	Change in building use and characteristics
People and community	Anxiety and fear among community	-	Displacement of people psychological impact on people loss of livelihood	Loss of shade and community trees, loss of fuel wood and fodder, loss of income	Noise & air pollution	Odour and dust	Noise & air pollution collision with pedestrians livestock and vehicles	Community clashes with migrant labour	Noise pollution, Risk of accidents	Induced pollution
Cultural assets	-	-	Displacement of structures from Row	loss of sacred trees	Noise vibration may cause damage to structures	-	Damage from vibration and air pollution	-	Damage from vibration and air pollution	-
Utilities & amenities	-	-	Interruption in supply	-	-	-	Damage to utility and amenities	Pressure on existing amenities	-	-
Labour's health & safety	-	-	-	-	Increase of stagnant water and diseases	Asphalt odour and dust	collision with pedestrians livestock and vehicles	Increase in communicable diseases	collision with pedestrians livestock and vehicles	-

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
 Consultant: Feedback Infra Pvt. Ltd



The description and magnitude of impacts for the various environmental components as visualised for the project are presented in the following sections.

6.2 PHYSICAL ENVIRONMENT

6.2.1 Meteorological Parameters

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

This increase in the daytime temperature assumes significance especially to the slow moving traffic, the pedestrians and the first row of residences / receptors along the corridor, as the entire project stretch experiences temperatures as high as 48°C during summers. The impact will be felt more by the slow moving traffic and pedestrians along the project road. Although the impact shall be significant and long term in nature, it is reversible in nature and shall be compensated for by additional plantation of trees. It must be noted that the impact is unavoidable. However, it may be pointed out that the project has taken care to minimise tree felling in the ROW by realigning the road to save trees.

6.2.2 Land

Physiography

⊙ **Pre-construction and Construction Stage**

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

Geology and Seismology

⊙ **Pre-Construction, Construction and Operation Stage**

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

Quarries and Crushers

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

⊙ **Pre-Construction Stage**

Existing quarries that are already in operation with the required clearances have been recommended for this project. No new quarries are proposed and hence no major impacts, which arise in making new quarries operational, are likely. In case Patel Infra decides in opening new stone quarries he shall follow the guidelines stipulated in Sand required for the construction will mostly be procured from the river quarries as identified in Table 8.4. As an alternative to borrowing of sand from river bed, the possibility of using stone crusher dust has been explored. Stone dust from crusher can be used for the construction works provided the quantity and the quality produced is certified by the Independent Engineer to be satisfactory for all construction works, else river sand shall be used from the identified quarries. None of the sand quarry sites would require any preventive environmental measures. However, the long leads mean that care would have to be taken to prevent spillage of material and damage to the haul roads during transportation. No additional adverse environmental impact, except those resulting from spillage during transportation, is expected to occur.

⊙ **Construction Stage**

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

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

Soil Erosion

⊙ **Pre-Construction Stage**

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

⊙ **Construction Stage**

Elevated sections of road in all sections, particularly all high embankments along the bridges and the bridge approaches would be vulnerable to erosion and need to be provided proper slope protection measures to prevent erosion. Construction of bridges involves excavation of riverbed and banks for the construction of the foundations and piers. If the residual spoil is not properly disposed off, increased sedimentation downstream of the bridge is likely. Though during construction period, drainage alteration and downstream erosion / siltation is anticipated, due to the improved design and added capacity of the cross-drainage structures, there should be an improvement in the drainage characteristics of the surrounding area. Adequate slope protection measures are proposed as part of engineering design. Removal of trees to facilitate construction will cause erosion problems until the proposed compensatory afforestation plantation is established. Silt fencing to be provided to prevent eroded material from entering watercourses. The regular cleaning of the drains by Patel Infra will ensure that these structures will not be overloaded or rendered ineffective due to overload.

⊙ **Operation Stage**

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

Compaction of Soil

⊙ **Pre-Construction Stage**

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

⊙ **Construction Stage**

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

⊙ **Operation Stage**

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

Contamination of Soil

⊙ **Pre-Construction Stage**

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

⊙ **Construction Stage**

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

⊙ **Operation Stage**

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

6.2.3 Air

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

Generation of Dust

⊙ **Pre-Construction Stage**

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

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

⊙ **Construction Stage**

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

- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;

- Concrete batching plants;
- Asphalt mix plants due to mixing of aggregates with bitumen; and
- Construction and allied activities.

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

⊙ **Operation Stage**

- The negative impacts on air quality during operation stage shall not be significant as that of construction stage. This is due to the reduction of dust particles.
- No dust generation is envisaged during the operation stage as the all road shoulders are proposed to be paved and all slopes and embankments shall be turfed as per best engineering practices.
- The air quality shall also improve due to the plantation activity carried out in the ROW during the end of construction phase.

Generation of Exhaust Gases

⊙ **Pre-Construction Stage**

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

⊙ **Construction Stage**

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

⊙ **Operation Stage**

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

6.2.4 Water Resources

To facilitate the cross-drainage at water crossings, 101 cross-drainage structures including both slab and pipe culverts are proposed. The surface water bodies along the project road might be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project. The impacts on water resources have been summarised in table below. There is a number of water channels, irrigation canals and other minor nalla criss-crosses the project corridor.

Table 6-2: Likely Impacts on Water Resources during the Construction Stage

Impacts due to Construction	Indicators
Loss of water bodies	Area of water bodies affected
Loss of other water supply sources	Hand pumps, wells etc. affected
Alteration of drainage, run off, flooding	No. of cross drainage channels
Depletion of ground water recharge	Groundwater in Area rendered inaccessible & impervious
Use of water supply for construction	Quantum of water used



Impacts due to Construction	Indicators
Contamination from fuel and lubricants	Nature and quantum of contaminants
Contamination from improper sanitation and waste disposal in construction camps	Area of camp / disposal site and proximity to water bodies / channels

Alteration of Drainage

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

⊙ **Pre-Construction Stage**

No drainage modification of surface flow is envisaged during pre-construction period.

⊙ **Construction Stage**

Though the constructions along the watercourses are to be carried out in the lean flow periods, as the major lotic systems are perennial, the construction activities will necessitate the diversion of the waterway. This diversion of flow can significantly harm the aquatic habitat, if any. The waterway will be constricted, increasing velocity downstream of the structure. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of micro flora. The impact shall be direct but short term in nature and shall last till the construction period. Short-term increase in runoff during construction may occur due to the removal of trees, vegetative cover and compaction of the surrounding soil during pre-construction. Thus the increased sediment load will be a significant impact that needs to be addressed for all water bodies along the corridor and adequate silt fencing measures need to be provided. The design proposes the raising of the embankments from the existing levels to ensure that the finished pavement is above the maximum flood level so as to prevent any impacts due to any water seepage in the pavement. No significant impacts in the drainage pattern due to the raising of the road profile are likely, as the road design itself takes care of the cross-pavement drainage.

⊙ **Operation Stage**

One of the unavoidable aftermaths of road construction is the increased surface run off. The new lanes, which are essentially a paved impervious surface, will cause increased surface runoff along the roadsides. Increase in surface run-off is due to the creation of impervious surfaces that prevent the flow of water into the ground. The project involves the construction of 2 lanes with paved shoulders on either side. Impacts due to surface runoff include increased soil erosion and local flooding or water logging. However, as the proposed lanes has been designed with ditches on both sides to take care of surface runoff local flooding due to the proposed increased runoff shall be taken care of effectively. Surface runoff shall be drained to the nearest cross drainage structure. The engineering design includes design of cross drainage structures, which should take care of the extra flow.

Water Required for the Project

⊙ **Pre-Construction and Construction Stage**

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

Table 6-3: Water Requirement for Construction

Purpose	Total Demand
Maintain Hygiene in Labour Camps	19500
Mixed with Cement in batching plant	4320
Dust Suppression in Hot Mix plant	300
Curing of Structures	2100
Rolling and Compaction	12750
Domestic Chores	10500
Drinking	2000
Total	51470



The total demand of water to be used during the construction phase will be around 51470 KL. The demand though is only indicative in nature and shall differ during the lean period of construction. The demand shall be met through availability of sufficient supply both from surface and ground sources. However, mostly surface water shall be used for the construction work as all the blocks in the project area falls under over exploited zones as per Ground Water Information Booklet, CGWB. To minimise the minor impacts of the project on the water resources, water harvesting structures and ground water recharge measures have been proposed.

⊙ **Operation Stage**

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

Water Quality

⊙ **Pre-Construction Stage**

Water sources including flowing and stagnant water sources are likely to be contaminated due to activities such as setting up workers camp near water sources or transportation of construction material such as sand, borrow material etc. without covering it. Due to tree felling soils around the water bodies and surface drainage channels will be exposed during the pre-construction stage, during which, the suspended sediments and the associated pollutants can be washed in to these water sources. As soil all along the corridor is of alluvial type, the impacts due to the increased sediment load will be significant to some extent. However, adequate silt fencing measures need to be provided. Contamination of groundwater is another likely impact of road construction and allied activities. The groundwater recharge areas may be reduced due to an increase in impervious layers due to the construction. The contamination of the groundwater resources due to the project is likely at the following locations:

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

Construction camps or stockyards are not to be set up near Rivers, irrigation canals and water bodies to prevent oil spills.

⊙ **Construction Stage**

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

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

Also, the raising of the road shall mean that more embankment surface is prone to erosion. However, the engineering design shall ensure protection of embankment slopes. The spoil heaps around the construction sites are also prone to erosion and contribute to the increased sediment load in the near-by water bodies. The major parameter of concern would be the sediment load from the spoils. The major pollutants of concern are suspended solids, oil and grease, lead and other heavy metals.

- Concentration of suspended solids is likely to be highest during the construction stage and immediately after the construction when vegetation has not been fully established on the embankment slopes.
- Oil and grease form a film on the water surface and hinder the transfer of oxygen into water.
- Though the compounds of lead are suspected to be carcinogenic, it is unlikely that leads pollution to have significant effects as 90-95% of lead in run-off is inert, and will be further diluted in the receiving water bodies, where the lead concentrations are minimal.

Discharge from labour camps and vehicle parking areas will have to be treated before discharge into any watercourse. It is during the operation stage that the leakage or spillage from vehicles damaged, overturned or just badly maintained is more likely. The existing levels of contaminants, which can trace their origin to road run-off, indicate that water quality degradation is not a significant impact. Normally groundwater is shielded from the effects of such degradation, but if the discharges from construction camps were disposed of using soak-pits / septic-tanks that were not adequately designed, the consequences would be disastrous since restoration of groundwater quality is a much slower process.

The impacts of run-off laden with sediment may be felt in villages that depend on the fish living in the water-body. Increased sediment load, lesser sunlight, difficulty to settle, etc. will make the water more turbid. If the concentrations are higher, smaller fish may be harmed. Large, heavy sediment, particularly with slow moving water may smother algae and eventually alter the nature of the sub-stratum. Excessive sediment loads may also mean disruption to areas where fish lay their eggs. However, it must be noted that these effects are probable only during construction stage. The water quality of surface drainage channels is likely to be impaired as long as the construction period continues. However, measures to divert the passage of pollutants into the river can be adopted to minimise the impact.

⊙ **Operation Stage**

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

Volumetric Capacity of Water Resources affected

Best effort shall be given to avoid loss of volumetric capacities of water bodies. However, this shall be envisaged in detail during detailed designing phase.

Impact on other Water Supply Sources

The impact on the local water supply sources like hand pumps, natural and manmade water bodies, wells and concrete tanks will be insignificant as most of the sources are located beyond PROW. These though shall be replaced with new sources at locations near to the existing ones if affected. The project alignment affects some water resources. As part of the project preparation, the alignment has been carefully routed to avoid any direct impact on these water bodies. However, at some locations; the encroachment onto these water resources has been unavoidable. In such locations the relocations of all these water supply sources has been recommended and the cost of the relocation has been included as part of the project cost.

Table 6-4: Impact on Water Resources

Sl. No.	Existing Chainage (Km)	Structure / Features	Settlement	Side (LHS/RHS)	Distance from ECL (m)	Direct Impact (Yes/No)
1	0+000	Hand Pump	Near Silver city	LHS	10	May be
	0+000	Hand Pump	Near Silver city	RHS	12	No
2	0+250	Hand Pump	Ward no. 24	LHS	15	May be
3	0+500	Hand Pump	Ward no.24	RHS	10	May be
4	0+550	Hand Pump	Ward no.24	RHS	10	May be
5	1+900	Hand Pump	Ram ditte wala	RHS	10	May be
6	1+860	Hand Pump	Ram ditte wala	LHS	10	May be
7	2+000	Hand Pump	Ram ditte wala	RHS	16	May be
8	5+680	Hand Pump	Mussa	LHS	15	May be
9	5+700	Hand Pump	Mussa	LHS	14	No
10	6+700	Hand Pump	Mussa	LHS	8	Yes
11	7+900	Hand Pump	Mussa	RHS	6	Yes
12	8+920	Hand Pump	Mussa	LHS	12	No
13	11+830	Hand Pump	Akalia Talwandi	RHS	15	May be
14	11+840	Hand Pump	Akalia Talwandi	RHS	10	May be
15	14+900	Hand Pump	Banawali	LHS	10	May be
16	15+100	Hand Pump	Banawali	RHS	12	No
17	15+800	Hand Pump	Baniwala	RHS	10	May be
18	17+630	Hand Pump	Baniwala	LHS	6	Yes
19	20+500	Hand Pump	Baniwala	RHS	8	Yes



Sl. No.	Existing Chainage (Km)	Structure / Features	Settlement	Side (LHS/RHS)	Distance from ECL (m)	Direct Impact (Yes/No)
20	23+160	Hand Pump	Jagga Ram Tirath	LHS	8	Yes
21	23+600	Hand Pump	Jagga Ram Tirath	RHS	7	Yes
22	25+000	Hand Pump	Jagga Ram Tirath	RHS	6	Yes
23	1+980	Water Tank	Ram ditte wala	RHS	12	No

Source: Primary Survey

6.2.5 Noise levels

Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration / deceleration / gear changes by the vehicles depending on the level of congestion and smoothness of road surface. The baseline noise levels monitored at various along the project packages indicate the baseline levels is within the permissible limits for residential commercial areas. Noise is a major area of concern, especially since a few number of sensitive receptors have been identified to be quite close to the road. The impacts on noise due to the project will be of significance in both the construction as well as the operation stages.

Table 6-5: Noise Impacts

Sl. No.	Phase	Source	Impact
1	Pre-Construction	<ul style="list-style-type: none"> Man, material and machinery movement Establishment of camps, site office, stock yards, construction plants etc. 	<ul style="list-style-type: none"> Short duration Localised impact Negligible
2	Construction	<p>Plant site</p> <ul style="list-style-type: none"> Crushing, hot mix plants, machineries, batching plants, excavation, grading, paving activities <p>Work zones</p> <ul style="list-style-type: none"> Community residing near the work zones 	<ul style="list-style-type: none"> Plant site: significant impact within 500m Work zones: temporary and negligible
3	Operation	<ul style="list-style-type: none"> Increase in traffic 	<ul style="list-style-type: none"> Negligible impact

Though the noise levels are within the stipulated standard, the noise levels are a concern due to the number of sensitive receptors located along the project road. The impacts on the receptors shall basically relate to increase in noise levels, access and physical damage to the structure. There are approximately 2 educational institutes (schools) along the project corridor which are likely to be affected due to the generation of noise though the proposed development doesn't cause any physical damage to the structures. No Hospital/Health care unit has been identified along the project road. As many of the sensitive receptors are located in the vicinity of project area, noise could be a considerable issue.

Table 6-6: Sensitive Receptors – Impacts

Sl. No.	Existing Km	Structure / Features	Settlement	Side (LHS/RHS)	ECL Distance (m)	Length (m)	Direct Impact
1	19+660	Akal Sahai Public School	Baniwala	RHS	15	80	No
2	2+000	Anganvadi Center	Ram ditte wala	LHS	15	25	No
3	1+900	Primary School	Ram ditte wala	RHS	80	100	No

Source: Primary Survey

6.3 BIOLOGICAL ENVIRONMENT

6.3.1 Forest Areas

The OPRC intervention in the project involves widening of the existing road. The widening is involved within the existing ROW which has been declared as protected forest. Hence diversion of forest land is required.

6.3.2 Roadside Plantations

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

- To prevent single-vehicle collision with the roadside trees, trees very close to the road need to be cleared. Roadside trees are safety hazards, particularly those trees with strong and rigid stems. Some trees are safety hazards because they preclude clear sight distances. Some trees such as *Tamarindus indica* have a propensity to overturn when old and are potential safety hazards depending upon age and decay condition. All trees that are safety hazards need to be cleared.
- To ease construction of the embankment for the widened road formation and, to permit construction of adequate roadside drainage structure, trees located within the area between the pavement and the daylight line needs to be removed.
- Trees need to be cleared to facilitate construction of traffic detours. As the present project road is mainly two lanes, there shall be need for diversions especially except for construction of bridges.

The stage wise impact on roadside trees and plantation has been described in the following sections.

⊙ **Pre-Construction Stage**

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

A far less contentious issue, which normally takes the back seat, is the importance of the ecosystems supported by the roadside trees. Not only would the removal of trees lead to erosion, it would also mean that the micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost too. The only mitigation would be to ensure that the compensatory afforestation required as per the MoEF guidelines for the project is carried out with native species and proper care of the saplings is taken to ensure that the roadside plantation returns to its previous state as quickly as possible. Co-operation of locals to ensure that local cattle do not damage the saplings during the early stages of growth will be required. The roadside plantations will need to be cleared for the project. Though the loss of these trees is an irreversible and long-term impact, the loss of the roadside plantations shall have to be compensated in accordance to the principles of the Forest (Conservation) Act.

⊙ **Construction Stage**

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

Table 6-7: Likely Impacts on Flora

Activity	Impact
Cutting and removal of earth/rock Road Construction	<ul style="list-style-type: none"> • Loss of vegetation cover (shrubs & grasses) canopies; <ul style="list-style-type: none"> • Felling of trees of girth more than 30 cm; • Reduced shade and shelter for roadside fauna • Reduction in soil fertility, moisture and humidity
Workers Camps	Use of plants and trees as fuel wood

6.3.3 Fauna

Domesticated animals dominate fauna species. There is likelihood of slight impact to local domestic animals, which graze in the area especially after the road is constructed. Increased vehicle movement in the area might lead to accidents involving animals. In areas with high traffic volumes, road kill can be a considerable or even the predominant cause of mortality. Apart from this, micro-ecosystems developed on the roadside with the birds, animals and insects using the plantation over the years would be lost due to loss of their habitat.

To avoid such accidental kill, the project shall provide proper signage as part of the project. More over there shall be positive impact on the faunal species during the operational phase. The plantation activity carried out, as part of the project component shall provide shelter and food for the smaller avian and mammalian species, which in turn shall improve the overall food chain and food web and ultimately the



ecology of the area.

6.3.4 Aquatic Ecology

No major impact on aquatic ecology has been envisaged as no construction/rehabilitation of major bridge will take place. However, some contamination of canal water/water bodies due to spillage of construction material, sediment loading & increased turbidity shall have some impact on the flora and faunal species and change the nature of the substratum resulting in decline in the number and diversity of plants and thus the food web. No negative impacts are envisaged on the aquatic ecology during the operational phase.

6.4 SOCIAL ENVIRONMENT

6.4.1 Human Use Values

Amenities and Facilities

Though land acquisition is not envisaged at this stage, some minor LA might be involved to improve the deficiency in the existing road at a few locations. The traffic movement will be within the constricted width available and the traffic shall be managed as per the Traffic management Plan. All public utilities like electricity lines, telephone lines or water pipelines which are likely to be impacted shall be replaced before the start of work. Some squatters shall be affected and the compensation and mitigation shall be as per the RAP prepared for the project. Table 6-8 depicts the details of Community Properties located along the project corridor.

Table 6-8: Impact on Community Properties

Sl. No.	Existing Km	Structure / Features	Settlement	Side (LHS/RHS)	ECL Distance (m)	Direct Impact
1	0+000	Market	Ram ditte wala Chowk	Both	18	No
10	15+850	Stadium	Banawali	RHS	30	No

Source: Primary Survey

Change in Land Use

The development that the improved road will bring with it will induce a chain reaction towards change in land use. Change In land use will be sparked off as a result of land speculation. The road, which is flanked by agricultural fields, will witness overnight selling of these lands for the prices that they will fetch. Industrialisation of fringe areas of cities is also a possible impact of a road development scheme. The availability of cheap labour and easy access to markets in the city will make roadside areas quite an incentive for the industrialist. Reduced transportation costs and availability of high-class transportation facilities for raw materials and products will be the most important advantage of the improved road. The mushrooming of industrial areas on roadside will mean that the use of whatever infrastructure facilities that may be available will preferentially go to the 'deep pockets' of the industry. This will further strain these almost non-existent services.

Cropping Pattern and Crop Productivity

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

Exploitation of Resource base

Development of a road in areas previously not easily accessible can work like a double-edged sword for the environmental resources in the area. While the road would unlock potential value in the area, stimulate growth and make the environment hospitable, the rapid depletion of natural resources, by means with which these areas cannot cope is a distinct possibility. Development of such vital Infrastructure will lead to over exploitation of the environmental resources (e.g. too much groundwater pumping, indiscriminate wastewater disposal, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

Road Safety



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

Induced Ribbon Development

The development of a road scheme will lead to extension of urban areas especially at the ends of cities and towns through which the road passes. The improved transportation facility provides the linkages that will allow much better access to previously difficult to reach markets (for buyers and sellers). This would mean not only the people from congested areas in cities will want to move to the fringe, but also, people from nearby rural areas would migrate to the city. Urban services are seldom able to keep pace with the growth of a city. The growth of a city beyond the established spread network will mean piecemeal arrangements for services like water supply, wastewater treatment and disposal, and transportation. All the settlements along the project corridor will experience a sudden boom in activity and population around the start of operation of the project corridor. Thus, a ribbon development is envisaged all along the project road.

6.4.2 Cultural Properties

There are no archaeological heritage, local built heritage and art forms along the project road. There are 1 temple, 2 Gurudwara along the project road. All are located outside of PROW. No impact has been envisaged during the study. Below table states the details of Cultural Properties.

Table 6-9: Impact on Cultural Properties

Sl. No.	Existing Chainage (Km)	Structure / Features	Settlement	Side (LHS/RHS)	Distance from ECL (m)	Length along the Road (m)	Direct Impact (Yes/No)
1	1+900	Gurudwara	Ram ditte wala	RHS	50	30	No
2	6+600	Gurudwara	Mussa	RHS	40	40	No
3	1+900	Temple	Ram ditte wala	RHS	30	10	No

Source: Primary Survey

6.4.3 Quality Of Life Values

Socio-Economic Profile

The detailed socio-economic analysis of people, structures and property likely to be impacted by the proposed project has been presented in the Social Impact Assessment Report.

Public health and safety

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

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



(medical services, power, water supply, etc.), can impose additional stress on these facilities.

- In and around forest areas if alternative fuels are not made available to the workforce, there is a likelihood that trees / branches will be cut down for cooking or heating purposes.
- Unsanitary conditions in the labour camps might also result in impact on health of labourers as well as the local population. Transmission of diseases is also facilitated by the migration of people. During the construction phase work, crews and their dependents may bring with them a multitude of communicable diseases including Sexually Transmitted Diseases (STDs) like AIDS. This is more so if the nature of the project requires more male-workers, who have migrated from other parts of the state or country.
- During road construction allied activities like quarrying and crushing operations, traffic diversions, etc., may cause disruption of social and economic life of the local population of the nearby areas. Dust and noise generated in crushing and blasting operations may cause nuisance to the nearby communities. Other problems perceived during construction period is inconvenience to the local people as well as the highway passengers due to traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.
- The traffic amount and speeds are likely to increase throughout the road corridors. The accident risk would tend to increase. Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas.

Land Acquisition & Extent of Loss to Properties

No land acquisition has been proposed as the developmental activity will take place within available ROW. Thus there shall be no land acquisition and hence no physical displacement of families, loss of livelihood and impact on other resources. However in some secluded sections land acquisition might be involved to improve the deficiency in the curves as per IRC codes. Land if thus acquired shall be as per the process defined by Govt. of Punjab. All rehabilitation and compensation shall be based on the Resettlement Action Plan prepared for the project.

Squatters

There are a number of squatters mainly in the urban / settlement sections which are likely to be affected. The below table depicts the details of squatters.

Table 6-10: Squatters along the Project Road

Owner of Structures	Type Of loss	Kutchha	Pucca	Total
Squatters/Kiosks	Commercial	14	0	14

Source: Primary Survey

Project Affected Families and Persons

There are a total of 14 project-affected families.

6.5 CONCLUSION

- Based on the analysis of environmental impacts in the above sections, it can be concluded that the project is anticipated to cause the following environmental impacts:
- No direct physical impact will take place on Sensitive receptors like educational institute, health facilities. However, impact due to noise and dust may occur which shall be tactfully mitigated.
- Loss of trees along the existing project road due to felling
- Road side plantation along the project road section is notified protected forest. Hence, diversion of forest land is involved as road side plantation will be felled.
- No acquisition of land is required and the proposed development will be accommodated within available ROW.
- No damage to Cultural and religious structures has been envisaged.

The specific and generic mitigation measures of impact and the management plan are discussed in details in Chapter 9 and 10.



7 ANALYSIS OF ALTERNATIVES

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

7.1 WITH AND WITHOUT PROJECT ALTERNATIVES

7.1.1 Without Project Scenario

The existing project road section is an intermediate lane highway with varying pavement width. With present and projected high traffic volumes, the capacity of the present highway is insufficient for handling the high volume of traffic and calls in for improvements to a 2 lane carriageway with hard shoulder. The road has many roadside settlements and the traffic flow is seriously impacted by severe conflicts between the local and the through traffic. This is further compounded by the various land use conflicts, in terms of uncontrolled development along the highway and the encroachments onto the ROW. The population growth, increase in traffic volumes and the economic development along the corridor would continue to occur and will worsen the already critical situation. The existing unsafe conditions and the adverse environmental consequences in terms of the environmental quality along the highway would continue to worsen in the absence of the proposed improvements. Moreover, if it is decided not to proceed with the project, then the attendant reduced socio-economic development of this remote, relatively poorly connected area cannot be justified. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed project, as it would amount to failure to initiate any further improvements and impede economic development.

7.1.2 With Project Scenario

The 'with project scenario' is found to have a positive impact in the long run on social, environmental, economic and financial issues. This scenario includes the widening to 2 lanes of the existing intermediate lanes stretch as envisaged in the project objectives. The scenario is economically viable and will improve the existing conditions. It, would thereby, contribute to the development goals envisaged by the Governments of Punjab and India, and enhance the growth potential of the area.

To avoid the acquisition of land and properties, the project envisages the development within the existing ROW. In spite of the various development benefits likely to accrue due to the project, as is the case of every road development project, the project would be accompanied by certain impacts on the natural, social and environmental components. The potential impacts on the various environmental components can be avoided through good environmental practices. Wherever avoidance of negative impact has not been possible, appropriate mitigation and enhancement actions will be worked out to effectively offset the environmental damages inflicted due to the project. A detailed Resettlement and Rehabilitation (R&R) Action Plan has been worked out to improve the well-being and livelihood of the people to be impacted. Comparative assessments of the "with and without" project scenarios are presented in the following Table 7-1.

Table 7-1: "With and Without" Project Scenarios - A Comparative Assessment

Component	"With" Project Scenario	"Without" Project Scenario
Highway Geometrics	Divided 2/ lane carriageway with paved shoulder with geometric improvements	Existing intermediate lane carriageway with poor geometrics
Design Speed	80-100 Kmph	50-60 Kmph in rural Sections, 20-30 Kmph in Urban Sections
Congestion in Settlements	Free flow of traffic due to widened carriageway.	Congestion In urban areas
Felling of road side trees	Felling of both old and young trees. Old and weak trees near the road edge shall be a road hazard and shall be felled. Double the number of new young and healthy trees to be planted in compensation.	No felling of trees. The old trees may become a safety hazard to the road users with passage of time.
Cattle safety	Provision of cattle crossing to provide safety to both road users and cattle from accidents.	Accidents involving cattle and livestock shall be a concern.
Pedestrian safety	Along the settlement stretches with significant pedestrian traffic, Service road has been provided	Pedestrian safety an issue of major concern especially along the settlements and

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
 Consultant: Feedback Infra Pvt. Ltd

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Component	"With" Project Scenario	"Without" Project Scenario
	besides pedestrian (zebra) crossings and footpath in urban sections.	congested sections.
Road Safety Measures	Provision of proper road markings, zebra crossings, service roads, crash barriers and improvement of geometry to reduce accidents.	Accident incidents shall rise with an increased traffic volume.
Environmental Quality	Provision of service lane in urban settlements improves environmental quality within the urban areas due to lowered pollution levels and relieving of congestion. Besides an aggressive tree plantation and provision of enhancement features shall not only provide aesthetics but also improve the quality of air	Poor due to congestion and high emission levels because of slow movement of traffic. A further deterioration is expected due to increase in traffic volumes and further congestion.
Drainage	Will be improved due to reconstruction of culverts / bridges with adequate hydraulics.	These issues remain unaddressed without the project
Road Side Amenities	Appropriate road side amenities to be provided at various locations along the corridor.	Not adequate.
Environmental Enhancement	Enhancement of community and cultural properties and also water front in an aesthetic manner.	No enhancement measures involved.
Development	Higher potential for development due to improvement in access and consequent increase in connectivity	Development activities will be greatly hampered by the gross inadequacy of infrastructure.

7.2 JUSTIFICATION FOR SELECTION

The major difficulties with following an entirely new alignment or for that matter providing bypasses or major realignments are the magnitude of land acquisition and social disruption likely, lack of funds, and lack of viability for private financing. Therefore, as an alternative, the project proponent has adopted the policy of widening of intermediate highway to 2 lanes with paved shoulder on existing alignments in order to minimise new land requirements and negative environmental and social impacts.

The project, therefore, involves mostly concentric widening of the existing alignment to fully utilise the available ROW. The project road shall be flexible pavement throughout the stretch.

7.3 ALIGNMENT MODIFICATIONS

The selection of the alignment along various sections has been worked out based on continuous interaction between the highway and environmental teams. However, existing alignment has been followed almost throughout the stretch except few realignment sections. Various alignment improvement alternative for the project corridor shall be analysed in detailed design phase.

7.3.1 Curve Improvement Locations

Various locations have been identified along the project corridor, where the poor geometrics warrant a deviation from the existing alignment. Most of these locations are situated in curves both horizontal and vertical. The existing alignment was followed at some locations due to the following reasons:

- Minor curves
- Reduction in LA

Care shall be taken to minimise the impact on sensitive, cultural and community features like forest areas, schools, hospitals etc.

7.4 WIDENING / SERVICE ROAD OPTIONS

Widening options:

Concentric widening has been proposed almost throughout the project road.

Service Road:

No Service road has been provided in the project stretch.

7.5 UNDERPASS / OVER PASS OPTION

- No underpasses, overpasses & flyovers proposed



7.6 COLD MIX & HOT MIX TECHNOLOGY ANALYSIS

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

Table 7-2: Analysis of Cold & Hot Mix Technology

Sl. No.	Parameter	Cold Mix	Hot Mix
1	Description	<ul style="list-style-type: none"> Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity and material design, of the various components of an asphalt mix - Street Cold Asphalt is soft and sticky out of the bag, but it quickly hardens after application and the end result is a pavement patch with better strength but similar properties to hot asphalt. 	<ul style="list-style-type: none"> Hot mix asphalt is used primarily as paving material and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities. Hot mix asphalt facilities can be broadly classified as either drum mix plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate is dried first, and then transferred to a mixer where it is mixed with the liquid asphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement.
2	Requirements	<ul style="list-style-type: none"> Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shoveled or poured into a pothole or utility cut and tamped down with a hand tool. 	<ul style="list-style-type: none"> Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C) for virgin asphalt and 330 °F (166 °C) for polymer modified asphalt, and the asphalt cement at 200 °F (95 °C). Paving and compaction must be performed while the asphalt is sufficiently hot
3	Use	<ul style="list-style-type: none"> Cold mix asphalt concrete is produced by emulsifying the asphalt in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscous and the mixture is easy to work and compact The emulsion will break after enough water evaporates and the cold mix will, ideally, take on the properties of cold HMAC Cold mix is commonly used as a patching material and on lesser trafficked service roads 	<ul style="list-style-type: none"> HMAC is the form of asphalt concrete most commonly used on high traffic pavements such as those on major highways, racetracks and airfields Asphalt concrete has different performance characteristics in terms of surface durability, tire wear, braking efficiency and roadway noise.
4	Merits	<ul style="list-style-type: none"> Actually less expensive to use over the life of a road repair Completely seals and patches potholes, utility cuts, edge repairs, and even overlays. 	<ul style="list-style-type: none"> Less expensive for new road construction
5	Demerits	<ul style="list-style-type: none"> Less resilient and more vulnerable to cracking 	<ul style="list-style-type: none"> Expensive

Benefits over Cold Mix and Hot-mix Asphalt Concrete

- Durability and strength equivalent to using hot mix
- Permanent repair compared to traditional cold-mix which is only a temporary fix



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

Cold Mix technology is more suitable for repair of potholes and cracks on roads, bridges, overlays, parking lots and other asphalt and concrete surfaces. Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However for constructing of new roads hot mix technology is better suited. Patel Infra through his design engineer shall study the use of cold mix technology in more details and utilise the same where ever suitable.

7.7 ENVIRONMENTAL CONSIDERATIONS

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

Table 7-3: Minimisation of Environmental Impacts

Criteria	Means
Maintenance of Design Speed for through traffic	Improved geometrics
Improvement of Road Safety	Intersection Improvements; Geometric improvements at curves;
Adequate drainage	Provision of drains
Reduction of Air and Noise Pollution	Intersection improvements; site specific attenuation measures; aggressive tree plantations
Displacement of Local Population	Limiting of development within available ROW
Minimisation of Direct Impact on Sensitive Receptors, cultural and religious properties	Public consultations, Good EMP measures
Minimisation of Property acquisition	Concentric widening
Displacement of Commercial Properties	Concentric widening
Minimisation of Loss of Utility Lines	Centre line alterations
Minimisation of Tree Loss	Maximum effort shall be given to avoid avoidable tree felling and transplantation shall be adopted.
Stabilisation of Slope	Turfing / Pitching

7.7.1 Improvement of air and noise quality

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

7.7.2 Avoidance of Impact of Sensitive, Cultural and Community Properties

- By lateral shifting of the alignment, many cultural properties shall be saved;
- By providing zebra crossing for smooth and safe travel of local populace
- Providing noise attenuation measures mainly along schools and hospitals
- Avoiding direct impact on sensitive receptors



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8 MITIGATION, AVOIDANCE & ENHANCEMENT MEASURES

8.1 INTRODUCTION

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

8.2 MITIGATION MEASURES PROPOSED

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

8.2.1 Meteorological Parameters

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

8.2.2 Land

Land Acquisition, soil erosion and contamination of soil have emerged as major sources of land impact especially in urban areas and nearby watercourses. Due to the proposed road improvements aimed at enhancing the efficiency of road transport system, which will result in economic growth in the region over time.

Table 8-1: Summary of Mitigation on Impact on Land

Sl. No	Particular	Impact	Reason	Mitigation / Enhancement
1.	Change in Geology	Direct, long term, negative Impact	Extraction of materials (borrow earth, coarse and fine aggregates)	<ul style="list-style-type: none"> No blasting is envisaged. Quarry Development Plan need to be enforced.
2.	Change in Seismology	No Negative Impact	-	<ul style="list-style-type: none"> Cross drainage structures are checked and complied with the seismological settings of the region (Zone)
3.	Loss of land	Direct, long-term negative impact	Land Acquisition, Change in land use pattern	<ul style="list-style-type: none"> Design restricted within available ROW
4.	Generation of Debris	Negative Impact	May contaminate air, water and land, if not disposed properly	<ul style="list-style-type: none"> Disposed properly to avoid contamination.
5.	Soil Erosion	Moderate, direct, long-term negative impact	Road slopes and spoils	<ul style="list-style-type: none"> Embankment protection through: <ul style="list-style-type: none"> Stone pitching Turfing
6.			Construction of new bridges and culverts Quarry and Borrow areas	<ul style="list-style-type: none"> Residual spoil need to be disposed properly Silt Fencing need to be provided Quarries need to be reclaimed
7.	Contamination of Soil	Direct, long term negative impact	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix Production of hot mix and rejected materials Residential facilities for the	<ul style="list-style-type: none"> Hazardous Wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel Rejected material will be laid as directed by engineer.

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Sl. No	Particular	Impact	Reason	Mitigation / Enhancement
			labour and officers Routine and periodical maintenance	<ul style="list-style-type: none"> Septic tank will be constructed for waste disposal.
8.	Soil quality monitoring	-	Effectiveness / shortfall (if any) Any unforeseen impact	<ul style="list-style-type: none"> Measures will be revised & improved to mitigate / enhance environment due to any unforeseen impact.

Change in Seismology

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

Erosion

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

Contamination of Soil

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

Table 8-2: Mitigation Measures for Soil Contamination

Potential impact	Mitigation
Scarified Bituminous Wastes	<ul style="list-style-type: none"> No scarification involved. In case Contractor decides to scarify then the material to be reused in the GSB layer. Non reusable Bituminous wastes to be dumped in 30cm thick clay lined pits with the top 30cm layer covered with good earth for supporting vegetation growth over a period only after obtaining permission of Independent Engineer.
Scarified Non Bituminous Material	<ul style="list-style-type: none"> Used in the normal GSB layer (not the drainage layer)
Cut material	<ul style="list-style-type: none"> Reused as embankment, median & shoulder fill materials Excess material to be used for filling up of borrow areas identified by Patel Infra and approved by the Engineer
Construction debris generated from dismantling of structures	<ul style="list-style-type: none"> Annexure 8.1 : Guidelines for Identification of Debris Disposal Sites & Precautions needed Annexure 8.2: Guideline for Rehabilitation of Dumpsites & Quarries will be applicable
Soil Contamination due to accident spills	<ul style="list-style-type: none"> An emergency response team to be created. The team shall contain members of the district and police administration and also have specialist in remediation. Responsibility of Contractor to inform the team to take actions. The roles and responsibility of the members of the team shall be framed in conjunction with all the parties to address the situation arising out of the accidental spills resulting in situation like water and soil contamination, health hazards in the vicinity of the accident spot, fire and explosions etc.
Soil contamination due to Highway run off	<ul style="list-style-type: none"> Improvements of design shall lead to less accidents and hence less spillage of oil and grease
Soil Contamination during construction stage from fuel spills	<ul style="list-style-type: none"> Fuel storage will be in proper bunded areas. All spills and collected petroleum products to be disposed off in accordance with MoEF and SPCB guidelines and as per the directions of the Emergency Response team. Fuel storage and fuelling areas will be located at least 300m from all cross drainage structures and significant water bodies.
Operation of residential facilities for labour camps, Vehicle parking areas	<ul style="list-style-type: none"> Vehicle parking area will be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly sloped towards to adjacent edges towards the road. A drain will take all the spilled material to the oil interceptor

Productive Top Soil

- Efforts have been made to minimise the intake of productive lands. As the existing ROW is sufficient



to accommodate the proposed project, no acquisition of land has been proposed.

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

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

Quarries

Existing quarries that are already in operation with the required environmental clearances have been recommended for this project, and no new quarries have been proposed. The existing quarries are suitable for the requirement of coarse and fine aggregate required for the road works. In case Patel Infra decides in opening up of new quarries for the project, he shall follow the instructions / procedures as laid out in Annexure 8.3: Guidelines for New Quarry Management. For all existing quarries from where Patel Infra may source his supply of aggregates, Annexure 8.4: Guidelines for Existing Quarry Management shall be followed.

Similarly natural sand quarries have also been identified for the project road. Table 8-3 & 4 shows details of quarry areas identified and recommended for the project. It needs however, to be noted that recommendation on use of quarries is a guideline only and has been done to only establish the feasibility of construction.

Table 8-3: Details of Stone aggregates Quarries

Sl. No	Location	Distance to Quarry (Km)
1	Pathankot	350 KMS

Source: Primary Survey

Table 8-4: Details of Natural Sand Quarries

Sl. No	Location	Source	Distance to Quarry
1	Pathankot	Ravi River	350 KMS

Source: Primary Survey

Soil Quality Monitoring – Mitigation

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

8.2.3 Air Quality – Mitigation

Table 8-5: Summary of Mitigations for Impacts on Air Quality

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Meteorological factors and climate	Marginal impact	Due to production and laying of hot bituminous mix	<ul style="list-style-type: none"> • Comprehensive afforestation • Avenue plantation • Shrub plantation in the median / island
2.	Dust generation	Temporary and location specific	Shifting of utilities, removal of trees & vegetation, transportation of material	<ul style="list-style-type: none"> • Sprinkling of Water • Fine materials to be completely covered, during transport and stocking. • Plant to be installed in down wind direction from nearby settlement.



Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
3.	Gaseous pollutants	Moderate impact	Clearing and grubbing materials dumping brushing of the surface access roads to borrow area hot mix plants, Crushers paving of asphalt layers, Labour Camps	<ul style="list-style-type: none"> • Air pollution Norms will be enforced. • Labourers will be provided mask. • Local people will be educated on safety and precaution on access roads, newly constructed embankment etc.
4.	Air quality emissions	Moderate impact	Air pollutants from traffic	<ul style="list-style-type: none"> • Compliance with future statutory regulatory requirements
5.	Air quality monitoring		Effectiveness shortfall of any unforeseen impact	<ul style="list-style-type: none"> • Measures will be revised & improved to mitigate enhance

Design / Pre construction Stage

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

Construction Stage

Reduction in congestion due to better highway design being one of the objectives, an improvement in ambient air quality is expected to be one of the outcomes of the proposed improvements. However, these may be offset by the projected increase in traffic. Since the project cannot directly influence the adverse impacts of the operation stage, the efforts are concentrated in reducing air pollution during the construction phase. Several provisions can be incorporated within the contract, through the EMP, to ensure that the deterioration in air quality is limited to the maximum extent possible. During the construction stage, there are two major sources of Air pollution:

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

The specific measures include:

⊙ Dust Control

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

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

⊙ Emission Control

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

- The asphalt plants and the batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement.
- An adequate cyclone / scrubber to control emissions from the stack of hot mix plants will need to be provided in the event of the emissions exceeding the SPCB norms. Other potential measures include plantation around periphery of the hot-mix plants.
- To ensure the efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month during the period the plant is in operation.

- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. A vehicle maintenance schedule prepared by Patel Infra and approved by the Engineer shall be adhered to.

Operation Stage

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

- Broad-leaved pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, shall be planted as they help settle particulates with their higher surface areas along with thick foliage, which can reduce the distance for which particulates are carried from the road itself. *Cassia fistula* (Amaltas), *Ficus religiosa* (Peepal), *Ficus bengalensis* (Banyan), *Tamarindus indica* (Imli) and *Azadirachta indica* (Neem) are recommended.
- Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and upkeep, educating drivers about driving behaviour / methods that will reduce emissions are beyond the scope of the project but will be far more effective in reducing the pollutant levels. Patel Infra together with the Motor vehicles Department and SPCB can arrange for provision for inspection for the Pollution under Control (PUC) certificates at all the toll plazas proposed.

⊙ Air Quality Monitoring

Apart from provision of the mitigation measures, ambient air quality shall be monitored. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The air quality shall be monitored at all the locations as given in Environmental Monitoring Plan. The maximum desirable limits as per the national ambient air quality standards are given in Table 10.2 and the monitored values should correspond with the table. All deviated results shall be reported to engineer, for remedial measures.

8.2.4 Water – Mitigation

The table below presents the adverse impacts on water resources & the proposed mitigation measures.

Table 8-6: Summary of Mitigations for Impacts on Water

Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
1.	Loss of water bodies	Major, direct impact	Part or complete acquisition of source of water	<ul style="list-style-type: none"> Land acquisition to be minimized with provision of Retaining walls. Relocation of ground / surface water sources.
2.	Alteration of Cross Drainage	Very Low Impact	Major bridge constructions Widening of minor bridges and culverts.	<ul style="list-style-type: none"> Widening & construction of bridges, there will be an improvement in the drainage characteristics of the project area.
3.	Runoff and drainage	Direct Impact	Siltation of water bodies Reduction in ground recharge Increased drainage discharge	<ul style="list-style-type: none"> Silt fencing to be provided. Recharge well to be provided to compensate the loss of pervious surface. Continuous drain is provided, unlined in rural area and lined in urban area.
4.	Water requirement for project	Direct impact	Water requirement for construction activity. Water requirement for labour	<ul style="list-style-type: none"> Contractor needs to obtain approvals for taking adequate quantities of water from surface and ground water sources. This is required to avoid depletion of water sources. Water harvesting structures to be provided.
5.	Increased sedimentation	Direct impact	Increased sediment laden runoff after the nature and capacity of the watercourse	<ul style="list-style-type: none"> Silt fencing to be provided Instructions given in Annexure 8.5 Guidelines for Sediment Control to be enforced.
6.	Contamination of Water	Direct adverse impact	Scarified bitumen wastes Oil and diesel spills Emulsion sprayer and laying of hot mix	<ul style="list-style-type: none"> Hazardous wastes (Management and Handling) Rules, 1989 to be enforced. Oil Interceptor will be provided for accidental spill of oil and diesel



Sl. No.	Item	Impact	Impact (Reason)	Mitigation / Enhancement
			Production facilities for the labour and officers. Routine and periodical maintenance	<ul style="list-style-type: none"> Rejected material will be laid as directed by Engineer. Septic tank will be construction for waste disposal.
7.	Water quality monitoring		Effectiveness / shortfall (if any) Any unforeseen impact	<ul style="list-style-type: none"> Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

Loss of Water Resources

Loss of water resources includes removal of private and community water resources like hand pumps, water taps, OHTs, ponds, well etc. The losses have been covered under the utility relocation process. Compensatory water supply sources will be set up before the start of construction with location of the new point as close to the original as possible.

Table 8-7: Water Resources – Mitigation

Sl. No.	Existing Km	Structure	Settlement	Side (LHS/RHS)	ECL Distance (m)	Direct Impact	Mitigation
1	0+000	HP	Near Silver city	LHS	10	May be	Relocation if affected
2	0+250	HP	Ward no. 24	LHS	15	May be	Relocation if affected
3	0+500	HP	Ward no.24	RHS	10	May be	Relocation if affected
4	0+550	HP	Ward no.24	RHS	10	May be	Relocation if affected
5	1+900	HP	Ram ditte wala	RHS	10	May be	Relocation if affected
6	1+860	HP	Ram ditte wala	LHS	10	May be	Relocation if affected
7	2+000	HP	Ram ditte wala	RHS	16	May be	Relocation if affected
8	5+680	HP	Mussa	LHS	15	May be	Relocation if affected
9	6+700	HP	Mussa	LHS	8	Yes	Relocation to nearby places
10	7+900	HP	Mussa	RHS	6	Yes	Relocation to nearby places
11	11+830	HP	Akalia Talwandi	RHS	15	May be	Relocation if affected
12	11+840	HP	Akalia Talwandi	RHS	10	May be	Relocation if affected
13	14+900	HP	Banawali	LHS	10	May be	Relocation if affected
14	15+800	HP	Baniwala	RHS	10	May be	Relocation if affected
15	17+630	HP	Baniwala	LHS	6	Yes	Relocation to nearby places
16	20+500	HP	Baniwala	RHS	8	Yes	Relocation to nearby places
17	23+160	HP	Jagga Ram Tirath	LHS	8	Yes	Relocation to nearby places
18	23+600	HP	Jagga Ram Tirath	RHS	7	Yes	Relocation to nearby places
19	25+000	HP	Jagga Ram Tirath	RHS	6	Yes	Relocation to nearby places

Drainage and Hydrological flow

Various nalla, irrigation canals at different locations have intersected the project corridor. To facilitate the cross-drainage at these water crossings, 101 cross-drainage structures including are proposed. The existing structures shall be retained and upgraded as per the requirement.

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Mitigation measures will include contractual obligations for relocation of sources of water supply at locations desired by the host community, provision of balancing culverts of adequate capacity where the level of the formation is being raised, and provision for adequately sized drains to prevent flooding etc. All these measures form a part of the good engineering practice and should be part of the design drawings themselves.

- To ensure efficient flow of surface water and to prevent water logging along the side of the roads, adequate size and number of cross-drainage structures shall be provided
- Detailed drainage surveys and hydrological investigations have been carried out and suitable design of bridges and culverts proposed
- Provision of lined drains at settlement areas and unlined drains at other areas

In addition to the above design requirements, Patel Infra shall ensure that during construction work the following are taken care of:

- Construction work near water channels, irrigation canals and rivers have to be carried out in such a way that flow of water is not blocked and even if it has to be blocked then Patel Infra must ensure that the local communities are informed about the same in advance. Work near the water bodies should be carried out in dry season to avoid shortage of water,
- Flooding of local drainage channels,
- Measures to ensure that remnants from earthwork, stonework and other waste material do not hinder the cross-drainage of rivers, nalla,
- In sections of the road near to watercourses or cross-drainage channels, the construction material waste would be disposed of in a manner not to block the flow of water.
- To maintain efficient storm water flow, the roadside drains will be cleaned regularly, especially before the monsoon season.

Protection from Run off

Road run-off is let off into natural drains of adequate capacity from ditches at the end of formation to prevent destabilisation of the embankment. Release of road run-off directly from the ditches can erode edges of the water body into which the run-off is let off. Scouring of banks of flowing water bodies due to high velocity run-off is also a potential danger. To ensure that run-off does not damage the water body it enters, cascading for scour protection through stepped gabion is recommended.

Protecting Water Quality

To prevent any degradation of water quality of the various surface and ground water resources due to the proposed project, Patel Infra shall work out the following mitigative measures during the construction period:

- Provision of necessary mitigation measures at the various locations proposed in the design to prevent contamination and degradation of water quality.
- Construction work close to the streams or water bodies must be avoided during monsoon.
- The discharge standards promulgated under the Environmental Protection Act, 1986 will be strictly adhered to.
- Impact on the lotic system can be minimised if the construction is taken up during the lean flow season and construction work close to the water bodies avoided during monsoon.
- The fuel storage and vehicle cleaning area shall be stationed at least 500m away from the nearest drain / water body
- The slope of the embankments leading to water bodies shall be modified and re-channelled to prevent entry of contaminants into the water body.
- Provision of silt fencing and oil interceptors the details of which are given below

⊙ Silt Fencing

Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. The silt fencing consists of geo textile with extremely small size supported by a wire mesh mounted on a panel made up of angle / wooden frame and post. It is expected a single person will be able to drive the angles by pressing from the top. The frame will be installed at the edge of the water body along which construction is in progress. The number of such units to be installed can be decided

depending upon the length of the water body along the side of the road construction.

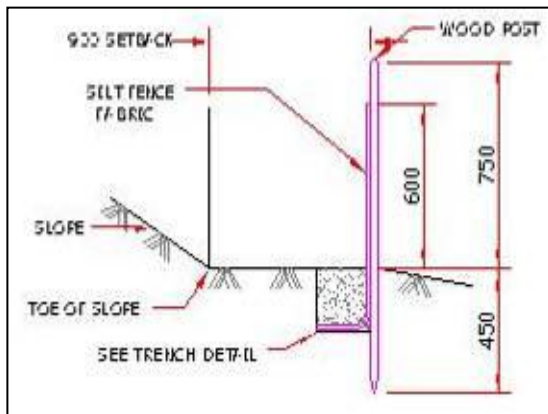


Figure 8-1: Oil interceptor

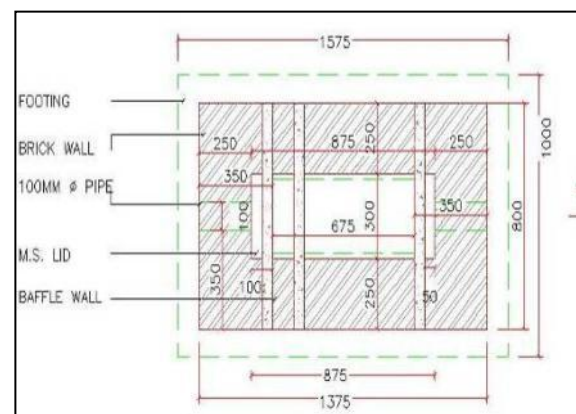


Figure 8-2: Silt Fencing

Silt fencing is proposed for a length of 1000m. This is based on the primary survey data and detailed discussions with structure engineers wherein it was found that the length shall be sufficient to cover all minor and major bridge locations and the road side water bodies. Depending on the length of the individual water body, the number of units of silt fencing to be installed is decided by the Independent Engineer.

⊙ **Oil interceptor**

Oil and grease from road run-off is another major concern during construction as well as operation. During construction, discharge of oil and grease is most likely from workshops, oil and waste oil storage locations and vehicle parking areas of Patel Infra's camps. A total of 7 oil interceptors shall be provided at all such locations to arrest oil and grease, as per figure 8-2. The arrested products shall be disposed as per MoEF and SPCB guidelines. The location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain / water body.

Disruption to Other Users of Water during Construction

- Patel Infra will arrange for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected.
- If new tube-wells are to be bored, due to the non-availability of water required for construction, prior sanctions and approvals by the Ground Water Department has to be obtained by Patel Infra.
- Wastage of water during the construction should be minimised.
- Construction over and close to any non-perennial streams shall be carried out in the dry season. Construction over irrigation canals should be carried out so as to minimise any disruption to the flows and to ensure that a high quality of water is maintained.

Water Quality Monitoring

Apart from provision of the mitigation measures, water quality shall be monitored to understand the effectiveness and further improvement in designs in reducing the concentration of pollutants. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Environmental Monitoring Plan. The water quality shall be monitored at all the locations as given in Environmental Monitoring Plan. The maximum desirable limits as per the water quality standards are given in Table 10.4 & 10.5 and the monitored values should correspond with the table. All deviated results shall be reported to engineer, for remedial measures. It should be ensured that no construction camps or stockyards are set up near the irrigation canals, rivers and water channels to prevent oil spills.

Rain Water Harvesting

Rainwater harvesting structures all along the proposed alignment as per as per MoEF guidelines and are a cost effective method for recharging of ground water level in the project area. The rainwater-harvesting chamber shall be placed at every 1000m interval c/c with dimensions of 2 x 2 x 0.75m³ all throughout the project corridor except at urban areas. A perforated RCC Slab covers the chamber. There is a 20cm filling, which also acts as sediment trap. There is another sediment trap in the bottom from where debris can be removed manually after certain period. A vertical drain (PVC pipe) is then sunk from the bottom of

the chamber to a depth which varies as per the water table. However the Rain water harvesting pit should be at least 3 - 5 m. above the highest ground water table. Drains interconnect these chambers.

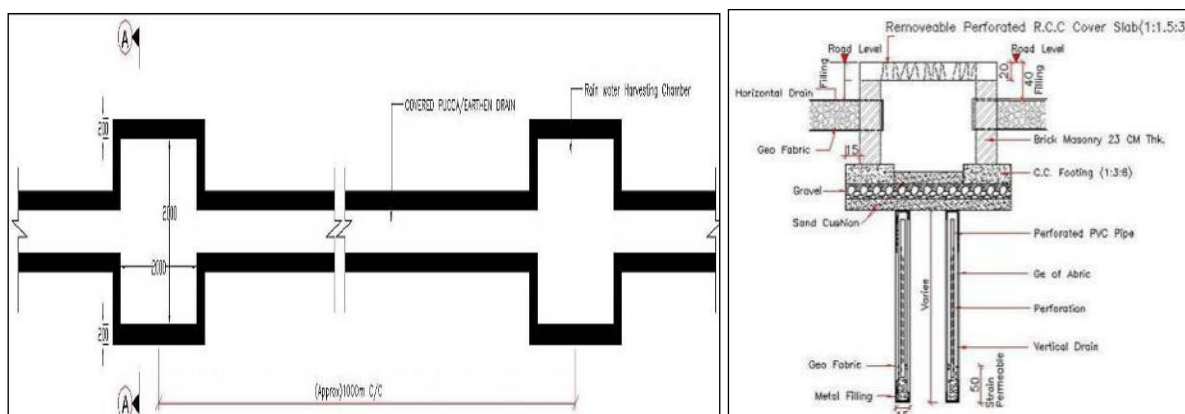


Figure 8-3: Rain Water Harvesting Structure

Patel Infra, along with the Engineer shall identify locations along the project route where water can be stored for the summer at least in 5 locations. Since the project area is in a water scarcity area, this shall act as good environmental practice. The measure will also reduce the cost of transportation of water. These locations should be permanent which shall be handed over to the local residents at the end of the project so that the water shortages can be reduced to a certain extent. Lump sum provision has been provided in the EMP.

8.2.5 Noise - Mitigation

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

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

Table 8-8: Sources of Noise Pollution, Impacts and Generic Mitigation Measures

Source of Noise Pollution	Impacts	Generic Mitigation Measures
<ul style="list-style-type: none"> Mobilisation of heavy construction machinery; Acceleration / deceleration /gear changes by the vehicles depending on the level of congestion and smoothness of road surface; Excavation for foundations and grading of the site; Construction of structures and facilities; Crushing plants, asphalt production plants; and Loading, transportation and unloading of construction materials. 	<p>Increased Noise Levels causing discomfort to local residents and workers</p>	<ul style="list-style-type: none"> All construction equipment, plants, machinery and vehicles will follow prescribed noise standards. All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB (A). If required, machinery producing high noise as concrete mixers, generators etc., must be provided with noise shields; At construction sites within 500 m of human settlements, noisy construction shall be stopped between 9.00 PM and 6.00 AM; Vehicles and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum; Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB (A) per 8 hour shift; Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use and settlements; All activities pertaining to procurement, storage, transport and handling of explosives and subsequent blasting will be carried out as per the statutory Indian Explosives Act 1984. Blasting shall be restricted only to daytime hours. Prior information of blasting operational times shall be given to people living near such blasting sites. The project road designed is a divided raised carriageway all

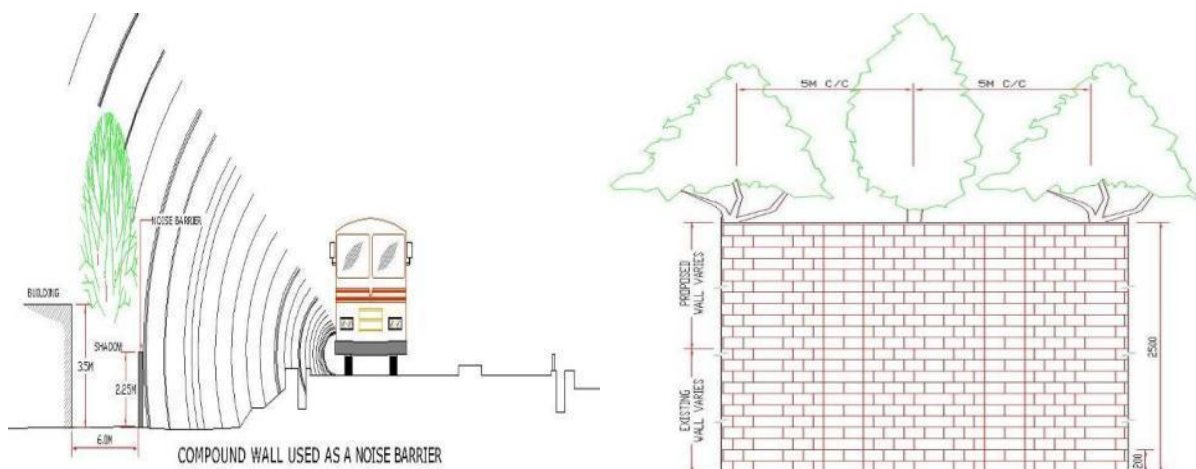


Source of Noise Pollution	Impacts	Generic Mitigation Measures
		throughout. This design shall help in reducing the impact of highway noise. <ul style="list-style-type: none"> Planting of trees, bushes and shrubs shall also to reduce noise levels. Provision of noise barriers. Noise barriers will be most effective if they break the line of sight between noise source and the properties being protected, and if these are thick enough or adsorb or reflect the noise received.

Table 8-9: Specific Noise Mitigation Measures

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Sensitive receptors	Direct impact	Increase in noise pollution Man, material and machinery movements.	<ul style="list-style-type: none"> Noise barrier to be provided where ever required Traffic calming devises to be used. No Horn Zone sign Post.
2a.	Noise Pollution (Pre-Construction Stage)	Direct impact, short duration	Establishment of labour camps, onsite offices, stock yards and construction plants	<ul style="list-style-type: none"> Area specific and for short duration. Machinery to be checked and complied with noise pollution regulations. Camps to be setup away from the settlements, in the down wind direction
2b.	Noise Pollution (Construction Stage)	Marginal Impact	Stone crushing, asphalt production plant and batching plants, diesel generators etc. Community residing near to the work zones.	<ul style="list-style-type: none"> Camps to be setup away from the settlements, in the down wind direction. Noise pollution regulation to be monitored and enforced. Temporary as the work zones will be changing with completion of construction.
2c.	Noise Pollution (Operation Stage)	Marginal Impact	Due to increase in traffic (due to improved facility)	Will be compensated with the uninterrupted movement of heavy and light vehicles
3.	Noise Pollution Monitoring	-	Effectiveness / shortfall (if any) Any unforeseen impact	Measures will be revised and improved to mitigate / enhance environment due to any unforeseen impact.

Figure 8-4: Compound Wall and Trees as Noise Barrier



To reduce noise and vibrations, noise barriers in the form of compound wall is proposed. In case of space crunch, the use of concrete screens is also suggested. However Patel Infra shall identify such areas where concrete screens shall be used. The noise barrier wall shall be constructed by excavation of foundation, laying of brick masonry wall up to a height of 2m above ground, plastering and coping as per

the direction of the engineer and as laid in the specification. Creepers and paints shall be used in consultation with the affected community to give an aesthetic look. Shade and flowering trees shall be planted within the boundary of the sensitive receptor, between the building line and the compound wall, wherever space shall be available, 5m centre to centre. Figure 8.4 shows the combination of compound wall and trees which shall be used as noise barrier.

Table 8-10: Noise Impact on Sensitive Receptors and Mitigation

Sl. No.	Existing Km	Structure	Settlement	Side (LHS/RHS)	ECL Distance (m)	Length (m)	Mitigation
1	19+660	Akal Sahai Public School	Baniwala	RHS	15	80	Noise barrier shall be provided
2	2+000	Anganvadi Centre	Ram ditte wala	LHS	15	25	Noise barrier shall be provided
3	1+900	Primary School	Ram ditte wala	RHS	80	100	Noise barrier shall be provided

The measures adopted for noise attenuation for receptors (schools and hospitals for all type of land use) identified above are as below:

- Plantation within the premises if space available for plantation
- Rising of existing boundary wall / construction of new wall up to 2m height
- Planting creepers to provide aesthetic view
- In urban areas the boundary wall can be painted with posters to provide aesthetic views. The option of posters or creepers shall be agreed by the school / hospital administrator.

Noise Pollution Monitoring – Mitigation

The effectiveness of mitigation measures and further improvement in designs to reduce the noise level due to construction and operational activity shall be monitored. The frequency, duration and monitoring plan shall be functional in construction as well as in operation stages as per the Environmental Monitoring Plan. Noise shall be monitored at all locations stated in Environmental Monitoring Plan beside the plant sites. The country standards are given in National Ambient Noise Standards in Table – 10.3. Any value / result not within acceptable limits shall be reported to engineer, for remedial measures.

8.2.6 Biological Environment

Flora

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

Table 8-11: Summary of Mitigations for Impacts on Biological Environment

Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
1.	Forest area	Direct Impact	Diversion of protected forest area (felling of road side plantation)	<ul style="list-style-type: none"> • Bearing cost for Net Present Value (NPV). • Compensatory afforestation.
2.	Wild Life	No Impact	No protected area like sanctuary, national park, biosphere reserve etc. located within 10Km of project area	<ul style="list-style-type: none"> • Provision for cattle crossing shall be provided • Avenue plantation shall act as the habitat for various faunal components.
3.	Trees Cutting	Direct Impact	Increase in soil erosion, silting of water bodies. Dust and noise pollution Loss of shade and loss of tree products	<ul style="list-style-type: none"> • Compulsory tree plantation in the ratio of 1:2. • Option of compensatory afforestation through Forest Department. • Avenue plantation along corridor, where ever possible. • Identification of incidental spaces (ox bow areas) for group plantation. • Transplantation of trees also explored.
4.	Vegetation	Direct	Increase in soil erosion, silting of water	<ul style="list-style-type: none"> • Clearing and grubbing will be

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
Consultant: Feedback Infra Pvt. Ltd



Sl. No.	Item	Impact	Reason	Mitigation / Enhancement
		Impact	bodies, noise pollution, dust pollution	minimised, and sprinkled with water to reduce dust pollution. <ul style="list-style-type: none"> Exposed surface like embankment slopes will be protected with stone pitching and turfing. Open land in and around plant will be vegetated.
5.	Cattle Grazing	No impact	No cattle grazing found	Nil

⊙ **Forest Areas - Mitigation**

The Forest Department has declared the entire avenue plantation area along the project road as protected forest as per information made available. The proposed project shall divert protected forest land as per as per Forest (conservation) Act, 1980. The application for obtaining forest clearance has already been made by the project proponent.

⊙ **Savings of Trees**

- Best effort shall be given to prevent loss of avoidable trees at every possible location.

⊙ **Transplantation**

- In order to minimise the negative impact of tree felling and to conserve the gene pool transplantation of trees shall be adopted wherever possible.
- Patel Infra to identify trees that can be transplanted and adopt methodology for transplantation. The methodology shall be approved by the Environmental expert and Employer.

⊙ **Avenue and Block Plantation**

- Avenue plantation along corridor, where ever possible shall be given to compensate the loss of trees due to felling.
- The plantation scheme shall involve a plantation contractor who shall supply and maintain the plantation as per details given in Annexure 8.6: Tree Plantation Strategy.
- Native indigenous trees species shall be used as far as practicable, strictly avoiding any exotic (but popular) species like *Eucalyptus* sp. that can have far-reaching adverse effects on the ecology and water regime of the area.
- Endeavour to initiate plantations before the construction is complete so that the trees are at least a year or two old when the project is completed.
- Patel Infra shall work out the number of trees to be planted around junctions and for enhancement purposes.
- Pure avenue plantation with single species like *Terminalia arjuna* (arjuna), *Magnifera indica* (mango), *Azadirachta indica* (neem) only to be planted for a few kilometres (or, the stretch between two market places for example) to provide harmonious and pleasing look, and a regular and wavelike skyline. This row of trees forms the first and innermost line.
- Selection of tree species in outer rows (where multiple rows can be accommodated) has been considered from economic point of view. Therefore, trees that provide fuel and fruit as well as small timber for agricultural implements have been suggested.
- The plantation of trees shall be done subject to availability of space in the proposed ROW.

Table 8-12: Species Recommended in Settlement Areas (Within 1 km of Last Dwelling)

Scientific name	Common Name	Reason
<i>Azadirachta indica</i>	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
<i>Bauhinia variegata</i> , <i>Bauhinia purpurea</i> , <i>Bauhinia racemosa</i>	Kachnar	Landscaping, Flowering plant, Pollution sink
<i>Cassia fistula</i>	Indian laburnum	Landscaping, Flowering plant, Pollution sink
<i>Ficus bengalensis</i>	Banyan	Noise barrier, Pollution sink, Shade, Supports other species, Religious values



Scientific name	Common Name	Reason
<i>Ficus religiosa</i>	Peepal	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
<i>Magnifera indica</i>	Mango	Noise barrier, Pollution sink, Economic Value, Shade

Table 8-13: Species Recommended in Rural Areas

Scientific Name	Common Name	Reason
<i>Azadirachta indica</i>	Neem	Noise barrier, Pollution sink, Economic & Medicinal Value
<i>Bauhinia purpurea, B. racemosa, B. Variegata</i>	Kachnar	Landscaping, Flowering plant, Pollution sink
<i>Butea monosperma</i>	Flame of the forest	Landscaping, Flowering plant, Pollution sink
<i>Cassia fistula</i>	Indian laburnum	Landscaping, Flowering plant, Pollution sink
<i>Ficus bengalensis</i>	Banyan	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
<i>Ficus religiosa</i>	Peepal	Noise barrier, Pollution sink, Shade, Supports other species, Religious values
<i>Magnifera indica</i>	Mango	Noise barrier, Pollution sink, Economic Value (fruit bearing)
<i>Syzygium cumini</i>	Jaman	Pollution sink, Economic Value (fruit bearing)
<i>Tamarindus indica</i>	Tamarind	Noise barrier, Pollution sink, Economic & Medicinal Value
<i>Terminalia arjuna</i>	Arjun	Noise barrier, Pollution sink
<i>Thespesia populnea</i>	Indian Tulip tree	Landscaping, Flowering plant, Pollution sink

Table 8-14: Species Recommended for Median Plantation

Scientific name	Common Name	Reason
<i>Bauhinia acuminata</i>	Kachnar	Landscaping, Flowering plant
<i>Bougainvillea sp.</i>	Bougainvillea	Landscaping, Flowering plant
<i>Hibiscus rosa sinensis</i>	Chinese Hibiscus	Landscaping, Flowering plant
<i>Lawsonia inermis</i>	Henna	Landscaping, Flowering plant
<i>Nerium indicum</i>	Pink oleander	Landscaping, Flowering plant
<i>Thevetia nerifolia</i>	Pila Kaneer, Yellow oleander	Landscaping, Flowering plant

© **Protection of Species**

Activities during the construction period are likely to have adverse impact on the plant species located along the carriageway. Tree guards shall be provided to protect the young trees in the median.

Landscaping Strategy

- Plantation along medians shall screen headlights glare from approaching vehicles and prevent distraction to the driver. Species like *Bauhinia purpurea*, *Thespesia populnea*, *Jackaranda mimosaeifolia*, *Thevetia nerifolia* etc. are recommended prevent glare from the headlights.
- Proper landscaping of the traffic islands and the surrounding areas shall integrate these features with the surrounding landscape. Junctions of relatively low importance shall be planted with flowering shrubs in the first row of planting in the curves and shade trees in the next rows. If the traffic islands are spacious enough small shrubs or ground cover shall be planted on them.
- The locations for landscaping shall be identified by Patel Infra.
- The Figures 8.5 & 8.6 shows thematic landscape sketches



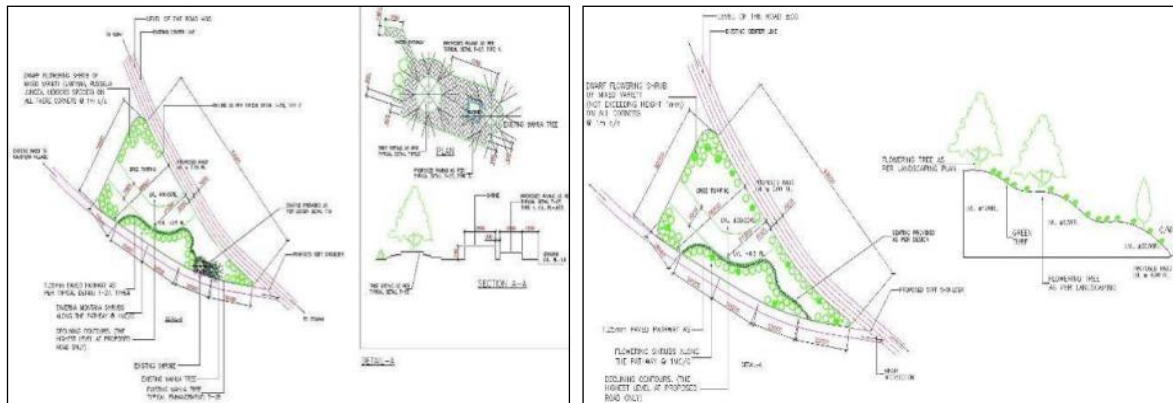


Figure 8-5: Conceptual Landscaping of Incidental Space

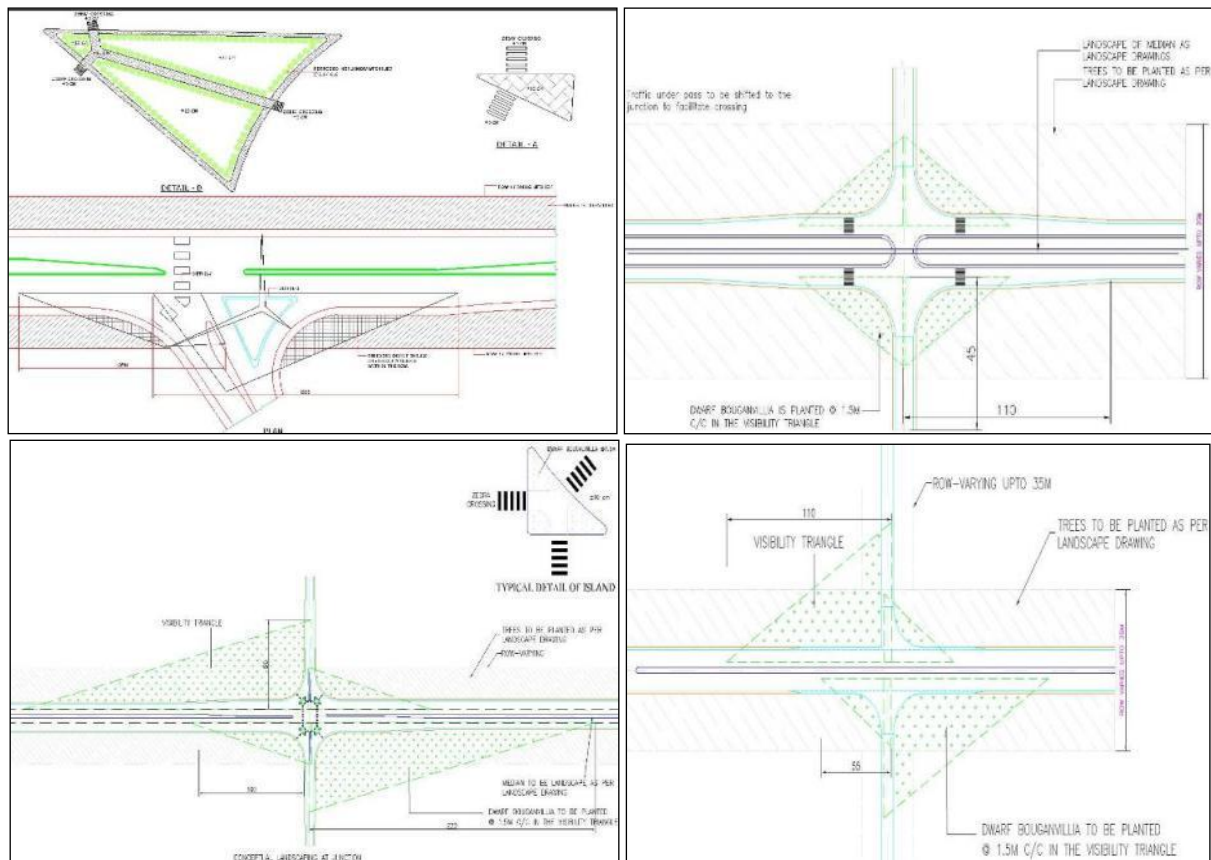


Figure 8-6: Thematic landscaping around intersections

Fauna

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

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

8.2.7 Social Environment

Entire corridor will acquire a pattern of urban and rural stretches. At certain stretches the concentration,



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

Loss of Land

No land acquisition is proposed at present. However in some secluded sections land acquisition might be involved to improve the deficiency in the curves as per IRC codes. Land if thus acquired shall be as per the process defined by Govt. of Punjab. All rehabilitation and compensation shall be based on the Resettlement Action Plan prepared for the project.

Bus Shelters and Bus Bays

The existing design is not suited to the local climate and thus only finds use during the rainy season. Further, utility of these facilities varies according to the traffic volume, intensity of user groups and visibility of the moving traffic from the bus stop and comfort conditions within the bus stop. In places where bus stops already exist, changes should be incorporated to increase the utility of these structures:

- Bus shelters shall be proposed near to residences to minimise walking distance.
- It should be positioned in straight and level sections of road and should be visible from a long distance in both directions.
- Bus bays shall be proposed as per the recommendations of IRC: 80-1981.
- New bus stops would be provided with shade, benches and railings.
- Interpretative signage would be displayed in Punjabi and English that could deliver information about the bus numbers, origin & destination and routes of buses.

Community / Cultural Resources

All of the religious/cultural structures are located beyond ROW. No cultural or community structures except few ground water source shall be affected as the proposed development will be accommodated within available ROW. However, if any structure gets affected in final design phase, the structure shall be relocated accordingly.

Disruption to the Community

⊙ Loss of Access

Patel Infra shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property access connecting the project road. The construction activities that shall affect the use of side roads and existing access to individual properties shall not be undertaken without providing adequate provisions. The construction works will not interfere with the convenience of the public or the access to, use and occupation of public or private roads whether public or private.

⊙ Traffic Control during Construction

- Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of the project road by Patel Infra. These plans shall be approved by the consultant and or the employer prior to execution. The traffic control plans will contain details of temporary diversions details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.
- Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the Engineer. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.
- Patel Infra will ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. The temporary traffic detours will be kept free of dust by frequent application of water, if necessary.
- Patel Infra will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Annexure 8.7: Traffic Control and Safety during Construction gives the details of the road safety measures to be adopted during construction.

Risks Associated - Mitigation

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

⊙ Risk from Electrical Equipment

Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from 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 Engineer.

⊙ Risk at Hazardous Activity

All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stonebreakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any toxic chemical, if any will be strictly in accordance with the manufacturer's instructions. The Engineer will be given at least 6 working days' notice of the proposed use of any toxic chemical. A register of all toxic chemicals delivered to the site will be kept and maintained up to date by Patel Infra. The register will include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, handling and storage procedures, and emergency and first aid procedures for the product.

⊙ Risk of Lead Pollution

No man / woman below the age of 18 years will be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

⊙ Risk caused by Force' Majure

All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, frowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.

⊙ Risk from Explosives

Patel Infra will not use explosives except as may be provided in the contract or ordered or authorized by the Engineer. Where the use of explosives is so provided or ordered or authorized, Patel Infra will comply with the requirements of the following sub-clauses of this clause besides the law of the land as applicable. Patel Infra will at all times take every possible precaution and will comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and will, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. Patel Infra will at all times make full liaison with and inform well in advance and obtain such permission as is required from all government authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.

⊙ Malarial Risk

Patel Infra will, at his own expense, conform to all anti-malarial instructions given to him by the Engineer; including filling up any borrow pits which may have been dug by him. Gravid, blood-laden mosquitoes cannot fly very far, so they generally bite within a kilometre or so of their breeding place. Thus borrow pits and any other water bodies created during the construction process will be situated 1 to 2km away from the human settlements. Pits dug up closer than these will be adequately drained to prevent water logging. Similarly compensatory measures for filling up part of the water bodies situated adjacent to the project corridors will be directed towards deepening of the water bodies concerned. This way the capacity of the water body remains the same, while water surface available for breeding of mosquitoes is reduced. This will have an additional advantage of decreased evaporation losses, which will be important in the water-

scarce project corridor.

⊙ **First Aid**

At every workplace, a readily available first aid unit including an adequate supply of sterilised dressing material and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided as prescribed.

⊙ **Potable Water**

In every workplace at suitable and easily accessible places a sufficient supply of cold potable water (as per IS) will be provided and maintained. If the drinking water is obtained from an intermittent public water supply then, storage tanks will be provided. All water supply storage will be at a distance of not less than 15m from any latrine, drain or other source of pollution. Where water has to be drawn from an existing well, which is within such proximity of any latrine, drain or any other source of pollution, the well will be properly chlorinated before water is drawn from it for drinking water. All such wells will be entirely closed in and be provided with a trap door, which will be dust proof and waterproof. 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 a month.

⊙ **Hygiene**

Patel Infra during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer. Refer Annexure 8.8: Guidelines for Sitting and Layout of Construction Camp.

There will be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of service) Act, 1996. Except in workplaces provided with water-flushed latrines connected with a water borne sewage system, all latrines will be provided with dry-earth system (receptacles) which will be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles will be tarred inside and outside at least once a year. If women are employed, separate latrines and urinals, screened from those for men and marked Woman in vernacular will be provided. There will be adequate supply of water, close to latrines and urinals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses take place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed of in a hygienic manner. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. Unless otherwise arranged for by the local sanitary authority, arrangement for proper disposal of excreta by incineration at the workplace will be made by means of a suitable incinerator approved by the local medical health or municipal authorities. Alternatively, excreta may be disposed of by putting a layer of night soils at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (by then it will turn into manure). On completion of the works, the whole of such temporary structures will be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively scaled off and the whole of the site left clean and tidy, at Patel Infra's expense, to the entire satisfaction of the Engineer.

8.3 ENHANCEMENT

8.3.1 Generic Enhancement Measures for Cultural Properties

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

8.3.2 Plantation

Trees not only enrich the visual quality of a space but also act as functional buffer screens to counter



pollution, define areas and provide shade. Plantation of trees has been a prime enhancement as well as mitigation measure in the project. Tree bases have been proposed around existing as well as proposed shade trees to form informal seating spaces, which are evidently preferred to the formal seating spaces. At cultural and religious properties locations, trees with religious significance like *Ficus religiosa* (Pipal), *Emblica officinalis* (Amia), *F. bengalensis* (Banyan), *Azadirachta indica* (Neem), *Magnifera indica* (mango), and *Anthocephalus cadamba* (Kadam) shall be planted. Seating arrangement as given below shall be adopted depending upon site conditions.

8.3.3 Enhancement of Cultural Properties

Enhancement of cultural properties including seating arrangements shall be provided wherever guided by the Project Manager.

8.3.4 Enhancement of Boundary Walls

Enhancement of boundary walls of Schools and hospitals by planting of creepers on the exterior wall and planting of 1 row of flowering, shade, medicinal, ornamental & fruit bearing trees inside the boundary at a distance of 3m c/c and as per directions of the Environmental Specialist.

8.3.5 Enhancement of Water Bodies

Enhancement of water bodies shall be done as per design, drawings and direction of the Environmental Specialist.

9 IMPLEMENTATION ARRANGEMENT

9.1 INTRODUCTION

The institutional arrangement proposed for the Project has been presented here with defined roles and responsibilities. The responsibility of implementing the mitigation measures lies with Patel Infra and all the construction activities being taken up by M/s Patel Infra. The PMC M/s Feedback Infra shall monitor the implementation of the work on behalf of Patel Infra, who will be responsible for planning all Environmental Management Plan (EMP) activities in the construction phase of the Project.

9.2 ENVIRONMENTAL EXPERT

For effective implementation and management of the EMP, the PMC has an Environmental Expert to deal with the environmental issues of the project. This officer shall interact with the Road Manager to ensure that the mitigation and enhancement measures mentioned in the EMP are adhered. His prime responsibility shall be to apprise the Team Leader of PMC and the Road Manager about the ground conditions. He shall also monitor that the requisite clearances and the NOCs for the project and shall also strictly supervise the adherence to the EMP. The qualifications and responsibilities of Environmental Expert are given in Box 9-1.

Box 9-1: Proposed Qualification and Responsibilities of Environmental Expert (EE)

Qualifications & Experience

- Postgraduate in Environmental Science / Environmental Management / degree in Civil Independent Engineering with specialisation in environment
- 7 years of total experience with a minimum of 3 years in the implementation of EMP of highway projects and an understanding of environmental, health and safety issues
- Prior practical experience in State and National Highways would be an advantage

Roles & Responsibilities

- Primarily responsible for implementation of the EMP on site and ensuring that the environmental quality is meeting the standards laid down by CPCB and other related authority
- The EE shall implement the EMP by assigning the necessary resources and attending such meetings as are required for the effective implementation of the EMP on behalf of M/s PATEL INFRA.
- The EE shall interact with the Road Manager to ensure that the mitigation and enhancement measures mentioned in the EMP are adhered

9.3 REPORTING SYSTEM

Reporting system provides necessary feedback to ensure quality of the works and that the program is on schedule. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the ESMF Framework and WB Guidelines provided in OPRC documents. Environmental Management Plan gets implemented in the Project. Reporting system shall be for environmental performance indicators as documented in the contract agreement. The items / performance indicators that shall be reported are:

- RoW Encroachment within five working days of observing any encroachment of RoW – Monthly
- Borrow area management – Monthly
- Construction waste management - Monthly
- Ambient Air Quality & Noise Levels in construction stretches - Quarterly (during construction period)
- Operational Management Processes including labour deployment during routine and maintenance work - Monthly
- Management of any chance discovery of archaeological remains at any site excavated under the contract. Quarterly (during construction period)
- Prevention of communicable diseases spreading to new areas due to increased communications - Quarterly

9.4 ENVIRONMENTAL CAPACITY BUILDING

Training of staff will be done at a number of levels to raise their levels of environmental awareness. The training can be conducted by either some external agency or through the help of in-house expertise. The main focus of training programmes shall be on implementation of EMP with special emphasis on OPRC Link road.



10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Environmental impacts could be positive or negative, direct or indirect, local or regional and also reversible or irreversible. The impacts generated during construction and operational phase of the roads along with management plan for these impacts has been discussed in Environmental Management Plan. Environmental management considerations in the form of EMP have been designed for project activities based on sample EMP and the Codes of practices. The EMP shall provide guidelines & help Patel Infra in implementing and incorporating environmental management practices to reduce negative environmental impacts of the project. The plan outlines existing and potential problems that may impact the environment and recommends corrective measures where required. Enhancement measures are also proposed in order to provide good environmental practices and improve the aesthetics. The EMP for the project road is being submitted separately. However, the key issues that require special attention along with the mitigations and enhancement measures to be implemented have been detailed in Table 10-1.



Table 10-1: Environmental Management Plan

Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency												
Pre-Construction Phase																	
P.1	Clearances and approvals	For construction works	<p>Secure the following clearances & NOCs prior to start of construction activity:</p> <table border="0"> <tr> <td style="text-align: center;">Type of Clearance</td> <td style="text-align: center;">Applicability</td> </tr> <tr> <td>NOC and consents under Air, Water & Environment Act and noise rules from SPCB</td> <td>For establishment of construction camp</td> </tr> <tr> <td>NOC and consents under Air, Water & Environment Act and noise rules from SPCB</td> <td>For operating construction plant, crusher, batching plant etc.</td> </tr> <tr> <td>Explosive License from Chief Controller of Explosives</td> <td>For storing fuel oil, lubricants, diesel etc.</td> </tr> <tr> <td>Quarry Lease Deed and Quarry License from State Department of Mines</td> <td>Quarry operation (for new quarry)</td> </tr> <tr> <td>Labour license from labour commissioner office</td> <td>Engagement of Labour</td> </tr> </table>	Type of Clearance	Applicability	NOC and consents under Air, Water & Environment Act and noise rules from SPCB	For establishment of construction camp	NOC and consents under Air, Water & Environment Act and noise rules from SPCB	For operating construction plant, crusher, batching plant etc.	Explosive License from Chief Controller of Explosives	For storing fuel oil, lubricants, diesel etc.	Quarry Lease Deed and Quarry License from State Department of Mines	Quarry operation (for new quarry)	Labour license from labour commissioner office	Engagement of Labour	M/s Patel Infra	PRBDB, Project Manager
Type of Clearance	Applicability																
NOC and consents under Air, Water & Environment Act and noise rules from SPCB	For establishment of construction camp																
NOC and consents under Air, Water & Environment Act and noise rules from SPCB	For operating construction plant, crusher, batching plant etc.																
Explosive License from Chief Controller of Explosives	For storing fuel oil, lubricants, diesel etc.																
Quarry Lease Deed and Quarry License from State Department of Mines	Quarry operation (for new quarry)																
Labour license from labour commissioner office	Engagement of Labour																
P.2	Ecologically sensitive areas (protected forests, reserve forests etc.)	Plantation along project road declared as protected forest	<ul style="list-style-type: none"> • Diversion of protected forest land involved • Tree felling (few numbers) to be carried out after obtaining prior permission from the District Forest Officer 	PRBDB	PRBDB, Project Manager, Forest Dept.												
P.3	Land Acquisition	ROW	<ul style="list-style-type: none"> • No Land acquisition envisaged for the project • However to correct some inherent deficiencies minor LA might be involved in few stretches. All LA shall be as per procedure laid down by the Govt. of Punjab and RAP 	PRBDB	PRBDB												
P.4	Clearance of Encroachment / squatters	ROW	Advance notice shall be given to the encroachers & squatters present, who need to be relocated as per RAP. All R&R activities will be completed prior to initiation of civil works.	PRBDB	PRBDB												
P.5	Tree Cutting	ROW	<ul style="list-style-type: none"> • Trees within the proposed widening area shall be felled along with some which pose potential safety hazard • Tree felling only after obtaining clearances from the Forest Dept • Felling of only those trees which are absolutely must • Stacking, transport and storage of the wood will be done as per Punjab State forest guidelines. 	Patel Infra and the PRBDB	PRBDB												
P.6	Preservation of Trees	ROW	<ul style="list-style-type: none"> • No tree will be cut beyond the proposed toe line. All efforts will be made to preserve trees 	PRBDB, Forest Department, Patel Infra	Project Manager												

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
P.7	Relocation of Community Utilities & Common Property Resources	Along the Project Road	All community utilities and properties i.e., hand pumps, open wells, water supply lines, sewer lines, telephone cables, buildings and health centres will be relocated before construction starts on the project road. All possible measures are to be taken to minimise inconvenience to public.	PRBDB, other Agencies and M/s Patel Infra	Project Manager
P.8	Relocation of affected Cultural and Religious Properties	Along the Project Road	<ul style="list-style-type: none"> Religious property resources such as shrines, temples and mosques will be preferably relocated beyond the RoW if affected Cultural properties affected to be relocated as per social screening and Public Consultation. LRC will finalise the details of such relocation work. 	PRBDB, M/s Patel Infra	Project Manager
P.9	Implementation Information Meeting and Disclosure of Information	Project road	<ul style="list-style-type: none"> Organise implementation information meeting in the vicinity of project site for general public to consult and inform people about plans covering overall construction schedule, safety, use of local resources, traffic safety and management plan of debris disposal, drainage protection, pollution abatement and other plans, measures to minimise disruptions, damage and inconvenience to roadside users and people along the road Locally relevant information such as Traffic Safety and Management Plan, Environment Management Measures proposed by Patel Infra, Enhancement Details, Enhancement Drawings, List of Common Property Resources, Complaints and Suggestion Book, Name & Address of the contact person, typical design cross-sections, etc. shall be disclosed by M/s Patel Infra through Project Manager 	M/s Patel Infra	Project Manager
P.10	Procurement of Crushers, Hot-mix plants & Batching Plants, other Construction Vehicles, Equipment and Machinery	For construction works	<ul style="list-style-type: none"> No crushers shall be set for the OPRC project HMP and camp site are being set at Khayala village for the entire project. Specifications of hot mix plants and batching plants, other construction vehicles, equipment and machinery to be procured will comply to the relevant Bureau of Indian Standard (BIS) norms and with the requirements of the relevant current emission control legislations 	M/s Patel Infra	PRBDB , Project Manager
P.11	Setting up of Hot mix Plants, Crushers & Batching Plant	For construction works	Hot mix plants, crushers and batching plants set up at Khayala village which is located at least 1000m away from the nearest habitation. Patel Infra in process of obtaining NOCs / Consent to Establishment & Operate the plants from the Punjab State Pollution Control Board (PSPCB) and submit a copy to the Project Manager.	M/s Patel Infra	PRBDB , Project Manager, Punjab PCB
Construction /Maintenance Phase					
C. 1	Air Pollution	Construction plants, equipment and vehicles	All vehicles used at project road shall have of valid Pollution under Control (PUC) Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract. For setting up the Construction plant at Khayala village following have	M/s Patel Infra	PRBDB, Project Manager, Appropriate Regulatory

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			been considered and maintained: <ul style="list-style-type: none"> • 1.5 km away from settlement, school, hospital on downwind directions • 1.5 km from any archaeological site • 1.5 km from ecologically sensitive areas i.e. forest, national park, sanctuary • 1.5 Km from rivers, streams and lakes 500 m from ponds • 500 m from National Highway, 250 m from State Highway, 100 m from District roads and other roads • Obtaining Consent-for-Establishment (CFE) and Obtaining Consent-for-Operation (CFO) under Air and Water Acts from the Punjab Pollution Control (PPCB). • Ensure adequate stack height for HMP as stipulated in CFE, • Install emission control devices such as bag house filters, cyclone separators, water scrubbers etc. • Greenbelt along the periphery of plant site. 		Authorities
C.2	Water Pollution	Dust during earth works or from spoil dumps	<ul style="list-style-type: none"> • To maintain adequate moisture at surface of any earthwork layer completed or non-completed to avoid dust emission. • Stockpiling spoil at designated areas and at least 5 m away from traffic lane. 	M/s Patel Infra	PRBDB, project manager, Regulatory Authorities
		Storage of maintenance materials	<ul style="list-style-type: none"> • Proper stockpiling and sprinkling of water as necessary 	M/s Patel Infra	PRBDB, project manager, Regulatory Authorities
		Clearing of waterways of cross drainage works including bridges and clearing of longitudinal side drains	<ul style="list-style-type: none"> • Clearance of waterway will be undertaken before onset of monsoon i.e. early in the month of June. • Debris generated due to clearing of longitudinal side drains and waterways of cross drainage will be stored above high flood level and away from waterway, and reused on embankment slope or disposed at designated areas. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.3	Noise Pollution and Vibration	Construction vehicles	Avoiding cleaning / washing of construction vehicle in any water body	M/s Patel Infra	Project Manager
		Construction camp and workers' camp	<ul style="list-style-type: none"> • Minimum distance of 1.5 km from river, stream and lake and 500 m from ponds. • Locate facilities in areas not affected by flooding and clear of any natural or storm water courses. • The ground should have gentle slope to allow free drainage of the site. • The camp must have impervious flooring to prevent seepage of any leaked oil & grease into the ground. The area should be covered with a roof to prevent the entry of rainwater. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			<ul style="list-style-type: none"> Degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any. 		
		Throughout Project Corridor, Construction Vehicles, Plants and Equipment	<p>Site Controls: All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.</p> <p>Noise standard at processing sites, eg. Aggregate crushing plants, batching plant, hot mix plant will be strictly monitored to prevent exceeding of noise standards.</p> <p>Scheduling of Project Activities: Operations will be scheduled to coincide with period when people would least likely to be affected. Construction activities generating noise level more than 75 dB (A) will be avoided between 10 P.M. and 6 A.M. near residential areas.</p> <ul style="list-style-type: none"> Protection devices: (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines. Construction equipment and machinery will be fitted with silencers and maintained properly. Source-control through proper maintenance of all equipment. Use of properly designed engine enclosures and intake silencers. Vehicles and equipment used will conform to the prescribed noise pollution norms. Movements of heavy construction vehicles and equipment near public properties will be restricted. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.4	Land Pollution	Spillage from plant and equipment at construction camps	<ul style="list-style-type: none"> Providing impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform. Collection oil and lubes drips in container during repairing construction equipment vehicles. Providing impervious platform and collection tank for spillage of liquid fuel and lubes at storage area. Providing bulk bituminous storage tank instead of drums for storage of bitumen and bitumen emulsion. Providing impervious base at bitumen and emulsion storage area and regular clearing of any bitumen spillage for controlled disposal and Reusing of bitumen spillage if any. Disposing non-usable bitumen spills in a deep trench providing clay 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			lining of 300 mm at the bottom and filled with soil at the top (for at least 0.5 m) to encourage vegetation growth. <ul style="list-style-type: none"> All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. 		
		Domestic solid waste and liquid waste generated at camps	<ul style="list-style-type: none"> Collecting kitchen waste at separate bins and disposing of in a pit at designated area. Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.5	Borrow Areas	Borrow area used for project road	<ul style="list-style-type: none"> 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 Patel Infra. Patel Infra will not start borrowing of earth from any borrow area until the formal agreement is signed between landowner and Patel Infra and the copy of agreement shall be submitted to the Project Manager. Planning of haul roads for accessing borrow areas will be undertaken during this stage. The haul roads shall be routed to avoid agricultural areas as far as possible and will use the existing village roads wherever available. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.6	Quarry	Establishment of Quarry site if required	<ul style="list-style-type: none"> No quarrying activity is envisaged for the project. However if required, Patel Infra will procure all necessary permissions for procurement of material from the Mining Department, District Administration and State Pollution Control Board and shall submit a copy of the approval and the rehabilitation plan to PRBDB through the Monitoring Consultant. M/s Patel Infra will also work out haul road network and report these details to the Project Manager who will inspect and in turn report to PRBDB before approval. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.7	Arrangement for Construction Water	Construction camp and Project road	<ul style="list-style-type: none"> The M/s Patel Infra will use ground / surface water as a source of water for the construction and where necessary set up own bore well facility for construction work. To avoid disruption/disturbance to other water users, Patel Infra will extract water from fixed locations and consult with the Project Manager before finalising the locations. Patel Infra will provide a list of locations and type of sources from where water for construction will be extracted. Patel Infra will need to comply with the requirements of the State Ground Water Department for the extraction and seek their approval for doing so and submit copies of the permission to the Project 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			Manager and the PRBDB.		
C.8	Sand	Riverbeds	<ul style="list-style-type: none"> The sand will be procured from identified approved sand mines or vendors The M/s Patel Infra will obtain copy of the Lease agreement of the supplier and submit this to the Project Manager before procuring the sand. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.9	Clearing and Grubbing	Within ROW	<ul style="list-style-type: none"> Vegetation will be removed, if required before commencement of construction. All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimised. Only ground cover/shrubs that impinge on the permanent work or necessary temporary work will be removed. Patel Infra under any circumstances will not cut or damage trees outside of the construction zone. Trees identified for removal will be cut only after receiving clearance from the forest department and after that the receipt of PRBDB's written confirmation in this regard. Vegetation only with girth of over 30 cm will be considered as trees. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.10	Disposal of debris from dismantling structures and excavation of the existing road surface and pavements	Within ROW	<p>Debris generated due to the excavation of the existing road will be suitably reused in the proposed construction, subjected to the suitability of the materials and approval from the Project Manager as follows:</p> <ul style="list-style-type: none"> The sub-grade of the existing pavement may be used as embankment fill material. The existing sub base material may be recycled as sub base of any haul road or access road. The existing bitumen surface may be utilised for the paving of access roads and paving works in construction sites and campus, temporary traffic diversions, haulage routes etc. Patel Infra shall identify disposal sites report to the Project Manager. This location will be checked on site and accordingly approved prior to any disposal of waste materials. All arrangement for transportation during construction including provision, maintenance, dismantling and clearing debris, will be considered incidental to the works and will be planned and implemented by Patel Infra. Debris generated from other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area. No debris will be staged on the road or culvert/bridges locations. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.11	Drainage	Within ROW	<ul style="list-style-type: none"> Patel Infra shall ensure that no construction materials like earth, stone, or similar is disposed off in a manner that may block the flow of water 	Patel Infra	PRBDB, Project Manager,

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			<p>of any water course and cross drainage channels.</p> <ul style="list-style-type: none"> Patel Infra will take all necessary measures to prevent any blockage to the water flow. In addition to the design requirements, Patel Infra will take all required measures as directed by the Project Manager to prevent temporary or permanent flooding of any site or any adjacent area. 		Regulatory Authorities
C.12	Siltation of Water Bodies and Degradation of Water Quality	Borrowing of earth for embankment construction	<ul style="list-style-type: none"> Patel Infra will not excavate beds of any stream/canals/ any other water body for borrowing earth for embankment construction. If required Patel Infra will construct silt fencing at the base of the embankment construction where these are adjacent to water bodies and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthwork and maintained in an effective state until the stabilisation of the embankment slopes has occurred. Patel Infra will ensure that construction materials containing fine particles are stored in a suitable enclosure such that sediment-laden water does not drain into any nearby watercourse. 	Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C.13	Planning for Traffic Diversions and Detours	Project road	<ul style="list-style-type: none"> Any temporary traffic diversions need to be constructed after approval from the Employer and under the supervision of the Project Manager. Detailed Traffic Control Plans will be prepared by Patel Infra and approved by the Project Manager 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 for night time traffic and precaution for transportation of hazardous materials and arrangement of flagmen. Patel Infra will provide specific measures for safety of pedestrians, school children's (close to project road) and workers at night as part of traffic control plans and ensure that the diversion/detours are always maintained in usable condition, particularly during the monsoon to avoid disruption to traffic flow. Patel Infra will also inform local community of changes to traffic routes, conditions and pedestrian access arrangements with assistance from the LRC and the PRBDB. The temporary traffic detours will be kept free of dust by sprinkling of water at a sufficient frequency and as required under specific conditions (depending on weather conditions, construction in the settlement areas and volume of traffic). <p>Safety of Children Entering or Exiting Schools</p> <ul style="list-style-type: none"> Where the work site is within 500m of a school entrance, Patel Infra 	Patel Infra	Project Manager, Traffic Police

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			will shall provide a specific traffic management plan that clearly demonstrates the extra steps to mitigate risk for school children passing through the work site.		
C.14	Accidents	Project road	Patel Infra will provide, erect and maintain barricades, including sign boards, road marking, traffic lights for night traffic and flagmen as required by the Project Manager	M/s Patel Infra	Project Manager, Traffic Police
C. 15	Public Health and Safety	Project road	Debris generated will be disposed to the satisfaction of Project Manager. Monitoring of air, water, noise and land during construction and operational phase.	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 16	Risk from Operations	Project road	<ul style="list-style-type: none"> M/s Patel Infra shall comply with all the precautions as required for the safety of the workmen as per the International Labour Organisation (ILO) Convention No. 62 as far as those are applicable to this contract. M/s Patel Infra shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. M/s Patel Infra shall comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. Minimise significant hazards, where elimination and isolation are both impractical No child labour shall be utilized in the project 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 17	Risk caused by Force' Majure	Project road	<ul style="list-style-type: none"> All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 18	First Aid	Project road, construction site etc.	<ul style="list-style-type: none"> At every workplace, a readily available first aid unit including an adequate supply of sterilised dressing material and appliances will be provided as per the Factory Act. Workplaces, remote and far away from regular hospitals will have indoor heath units with one bed for every 250 workers. Suitable transport will be provided to facilitate take injured or ill person(s) to the nearest applicable hospital. At every workplace and construction camp, equipment and nursing staff shall be provided. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 19	Safety Measures During Construction	Project road, construction site etc.	<ul style="list-style-type: none"> All relevant provisions of the Factories Act, 1948 and The Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 will be adhered at site. Adequate safety measures for workers during handling of materials at site will be taken up. The register will include the trade name, physical properties and 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.		
C. 20	Hygiene	Camp site	<ul style="list-style-type: none"> All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Latrines shall be provided with septic tank for the workers and labours inside the camps. Garbage bins must be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner. Adequate health care is to be provided for the work force. Unless otherwise arranged for by the local sanitary authority, the local medical health or municipal authorities. On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, septic tank and other disposal pits filled in and effectively sealed off and the outline site left clean and tidy, at Patel Infra's expense, to the entire satisfaction of Project Manager 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 21	Transmission of Diseases and HIV/ AIDS prevention and control	Workers / labourers Camp along the project	<ul style="list-style-type: none"> M/s Patel infra will create awareness among workers to prevent transmission of diseases between the local inhabitants and the labourers engaged for the works, including sexually transmitted diseases. Patel Infra will engage a professional agency for implementing the guidelines laid down in the policy and communicate to OPRC project M/s Patel Infra shall extend necessary support to the appointed agency by deputing the workmen to attend the awareness creation programmes. 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities
C. 22	Prevention of Mosquito Breeding	Workers / labourers Camp along the project	<p>Measures shall be taken to prevent breeding at site. The measures to be taken shall include:</p> <ul style="list-style-type: none"> Empty cans, oil drums, packing and other receptacles, which may retain water shall be deposited at a central collection point and shall be removed from the site regularly. Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding. Patel Infra equipment and other items on the site, which may retain water, shall be stored, covered or treated in such a manner that water could not be retained. Water storage tanks shall be provided. Posters in Hindi, Punjabi and English which draw attention to the 	M/s Patel Infra	PRBDB, Project Manager, Regulatory Authorities

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Sl. No.	Environmental Issue	Location / sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
			<p>dangers of permitting mosquito breeding shall be displayed prominently on the site.</p> <ul style="list-style-type: none">• Patel Infra at periodic interval shall arrange to prevent mosquito breeding by fumigation / spraying of insecticides		

10.2 ENVIRONMENTAL MONITORING PROGRAMME

To mitigate the potential negative impacts of OPRC Link road, an Environmental Monitoring Plan is developed typically to identify the mitigation measures to be undertaken during construction, and operation stages. The formulation of an appropriate environmental monitoring plan and its diligent implementation are key to overall success for the project. Monitoring includes:

- Selection of environmental parameters at specific locations;
- Sampling and regular testing of these parameters.

10.3 Monitoring Parameters and Standards

The Environmental monitoring of the parameters involved and the threshold limits specified are discussed below:

10.3.1 Ambient Air Quality Monitoring (AAQM)

The air quality parameters viz: Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Particulate Matters (PM_{2.5} & PM₁₀) shall be regularly monitored at identified locations from the start of the construction activity. The air quality parameters shall be monitored in accordance with the National Ambient Air Quality Standards as given in Table 10-2. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan in Table 10-6.

Table 10-2: National Ambient Air Quality Standards

Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
1	Sulphur Dioxide (SO ₂) µg/m ³	Annual*	50	20	- Improved West & Gaeke - Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO ₂) µg/m ³	Annual*	40	30	- Modified Jacob and Hochheiser (Na-Arsenite) - Chemilumiscence
		24 hours**	80	80	
3	Particulate Matter (size less than 10 µm) or PM ₁₀ µg/m ³	Annual*	60	60	- Gravimetric - TOEM - Beta attenuation
		24 hours**	100	100	
4	Particulate Matter (size less than 2.5µm) or PM _{2.5} µg/m ³	Annual*	40	40	- Gravimetric - TOEM - Beta attenuation
		24 hours**	60	60	
5	Ozone (O ₃)µg/m ³	8 hours**	100	100	- UV photometric - Chemilumiscence - Chemical Method
		1 hours**	180	180	
6	Lead (Pb) µg/m ³	Annual*	0.50	0.50	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO) (mg/m ³)	8 hours**	02	02	- Non Dispersive Infra-Red (NDIR) spectroscopy
		1 hours**	04	04	
8	Ammonia (NH ₃) µg/m ³	Annual*	100	100	- Chemilumiscence - Indophenol Blue Method
		24 hours**	400	400	
9	Benzene (C ₆ H ₆) µg/m ³	Annual*	05	05	- Gas chromatography based continuous analyser - Adsorption and Desorption followed by GC analysis
10	Benzo(a) Pyrene Particulate Phase only ng/m ³	Annual*	01	01	- Solvent Extraction followed by HPLC/GC analysis
11	As ng/m ³	Annual*	06	06	- AAS/ICP method after sampling on EPM 2000 or

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Sl. No.	Pollutants	Time-weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural & other Areas	Ecologically Sensitive Areas (notified by Central Government)	
					equivalent filter paper
12	Ni ng/m ³	Annual*	20	20	- AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or monitoring and further investigation.

Source: MoEF Notification dated 16th November, 2009

10.3.2 Noise Quality Monitoring

The noise levels shall be monitored at already designated locations in accordance with the Ambient Noise Quality standards given in Table 10-3 below. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan Table-10.6.

Table 10-3: National Ambient Noise Quality Standards

Category of Area / Zone	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Note: (1) Day time shall mean from 6.00 a.m. to 10.00 p.m. (2) Night time shall mean from 10.00 p.m. to 6.00 a.m. (3) Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority (4) Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

10.3.3 Water Quality Monitoring

Water quality parameters such as pH, BOD, COD, DO, coliform count, total suspended solids, total dissolved solids, Iron, Fluorides etc. shall be monitored at all identified locations during the construction stage as per standards prescribed by Central Pollution Control Board and Indian Standard Drinking water specifications IS 10500, 1991, presented in Table 10-4 & 10-5 respectively. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed out in the Environmental Monitoring Plan in Table 10-6.

Table 10-4: Primary Water Quality Standards

S. No.	Designated Best Use	Class of Water	Criteria
1	Drinking Water source (with conventional treatment)	A	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 50 or less pH between 6.5 to 8.5 Dissolved Oxygen 6 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 200C 2 mg/1 or less
2	Outdoor bathing (organised)	B	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 500 or less pH between 6.5 to 8.5 Dissolved Oxygen 5 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less

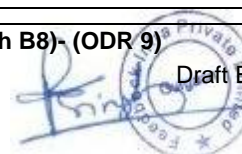
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S. No.	Designated Best Use	Class of Water	Criteria
3	Drinking Water source (without conventional treatment)	C	<ul style="list-style-type: none"> Total Coliform MPN/100 ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg / 1 or more Biochemical Oxygen demand (BOD) 5 days 200C 3 mg/1 or less
4	Propagation of Wildlife	D	<ul style="list-style-type: none"> pH between 6.5 to 8.5 for fisheries Dissolved Oxygen 4 mg / 1 or more Free Ammonia (as N) 1.2 mg/1 or less
5	Irrigation, Industrial Cooling, Controlled Waste	E	<ul style="list-style-type: none"> pH between 6.0 to 8.5 Electrical Conductivity at 250C μmhos/cm Max. 2250 Sodium absorption ratios Max. 26 Boron, Max.2 mg/1

Ref: CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

Table 10-5: Indian Standard Drinking Water Specifications (IS 10500: 1994)

S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
Essential Characteristics						
1	Colour, Hazen Units, Max.	5	Above 5, consumer acceptance decreases	25	3025 (part4) 1983	Extended to 25 only if toxic substances, in absence of alternate sources.
2	Odour	Unobjectionable	-	-	3025 (parts 5): 1984	A test cold and when heated. Test at several dilution
3	Taste	Agreeable	-	-	3025 (part 8): 1984	Test to be conducted only after safety has been established
4	Turbidity NTU, Max.	5	Above 5, consumer acceptance decreases	10	3025 (part 7): 1984	
5	PH value	6.5 to 8.5	Beyond this range the water will not effect the mucous membrane and /or water supply system	No relaxation	3025 (part 11): 1984	
6	Total hardness (as CaCo ₃) mg/1, Max.	300	Encrustation in water supply structures an adverse effect on domestic use	600	3025 (part 21): 1983	
7	Iron (as Fe) mg /l Max.	0.3	Beyond this limit taste/appearance are affected has adverse effect on domestic uses and water supply structures and promotes iron bacteria	1	3025 (part 21): 1983	
8	Chlorides (as Cl) mg/1 Max.	250	Beyond this limit, taste corrosion and palatability are affected	1000	3025 (part 32): 1988	
9	Residual, free chloride, mg/1 Min.	0.2			3025 (part 26): 1986	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral

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S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
						infection is required, it should be Min. 0.5 mg/1
Desirable characteristics						
1	Dissolved solids mg/1 Max.	500	Beyond the palatability decreases and may cause gastro intestinal irritation	2000	3025 (part 16): 1986	
2	Calcium (as Ca) mg/1 Max.	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 16) 1986	
3	Magnesium (as Mg) mg/1, Max.	30	Encrustation in water supply structure and adverse effects on domestic use	1.5	16,33,34 of IS 3025: 1964	
4	Copper (as Cu) mg/1 Max.	0.05	Beyond taste, discoloration of pipes, fitting and utensils will be caused beyond this	0.3	35 of 3025: 1964	
5	Manganese (as Mn) mg/1, Max.		Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	35 of 3025: 1964	
6	Sulphate (as 200 So2), mg/1, Max.	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	3025(part 24): 1986	May be extended up to 400 provided (as Mg) does not exceed 30
7	Nitrate (as No2) mg/l, Max.	45	Beyond this methaemoglobinemia take place	100	3025 (part24): 1988	To be tested when pollution is suspected
8	Fluoride (as F) mg/1, Max.	1	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	23 of 3025:1964	To be tested when pollution is suspected
9	Phenolic compounds (as C6H5OH) mg/1, Max.	0.001	Beyond this it may cause objectionable taste and odour	0.002	54 of 3025:1964	To be tested when pollution is suspected
10	Mercury (as Hg) mg/1, Max.	0.001	Beyond this the water becomes toxic	No relaxation	(See not mercury ion analyses)	To be tested when pollution is suspected
11	Cadmium (as cd), mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected
12	Selenium, (as Se). mg/1, Max.	0.01	Beyond this the water becomes toxic	No relaxation	28 of 3025:1964	To be tested when pollution is suspected
13	Arsenic (As) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 37); 1988	To be tested when pollution is suspected
14	Cyanide (as CN) mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	3025 (part 27) 1988	To be tested when pollution is suspected
15	Lead (as Pb), mg/1, Max.	0.05	Beyond this the water becomes toxic	No relaxation	(See note)	To be tested when pollution is suspected

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S. No.	Substance / Characteristics	Requirement (desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Methods of Test (ref. To IS)	Remarks
16	Zinc (as Zn) mg/1, Max.	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	39 of 3025:1964	To be tested when pollution is suspected
17	Anionic detergents (as MBAS) mg/1, Max.	0.2	Beyond this it can cause a light froth in water	1	Methylene-blue extraction method	To be tested when pollution is suspected
18	Chromium (as Cr6+) mg/1, Max.	0.05	May be carcinogenic above this limit	No relaxation	38 of 3025:1964	To be tested when pollution is suspected
19	Poly nuclear aromatic hydrocarbons (as PAH) mg/1, Max.	-	May be carcinogenic above this limit	-	-	-
20	Mineral oil mg/1, Max.	0.01	Beyond this limit undesirable taste and odour after chlorination take place.	0.03	Gas Chromatography method	-
21	Pesticides mg/1, Max.	Absent	Toxic	0.001	-	-
22	Radioactive material	-	-	-	58 of 3025:1964	-
23	Alpha emitters bq/1, Max.	-	-	0.1	-	-
24	Beta emitter pci/1, Max.	-	-	1	-	-
25	Aluminium (as Al) mg/1, Max.	200	Beyond this limit taste becomes unpleasant	600	13 of 3025:1964	-
26	Aluminium (as Al) mg/1, Max.	0.03	Cumulative effect is reported to cause dementia	0.2	31 of 3025:1964	-
27	Boron mg/1, Max.	1	-	5	29 of 3029:1964	-

Source: Indian Standard Drinking Water Specification – IS 10500, 1994

10.4 Environmental Monitoring Plan

The Environmental Monitoring Plan is given in table below.

Table 10-6: Environmental Monitoring Plan

Environmental Component	Project Stage	Monitoring						Institutional Responsibility	
		Parameters	Special Guidance	Standards	Location	Frequency	Duration	Implementation	Supervision
Air	Construction Stage	PM10, PM2.5, SO2, NOX, CO,	High volume sampler to be located in the downwind direction. Use method specified by CPCB for analysis	Air (Prevention and Control of Pollution) Rules, CPCB, 1994	At construction stretches and camp	Three seasons annually for construction period	As per MoEF notification on Ambient Air Standard dated 16th November 2009 or its subsequent amendments	M/s Patel Infra through approved agency	PRBDB, Project Manager
Water Quality	Construction Stage	pH, Turbidity, TSS, TDS, COD, BOD, DO, Chlorides, Hardness, Oil & Grease, TSS, TDS, Total Coliform, Iron, Fluorides, Nitrates, E. coli, Total coliform, faecal coliform etc. as per IS 10500:1991	Grab sample collected from source and analyse as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	At sources of water identified for construction purpose and camp	Once during pre and post monsoon every year for 3 years	Once during a season		
Noise Levels	Construction Stage	Noise levels on dB (A) scale	Equivalent Noise levels using an integrated noise level meter kept at within a distance of 5 m from edge of Pavement	Noise standards by CPCB	At construction stretches and camp	Once during three seasons annually for construction period	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged		
Construction Sites and Construction Camps	Construction Stage	Monitoring of: Storage Area Drainage arrangements Sanitation in Construction Camps	The parameters mentioned are further elaborated in the reporting formats. These are to be checked for adequacy.	To the satisfaction of the employer and the standards	As storage area and construction camps	Quarterly in the construction stage	M/s Patel Infra		

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10.4.1 Monitoring of Earthworks Activities

Most of the environmental problems related to the construction works are anticipated to be associated with the earthworks, particularly for the Quarries and Borrow Areas. Details regarding the guidelines and procedures adopted to minimise the environmental impacts of opening, operating and closing of Quarries and Borrow Areas are presented in Annexure 8.3 & 8.4. Other environmental effects associated with the earthworks include the development of adequate temporary drainage to minimise detrimental effects (e.g. erosion) due to run-off, and safety aspects related to Works implementation.

10.5 BUDGET

The environmental budget for the various environmental management measures proposed in the EMP is detailed in table below. The rates adopted for the budget has been worked out on the basis of market rates.

Table 10-7: Environmental Budget

Item No.	Component	Description	Cost in Crores
1	Mitigation / Enhancement Cost		
1.1	Construction Stage		
1.1	Air	Dust Management with sprinkling of water, covers for vehicles transporting construction material	0.075
1.2	Environmental Enhancements	Enhancement of 2 water bodies at locations and chainages as per design, drawings and direction of the Environmental Engineer / Environmental Specialist of the Engineer.	0.050
1.3		Enhancement of cultural properties including seating arrangements.	0.010
1.4		Enhancement of boundary walls of 1 schools by planting of creepers on the exterior wall and planting of 1 row of flowering, shade, medicinal, ornamental & fruit bearing trees inside the boundary at a distance of 3m c/c and as per directions of the Engineer	0.010
Total Mitigation / Enhancement Cost			0.095
2	Monitoring Cost		
2.1.1	Air	Sampling, monitoring & analysis of ambient Air Quality and gaseous pollutants as per CPCB Standard Procedures at as per direction by Environmental Specialist as per CPCB guidelines	0.016
2.1.2	Water	Sampling, monitoring & analysis of water Quality as per Standard Procedures at as per direction by Environmental Specialist as per CPCB guidelines	.013
2.1.3	Noise	Monitoring Noise level as per directions of Environmental Specialist as per CPCB guidelines	0.008
2.1.4	Transportation Cost	Transportation cost for monitoring	0.003
Total Monitoring Cost			0.04
3	Miscellaneous Cost		
3.1	Training	Training	0.025
3.2	Advocacy and Policy Making	Holding meetings for policy planning and subsequent review meetings with Revenue Department, Forest Department, local representatives, NGOs, etc. regarding development controls.	0.014
3.3	Administrative Charges including logistics	Maintenance of vehicle with the Environment Cell, Data processing, administrative support, stationery etc.	0.042
3.4	Miscellaneous Items	Digital Camera for the Environment Cell	0.001
Total Miscellaneous Cost			0.082
Total Cost			0.217
Contingency @ 5% on Total Environmental Cost			0.010
Grand Total			0.227



11 BORROW AREAS STUDIES

11.1 IMPACT ASSESSMENT OF BORROW AREAS FOR THE PROJECT

Borrow areas are required to be identified in order to supply earth materials for filling materials to be used in sub grade and embankments. It is the endeavour to utilise the cut materials generated from the project road to be utilised in the embankment and sub grade. However the quantity generated is not sufficient to meet the demand of the filling materials and hence borrow areas are to be identified and selected after material testing to use as fill materials.

11.1.1 Quantities Required

Significant borrowing of earth is required for the embankment fill material, and for the construction of the pavement, sub grade and fill materials

Use of Fly Ash as Fill Material

The last 10 Km of the project road falls within 100 km of Kota Thermal Power Station. As per MoEF notification on fly ash, fill material required for the project should be filled up of fly ash from the Thermal Power Station. Since the proposed embankment height on an average is less than 1 m, technically it isn't feasible to use fly ash as per IRC-SP-58: Guidelines for Use of Fly Ash in Road Embankments, which stipulates that the earthen casing to be provided for fly ash layers to be of 1 to 3 m thick depending upon the height of embankment. The minimum casing stipulated is 0.5m for 1m high earthen embankments.

11.1.2 Proposed Borrow Areas

Siting

Specific locations of borrow areas to be used will be identified by Patel Infra based on environmental as well as civil engineering considerations. Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoEF, PWD and as specified in IRC: 10-1961.

Patel Infra shall establish new borrow areas only with the prior consent of the Client or Client's Engineer. Certain precautions have to be taken to restrict unauthorised borrowing by Patel Infra. No borrow area shall be opened without permission of the Authority's Engineer. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Engineer that there is no suitable uncultivable land in the vicinity for borrowing or private landowners are willing to allow borrowing on their fields. The construction schedule and operations plans to be submitted to the Authority's Engineer prior to commencement of work shall contain a detailed work plan for procuring materials that includes procurement; transportation and storage of borrow earth material. Patel Infra shall provide the following:

Selection Criteria

Borrow areas shall be identified based on a number of selection criteria. These include:

- Total amount of borrow area available and quantity that can be made available
- Lead distance of the borrow area from the project road
- Existing land use including Agricultural / Barren / Scrub / grazing / any other type (priority were given to barren & non-agricultural areas)
- Alternative sites
- Ownership of the land
- Vegetation / trees to be removed
- Erosion / degradation potential
- Distance and name of the nearest settlement
- Distance from the nearest surface water body
- Drainage pattern of the area
- Distance of the nearest Reserve Forest (if any)
- Distance of the nearest Sacred Tree (if any)
- Suitability of material for sub grade and embankment use through material testing

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- Distance from the nearest school / hospital / primary health centre
- Daily / Occasional use of borrow area by the community
- Any schemes or avenues for generation of income for adjoining community
- Record any public consultations involved while choosing and what the public concerns were, if any.

Agreement with Landowners

Patel Infra shall sign a lease / purchase agreements with the present owner of the land & furnish the statement of ownership of the land along with lease / purchase agreements to the Project Proponent.

NOC from the Gram Panchayat / Local body

NOC from the Gram Panchayat / Local Bodies shall be collected for each and every individual borrow areas and submitted at the stage.

Location and Layout

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

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

Documentation of Borrow Pit

Following checklist provides guidelines in order to ensure that redevelopment of borrow areas must comply with MoSRT&H, Clause 305.2.2.2 and EMP Requirement. Patel Infra shall ensure that following data based must be documented for each identified borrow areas that provide the basis of the redevelopment plan.

- Chainage along with offset distance
- Area (in Sq. m)
- Type of Access/width/kutcha/pucca etc. from carriageway
- Soil Type
- Slope / Drainage Characteristics
- Water Table of the area or identify from nearest well etc./ask people
- Existing Land-use such as barren/agricultural/grazing land
- Location/Name/Population of Nearest Settlement/Community & distance from Borrow Area
- Daily / occasional use of the Borrow Area by the community, if any
- Identification of any other community facility in the vicinity of the borrow pit

Workers Accommodation & Other Infrastructure

- Patel Infra shall provide details of how many workers will be accommodated on site and what the accommodation arrangements and standard will be.
- All basic amenities and other infrastructure requirement of the labourers shall be made available by Patel Infra

Removal of trees and plants

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

Approach road

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

Dismantling and removal of machinery

- Patel Infra to state whether and when this shall be done.

Slope stabilisation and / or protection

- Measures taken to protect the slope and to guard against any possible serious hazards

Hand-over

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

Removal of debris and solid waste

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

For each borrow area source, the plan should be the same. The box below gives the format:

Box 11-1: Borrow Area Plan Format

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



11.1.3 Impact

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

Pre-Construction Stage

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

Construction Stage

Cartage of the borrow materials to the construction sites can be of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protection measures need to be worked out for the minimising of such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated can be a major potential problem. In addition to visual blight, the other problems more down-to-earth are the safety issues. At borrow area locations where the owners are willing to create ponds for fisheries etc., proper protection measures for the drainage of the surrounding land and slope protection measures need to be worked out.

The soils along the corridor are in general capable to produce high yielding agricultural produce and may be negatively impacted if unduly borrowed. The loss of productive topsoil due to road construction is a direct adverse long-term impact. Patel Infra should ensure that in all such locations topsoil must be stacked aside and replaced after the borrowing activity is over. The soil heaps should be periodically compacted and sprinkled with water to avoid loss. Emphasis should be laid on maximum use of the stripped topsoil in medians, road junctions, redevelopment of borrow areas and additional landscaping works in the road project. The project shall take enforcement measures to prevent / minimise the use of topsoil from other locations such as borrow areas, stockyards, lands for diversions.

11.1.4 Mitigations, Enhancement & Rehabilitation of Borrow Areas

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

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

For opening new borrow areas other than those identified Patel Infra shall follow section 11.6 above. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Authority's Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private land owners willing to allow borrowing on their fields. Borrowing of earth shall be carried out at locations recommended as follows:

- **Non-Cultivable lands:** Borrowing of earth will be carried out to a depth of 1 m. The borrowing of earth shall not be done continuously and the slope of the edges shall be maintained at not more than 1:4.
- **Productive lands:** Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, Patel Infra has to obtain the prior permission of the Authority's Engineer. At such locations, the depth of borrow pits shall not exceed 45 cm and if may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside and the topsoil shall be carried out and preserved.



- **Borrow Areas near Settlements:** Borrow pit location shall be located at least 0.8 km from villages and settlements. If unavoidable, they should not be dug for more than 30 cm and should be drained.

To avoid any embankment slippages, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Authority's Engineer. The borrow pits will be redeveloped by filling and providing 150 mm thick layer of preserved top-soil; by creating shallow pond for water harvesting etc. Replantation of trees along the edges of borrow areas will be carried out.

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

Rehabilitation

- The objective of the rehabilitation programme is to return the borrow pit sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing borrow pits sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the borrow pit floor to approximately the access road level.
- It is important to plan restoration from the outset and coordinate restoration activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework rehabilitation often leads to the creation of wetlands and or recreation areas.
- Special borrow pit rehabilitation plan shall be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., the re-greening and replanting methods..

Other criteria which shall be followed for rehabilitation of quarry/ borrow pits are as given below:

- Borrow pits can be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, Patel Infra shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; reestablishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense Patel Infra shall restore the environment around the work site to its original splits.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.
- The borrow pit immediate surroundings shall be developed as a low maintenance reserve, with significant areas of native trees and shrubs and areas of longer grass and tussocks forming the open spaces. Walkways around the borrow site may be constructed. Provision for a future drive-in picnic area and car parking area may be developed.

Guidelines for Enhancement

As far as possible borrow area selected for enhancement shall be on government / community land in the vicinity of settlement. Patel Infra must ensure that any enhancement design proposed should be workable, maintenance free and preferably worked out in consultation with the community and proposed enhancement materials should be locally available. The borrow area can be developed either of the following:

Vegetative Cover

- Vegetative cover must be established on all affected land.

- 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 mixture thereof.
- Plant material must be planted during the first growing season following the reclamation phase.
- Selection and use of vegetative cover must take into account 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;
- The planting results in 90% ground coverage.
- The site shall be inspected when the planting is completed and again at one year to ensure compliance with the reclamation plan.

Certificate of Completion of Reclamation

- Patel Infra shall obtain certificate of satisfaction from the landowner and submits it to the Authority's Engineer before final payment is to done.

Working Plan

Patel Infra shall prepare a working plan before enhancing the identified borrow areas. Following are the inputs that provide the guidelines to Patel Infra to formulate the working plan:

- Access of Property / width of access / material
- Orientation of property with respect to the road
- Site Slope
- Local Drainage / water logging etc. if any
- Location of nearest culvert etc. if any to drain water if required
- Any other community resources such as tube well/well etc. in vicinity
- Location of trees including Species / girth / foliage spread and afternoon shaded area on ground
- Surrounding land use; nearby settlements (name of structure/pattern of settlement)
- Mark on plan part of the borrow area, most suitable for storing and staking topsoil.

Photographs to Include

Patel Infra shall ensure that photographs are to be taken before and after the excavation of borrow materials and also after the implementation of redevelopment plan, incorporating the following:

- Overall View from access side
- Any other community resource in the vicinity
- All spots to be detailed such as access to borrow pit /cluster of existing trees etc.

12 DISCLOSURE OF CONSULTANT

12.1 CONSULTANT'S DETAILS

Feedback Pvt. Ltd. (FIPL) is India's leading integrated infrastructure Services Company, with a mission of **"Making Infrastructure Happen"**. Totally focused on infrastructure development, Feedback Ventures offers an integrated suite of services across the core and social sectors of infrastructure. FIPL is known for its innovative work and for operationalising challenging projects in difficult locations. No wonder, 17 of India's 50 biggest listed companies are Feedback's clients. So are the governments of 22 of the 28 Indian states and 4 of India's 7 Union Territories. FIPL is presently working on more than 35,000 MW of new power generation capacity; 20,000 km of National and State Highways; 100,000 acres of real estate development and a building area of more than 22 million square feet.

This is enabled by a large pool of multidisciplinary experts; cutting-edge functional and domain knowledge; an all-India network of offices with corporate HQ at Gurgaon and 6 Regional Offices at Mumbai, Bangalore, Gandhinagar, Chandigarh, Kolkata & Hyderabad besides a host of site & project offices; and a strong shareholding — L&T, IDFC, and HDFC. FIPL offers a range of services including EIA across eleven focused infrastructure sectors including Transportation & Logistics (including highways, railways, MRTS, ports, airports and logistics), Energy (including Power Generation, Transmission, Distribution, Coal & Mines and Oil & Gas), Housing & Townships, Commercial Infrastructure (including IT Parks, Corporate Offices & Commercial Buildings), Industrial Infrastructure, Water & Sanitation, Retail & Entertainment, Healthcare, Hospitality, Urban Development & SEZ.

FIPL has been approved by NABET for sector 34 (Highways, railways, transport terminals, mass rapid transport systems) vide MoM of 87th Accreditation Committee Meeting of QCI NABET held on September 11, 2012.

12.2 PROJECT TEAM

The project team members involved in this project are:


Table 12-1: Project Team

Sl. No	Name	Qualification	Expertise
1	Dr. Raj Kumar Singh	MSc (Botany), PhD	EIA Team Leader
2	Mr. Arijit Choudhury	PGD Env Mgt., MSc (Env. Science)	EIA Expert
3	Mr. Prabhat Singh	M. Tech (Env Sc. & Engineering), AMIE (Mining Engineering)	EIA Expert
4	Mr. Satyajit Ray	MSc (Env. Science)	EIA Team Member
5	Mr. Ram Singh	MSc (Env. Science)	EIA Team Member
6	Mr. Nitish Yadav	MSc (Env. Science)	EIA Team Member
7	Dr. G. Ananda	MA (Social Science), PhD	R&R and Social Expert
8	Mr. Munna Kumar	MA (Geography), MA (Sociology), MPhil	R&R and Team Member
9	Ms. Aruna Tajeja	M. E. (Structural Engineering)	Hydrologist

12.3 LABORATORY

Envirotech East Pvt. Limited, Kolkata, has carried out the sampling and analysis for various air, water, noise samples as per procedure & guidelines of Central Pollution Control Board and the requirements of MoEF on behalf of Feedback Infra Pvt. Ltd. The laboratory is a MoEF approved Laboratory.

Annexure 4-1: Ground Water Resources along the Project Road

Properties	Details	Photograph	Details	Photograph
Existing Km	0+000		0+250	
Structure	Hand Pump		Hand Pump	
Settlement	Near Silver city		Ward no. 24	
Side (Left/Right)	LHS		LHS	
ECL Distance (m)	10		15	
Existing Km	0+500		0+550	
Structure	Hand Pump		Hand Pump	
Settlement	Ward no.24		Ward no.24	
Side (Left/Right)	RHS		RHS	
ECL Distance (m)	10		10	
Existing Km	1+900		1+860	
Structure	Hand Pump		Hand Pump	
Settlement	Ram ditte wala		Ram ditte wala	
Side (Left/Right)	RHS		LHS	
ECL Distance (m)	10		10	
Existing Km	2+000		1+980	
Structure	Hand Pump		Water Tank	
Settlement	Ram ditte wala		Ram ditte wala	
Side (Left/Right)	RHS		RHS	
ECL Distance (m)	16		12	
Existing Km	5+680		5+700	
Structure	Hand Pump		Hand Pump	
Settlement	Mussa		Mussa	
Side (Left/Right)	LHS		LHS	
ECL Distance (m)	15		14	
Existing Km	6+700		7+900	
Structure	Hand Pump		Hand Pump	
Settlement	Mussa		Mussa	
Side (Left/Right)	LHS		RHS	
ECL Distance (m)	8		6	
Existing Km	8+920		11+830	
Structure	Hand Pump		Hand Pump	
Settlement	Mussa		Akalia Talwandi	
Side (Left/Right)	LHS		RHS	

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
 Consultant: Feedback Infra Pvt. Ltd



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Properties	Details	Photograph	Details	Photograph
ECL Distance (m)	12		15	
Existing Km	11+840		14+900	
Structure	Hand Pump		Hand Pump	
Settlement	Akalia Talwandi		Banawali	
Side (Left/Right)	RHS		LHS	
ECL Distance (m)	10		10	
Existing Km	15+100		15+800	
Structure	Hand Pump		Hand Pump	
Settlement	Banawali		Baniwala	
Side (Left/Right)	RHS		RHS	
ECL Distance (m)	12		10	
Existing Km	17+630		20+500	
Structure	Hand Pump		Hand Pump	
Settlement	Baniwala		Baniwala	
Side (Left/Right)	LHS		RHS	
ECL Distance (m)	6		10	
Existing Km	23+160		23+600	
Structure	Hand pump		Hand Pump	
Settlement	Jagga Ram Tirath		Jagga Ram Tirath	
Side (Left/Right)	LHS		RHS	
ECL Distance (m)	8		7	
Existing Km	25+000		25+000	
Structure	Hand pump		Hand pump	
Settlement	Jagga Ram Tirath		Jagga Ram Tirath	
Side (Left/Right)	RHS		RHS	
ECL Distance (m)	6		12	

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited
Consultant: Feedback Infra Pvt. Ltd






Annexure 4-2: Surface Water resources along the project road



Properties	Details	Photograph	Details	Photograph
Existing Km	1+800		7+760	
Structure	Pond		Canal	
Settlement	Ram ditte wala		Musse	
Side (Left/Right)	RHS		Minor canal	
ECL Distance (m)	15		8	
Existing Km	11+850		17+630	
Structure	Pond		Canal	
Settlement	Akalia Talwandi		Baniwala	
Side (Left/Right)	RHS		Minor canal	
ECL Distance (m)	25			
Existing Km	21+440			
Structure	Canal			
Settlement	Jagga Ram Tirath			
Side (Left/Right)	Minor canal			



Annexure 4.3: Cultural/Religious Properties along the Project Road

Properties	Details	Photograph	Details	Photograph
Existing Km	1.900		6.600	
Structure	Gurudwara		Gurudwara	
Settlement	Ram Ditte Wale		Mussa	
Side (Left/Right)	RHS			
ECL Distance (m)	50		40	
Existing Km	1.900			
Structure	Temple			
Settlement	Ram ditte wala			
Side (Left/Right)	RHS			
ECL Distance (m)	30			

Annexure 4.4: Community Properties along the Project Road

Properties	Details	Photograph	Details	Photograph
Chainage Existing (Km)	15+850		0+000	
Structure	Stadium		Market	
Settlement	Banawali		Ram ditte wala Chowk	
Side (Left/Right)	RHS		RHS	
Distance From ECL (m)	30		18	
Length (m)	200		300	

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Contractor: Patel Infrastructure Pvt. Limited
 Consultant: Feedback Infra Pvt. Ltd



Annexure 4.5: Noise Sensitive Receptors along the Project Road

Properties	Details	Photograph	Details	Photograph
Chainage Existing (Km)	1+900		2+000	
Structure	Primary School		Anganvadi Center	
Settlement	Ram ditte wala		Ram ditte wala	
Side (Left/Right)	RHS		LHS	
Distance From ECL (m)	80		15	
Length (m)	100		25	
Chainage Existing (Km)	19+660			
Structure	Akal Sahai public School			
Settlement	Baniwala			
Side (Left/Right)	RHS			
Distance From ECL (m)	15			
Length (m)	80			

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Contractor: Patel Infrastructure Pvt. Limited
 Consultant: Feedback Infra Pvt. Ltd



Annexure 8.1: Guidelines for Identification of Debris Disposal Sites & Precautions Needed

Guidelines for identification

The locations of dumping sites have to be selected such that:

- No residential areas are located downwind side of these locations,
- Dumping sites are located at least 1000 m away from forest areas and water bodies
- Dumping sites do not contaminate any water sources, rivers etc.
- Dumping sites have adequate capacity equal to the amount of debris generated.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.

Precautions to be adopted during Dumping of Debris / Waste Material

Following precautions shall be taken while disposing off the waste materials:

- During the site clearance and disposal of debris, we will take care and ensure that public or private properties are not damaged / affected and traffic should not be interrupted.
- Construction debris shall be disposed only to the identified places with prior permission of the Client's Environmental Specialist.
- The disposal of debris shall be also done for the improvements in public utilities after the proper consent of villagers and approval of Engineers' Environmental Specialist.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, it will immediately remove and all such spoil debris restore the affected area to its original state to the satisfaction of the Client's Environmental Specialist.
- We will ensure that the entire existing stream courses and drains within and adjacent to the site are kept safer and free from any debris.
- The Patel Infra will utilise effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- During disposal of debris, proper warning signs to be installed to the satisfaction of Consultant's Environmental Specialist.
- 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 Client's.
- During the debris disposal, Patel Infra will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the Patel Infra will take into account the wind direction and location of settlements to ensure against any dust problems.
- Adequate arrangements will be made to ensure that the debris / waste material is disposed off nearest to the designated dumping site. The report on this activity shall be submitted to the client's Environmental Specialist.

Annexure 8.2: Guideline for Rehabilitation of Dumpsites & Quarries

Dumpsites

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

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

Quarries

The Pate Infra shall use materials from the existing and licensed quarry only. In case any new quarries are opened by the agency, it will secure permissions for the same and shall follow the rehabilitation plan.

- The objective of the rehabilitation programme is to return the quarry sites to a safe and secure area, which the general public should be able to safely enter and enjoy. Securing quarry sites in a stable condition should be a fundamental requirement of the rehabilitation process. This could be achieved by filling the quarry / quarry floor to approximately the access road level.
- It is important to plan restoration from the outset and coordinate restoration with quarrying activities. In addition to the bio-diversity issues, land planning considerations are also taken into account when defining a rehabilitation project in order both to preserve the environment and to generate income for the local communities. In this framework quarry rehabilitation often leads to the creation of wetlands and natural reserves or recreation areas.
- Special quarry / quarry rehabilitation plan should be specified according to the location and shaping of the mining slopes after exploitation and overburdened dump, with different subsequent uses e.g. forest, meadow, water body etc., the re-greening and replanting methods.

Other criteria which should be followed for rehabilitation of quarry sites are as given below:

- Quarries will be backfilled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Patel Infra shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; reestablishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense the contractor shall restore the environment around the work site to its original splits.
- To create a safe environment under the terms of the Mines and Quarries Act the faces have to be reduced to a naturally stable slope or be adequately fenced to prevent access to the top and bottom of the faces. Such a fence must be of a height as prescribed under the Mines Act with a barbed wire top strand designed to exclude the public from the quarry area. Depending on the location of the site presence of a permanent lake is considered to be a satisfactory alternative to a fence.
- Appropriate plant species for the planting programme have to be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and on-going quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

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

Annexure 8.3: Guidelines for New Quarry Management

1. Management Plan for New Quarry

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

1.1 Selection Details

1.1.1 Location and Layout

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

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

1.1.2 Selection Criteria

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

1.1.3 Agreement with landowners

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

1.1.4 Licenses and permits

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

1.2 Operation

1.2.1 Method of extraction

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

1.2.2 Loading and haulage

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

1.2.3 Crusher Plant

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

1.2.4 Storage of explosives

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

1.2.5 Products

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

1.2.6 Testing and quality assurance

- Refer CQAMP (Contract Quality Assurance Management Plan) plan for OPRC project road submitted by M/s Patel Infra Pvt. Ltd.

1.2.7 Water sourcing

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

1.2.8 Safety

- Patel Infra will reveal safety measures to the Client.
- Ensure that workers at the quarry sites are aware of the appropriate sections of the safety plan.

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1.2.9 Workers Accommodation

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

2. Environmental Management

2.1 Environmental Management during Operation

2.1.1 Removal of trees and plants

- Will describe briefly the floral species that shall be removed and roughly how many no.

2.1.2 Overburden

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

2.1.3 Silt management

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

2.1.4 Surface water drainage

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

2.1.5 Soil and water contamination

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

2.1.6 Air pollution

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

2.1.7 Noise

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

2.1.8 Traffic

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

2.1.9 Approach road

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

2.2 Environmental Management at Closure of the site

2.2.1 Dismantling and removal of machinery

- To state whether and when this shall be done.

2.2.2 Slope stabilisation and / or protection

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

2.2.3 Rehabilitation

- Rehabilitation plan of the quarry.
- The Agency shall be responsible for the Redevelopment Plan prior to completion after five years, during the defect liability period. The Environmental consultant and the client PRBDB (Punjab Roads and Bridges Development Board) shall be responsible for reviewing this case of redevelopment prior to the issuing the defect liability certificate.

2.2.4 Hand-over

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

2.2.5 Removal of debris and solid waste

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

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

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

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

Submitted

Signature
Name
Designation
Patel Infra Pvt. Ltd.

Checked & Approved

Signature
Name
Designation
PMC/Consultant



Annexure 8.4: Guidelines for Existing Quarry Management

The Patel Infra will finalise the locations and establish a new quarry only with the prior consent from the Client only in cases when: (i) Lead from existing quarries is uneconomical and (ii) Alternative material sources are not available. The Patel Infra will prepare a Redevelopment Plan for the quarry site and get it approved by the client.

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

CONSTRUCTION STAGE

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

- i) Adequate drainage system shall be provided to prevent the flooding of the excavated area
- ii) If any stockpiling locations, the agency shall construct sediment barriers to prevent the erosion of excavated material due to runoff
- iii) Construction of offices, laboratory, workshop and rest places shall be done in the up-wind of the plant to minimize the adverse impact due to dust and noise.
- i) The access road to the plant shall be constructed taking into consideration location of units and also slope of the ground to regulate the vehicle movement within the plant.
- iv) In case of storage of blasting material, all precautions shall be taken as per the Explosive Rules, 1983.

QUARRY OPERATIONS INCLUDING SAFETY

- i) Overburden shall be removed and disposed in line with Guidelines for Debris Disposal Site and Management giving in Annexure-8.1
- ii) During excavation, slopes shall be flatter than 20 degrees to prevent their sliding. In cases where quarry strata are good and where chances of sliding are less this restriction can be ignored.
- iii) In case of blasting, procedure and safety measures shall be taken as per The Explosive Rules, 1983
- iv) Will ensure that all workers related safety measures shall be done as per guidelines for Workers and Safety.
- v) Will ensure maintenance of crushers regularly as per manufacturer's recommendation.

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

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

POST CONSTRUCTION STAGE

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

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

Sl. No.	Item	Unit	Details	Remarks by Client, if any
1.	Name / identity of the location			
2.	Nearest project road Chainage.			
3.	Name of the owner			
4.	Area involved			
5.	Arrangement with the owner (agreement with the third party / Agency should be attached as an Annexure and should necessarily require the adaptation of good quarry management practices - a description of the requirements should be included)	Cum		
6.	Quantity of material to be withdrawn vis-a-vis the material available			
8.	Machinery & equipment to be used	Cum		

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Contractor: Patel Infrastructure Pvt. Limited
Consultant: Feedback Infra Pvt. Ltd



Sl. No.	Item	Unit	Details	Remarks by Client, if any
9.	Drainage plans			
10.	Top soil management			
11.	Description of the operating practices			
12.	Health facilities			
13.	Safety provisions made including fire protection systems and the availability of different personal protective equipment			
14.	Copy of the consents to operate from PCB, licences from Mining & Geology, Police & Fire dept should be attached as an Annexure.			
15.	Conditions laid down in the clearances / licenses and plans to ensure compliance			
16.	Monitoing plans for air quality			
17.	Information on whether or not the quarry will be closed under this project. If yes, the proposed closure & restoration plan.			
18.	Photograph of the quarry prior to commencing operations.			
19.	Sketch of the layout of the quarry			

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

REMARKS

Submitted & Checked

Signature
Name
Designation
M/s Patel Infra Pvt. Ltd.

Approved

Signature
Name
Designation
PMC/Environmental Consultant



Annexure 8.5: Guidelines for Sediment Control

All materials shall meet commercial grade standards and shall be approved by the Engineer before being used in the work.

CONSTRUCTION STAGE

Prior to the start of the relevant construction, the Agency will submit to the client for approval, his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across water courses, pavement courses and shoulders.

The surface area of erodible earth material exposed by clearing and grubbing, excavation, quarry and fill operations shall be limited to the extent practicable. The Patel Infra shall provide immediate control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties, or cause contamination of nearby streams or other watercourses. Such work may involve the construction of temporary berms, dikes, sediment basins, slope drains and use of temporary mulches, fabrics, mats, seeding, or other control devices or methods as necessary to control erosion and sedimentation.

It shall be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time as outlined in his accepted schedule to minimize the need for temporary erosion and sedimentation control measures.

Temporary erosion, sedimentation and pollution control measures will be used to control the phenomenon of erosion, sedimentation and pollution that may develop during normal construction practices, but may neither be foreseen during design stage nor associated with permanent control features on the Project.

Where erosion or sedimentation is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion or sedimentation control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion or sedimentation control measures may be required between successive construction stages. Under no conditions shall a Large surface area of credible earth material be exposed at one time by clearing and grubbing or excavation without prior approval from the Client/Environmental Consultant.

The Client may limit the area of excavation, quarry and embankment operations in progress, commensurate with the capability and progress in keeping the finish grading, mulching, seeding and other such permanent erosion, sedimentation and pollution control measures, in accordance with the accepted schedule.

Temporary erosion is sometimes caused due to the carelessness or failure to install permanent controls. Sedimentation and pollution control measures then become necessary as a part of the work as scheduled or ordered by the Engineer, and these shall be carried out by own expense. Temporary erosion, sedimentation and pollution control work required, which is not attributed to the negligence, carelessness or failure to install permanent control, will be performed as ordered by the client.

Temporary erosion, sedimentation and pollution control may include construction work outside the right of way where such work is necessary as a result of road construction such as quarry operations, service roads and equipment storage sites.

The temporary erosion, sedimentation and pollution control features installed and maintained at site till these are needed, unless otherwise agreed by the Client.

Annexure 8.6: Specifications & Strategy for Tree Plantation, Horticultural and Landscaping Works

1. INTRODUCTION

PWD has decided to widen and strengthen the Project road within available ROW. Due to this purpose, trees are to be felled. To offset this impact, compensatory afforestation programme through tree plantation, median plantation, horticulture and landscaping strategy has been prepared, based upon the experiences of successful implementation of a number of on-going and completed projects.

2. OBJECTIVE

The main objectives are as follows:

- Reducing the impacts of air pollution
- Natural noise barrier
- Arrest of land erosion
- Providing much needed shade during the day time
- Prevention of vehicle glare from vehicles coming from opposite direction
- Enhancement of aesthetic view of the corridors
- Climatic amelioration
- Defining of ROW especially at sharp curves during night

3. SPECIES SELECTION

Grasses, shrubs and trees are the main species that are readily available in India. Where possible, the use of non-native species should be avoided since they can out compete and displace native plants leading to loss of native biodiversity. To maximise the chances of success, one should try to select species whose growing conditions roughly match the environmental conditions of the project site. Care should also be taken to select species with root systems that match the nature of the soil movement at the project site. Homogenous avenues of trees should be selected for long stretches as it provides aesthetic qualities in the landscaping. One should also take into account the economic and other social benefits while selecting the species for plantation. During the selection of species preference should be given towards rapid growing and pest and disease resistant species. Shrub species, which are dwarf and pollution hardy, are to be planted in the median to prevent the glare of traffic moving in opposite direction. Flowering, ornamentals plants and climbers can also be planted in urban areas to provide beauty. For this purpose the species identified in Tables 8-10 & 8-11 shall be used.

4. TASKS OF THE CONTRACTOR

As part of this project implementation, the contractor shall plant and maintain 22561 flowering, shade, medicinal, ornamental & fruit bearing trees in suitable area for which cost has been budgeted besides planting and maintenance of 63450 ornamental, medicinal & flowering plants and shrubs in the median for which cost has also been budgeted. The specific roles and responsibilities of the Contractor include:

- Identification of the plantation stretches along with Employer and or Consultant.
- Identification of nursery area and preparation of nurseries
- Planting of saplings in the nurseries during the construction period so that the saplings are a minimum 24 months old
- Replantation of the 2 year old saplings to the plantation stretches and
- Maintenance for three years including watering, removal of weed, litter and debris from the vicinity of the plantation.
- Ensure the protection of the tree guards provided to the saplings from trampling and browsing by the cattle.

5. GUIDELINES FOR HORTICULTURE PLANTATION AND LANDSCAPING

5.1. General

5.1.1. Scope

Contractor to furnish all materials, labour and related items necessary to complete the work indicated on drawing and specified herein.

5.1.2. Materials

Project Road: S4-Mansa-Talwandi Sabo (up to intersection with B8)- (ODR 9)

Contractor: Patel Infrastructure Pvt. Limited

Consultant: Feedback Infra Pvt. Ltd



Plant Materials

- Plant Materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, sun-scaled, windburn, injuries, abrasion or disfigurement.
- All plant materials shall be healthy, sound, vigorous, free from plant diseases, insect's pests, of their eggs, and shall have healthy, well-developed root systems. All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall confirm to the names listed on the plant list given in Table no.1 and 2. Besides these plant species, the Contractor shall supply other species as desired by the landscaping specialist and or the environmental specialist of the engineer. Under no circumstances non-native species which might have a negative impact on the ecology of the area shall be permitted. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.
- Any nursery stock shall have been inspected and approved by the Environmental Specialist of the Engineer.
- All plants shall conform to the requirements specified in the plant list. Except that plants larger than specified may be used if approved, but use of such plants shall not increase the contract price if the use of the larger plant is approved, the spread of roots or ball of earth shall be increased in proportion to the size of plant. Deliver plants with legible identification labels.

Top Soil (Good Earth)

- Topsoil or good earth shall be a friable loam, typical of cultivated topsoil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth skids, sticks, roots or any other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. It shall have pH value ranging in between 6 to 8.5.

Fertiliser

- Measurement of sludge shall be in stacks, with 8% reduction for payment. It shall be free from extraneous matter, harmful bacteria insects or chemicals (Subjected to safety norms).

Root System

- The root system shall be conducive to successful transplantation. While necessary, the root-ball shall be preserved by support with Hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in such a way that the roots are not damaged.

5.1.3. Condition

Trees and shrubs shall be substantially free from pests and diseases, and shall and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions such as prolonged exposure to drying winds or subjection to water logging between lifting and delivery.

5.1.4. Supply and Substitution

Upon submission of evidence that certain materials excluding the plant Species prescribed are not available at time of contract, the Contractor shall be permitted to substitute with an equitable adjustment of price. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subjected to the approval of the Environmental Specialist of the SC.

5.1.5. Packaging

Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

5.1.6. Marking

Each specimen of tree and shrub, or each bundle, shall be legibly labelled with the following particulars:

- Its name
- The name of the supplier, unless otherwise agreed.
- The date of dispatch from the nursery.

5.2. Plantation Pattern

The type of plantation would be based upon the requirements and the feasibility of the sites along the project corridor. The availability of the space in the RoW is a major guiding factor for landscaping. The plantation pattern to be followed is:

- The first row of plants along the highways will be of small to medium height plants planted at a spacing of 3m c/c and the



distance from the second row should be 3m. The second row should be in staggered. The distance from the toe of the embankment should be 1m minimum and the height should be between 1.5m to 2m.

- Flowering shrubs shall be planted in the median in rows as per width availability. Where the width is less than 1.5m grass turfing is to be done. One row of plantation to be done at a spacing of 1.5m c/c.

For special landscaping, embankment slopes and ground cover, herbaceous species to be used. Turfing to be done by grass.

5.3. Tree Planting

5.3.1. Plants and Shrubs

Trees should be supplied with adequate protection as approved. After delivery, if planting is not to be carried out immediately, balled plants should be placed back to back and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in prepared trench and covering them with earth, which should be watered into, avoid air pockets round the roots and shrubs shall be planted with the approval of Site Supervision Engineer / Environmental Engineer.

5.3.2. Digging of Pits

Tree pits shall be dug a minimum of three weeks prior to backfilling. The pits shall be 120cms in diameter and 120cms deep. While digging the pits, the topsoil up to a depth of 30cms may be kept aside, if found good (depending upon site conditions), and mixed with the rest of the soil.

If the side of the below, it shall be replaced with the soil mixture as specified further herein. If the soil is normal it shall be mixed with manure; river sand shall be added to the soil if it is heavy. The bottom of the pit shall be forked to break up the subsoil.

5.3.3. Back Filling

The soil back filled watered through end gently pressed down, a day previous to planting, to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all-round for watering.

5.3.4. Planting

No tree pits shall be dug until final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not be buried deeper than in the nursery, or in the pot. Planting should not be carried out in waterlogged soil. Plant trees at the original soil depth; soil marks on the stem is an indication of this and should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other perishable containers should be removed before planting. Any broken or damage roots should be cut back to sound growth.

The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid on even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to shift into the root system to ensure close contact with all roots and prevent air pockets Back fill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid damaging the roots. The balance earth shall be filled in a mixture of 1:3 (1 part sludge to 3 part earth by volume) and 50gms potash, (Mop) 50gms of Super Phosphate and 1 Kg. Neem oil cake. Aldrin or equivalent shall be applied every 15 days in a mixture of 5ml in 5 litres of water.

5.3.5. Staking

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

The main methods of staking shall be:

- A single vertical stake, 900mm longer than the clear stem of the tree, driven 600mm to 900mm into the soil.
- Two stakes as above driven firmly on either side of the tree with a cross bar to which the stem is attached. Suitable for bare- rooted or Ball material.
- A single stake driven in at an angle at 45 degrees and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare- rooted or Ball material
- For plant material 3m to 4.5m high with a single stem a three- wire adjustable guy system may be used in exposed situations.

The end of stake should be pointed and the lower 1 m to 1.2m should be coated with a non-injurious wood preservative allowing at least 150mm above ground level.

5.3.6. Tying

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a



buffer, rubber or Hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level: normally two ties should be used for tree. These should be adjusted or replaced to allow for growth.

5.3.7. Watering

The Contractor through the Landscape Contractor should allow for the adequate watering in of all newly planted trees and shrubs immediately after planting and he shall during the following growing season, keep the plant material well watered

5.3.8. Fertilising

Fertilising shall be carried out by application in rotation of the following fertilisers, every 15 days from the beginning of the monsoon till the end of winter:

- Sludge or organic well-rotted dry farm yard manure: 0.05 cum or tussle.
- Urea 25gm.
- Ammonium sulphate 25gm.
- Potassium sulphate 25gm.

All shrubs, which are supplied pot grown, shall be well soaked prior to planting. Watering in and subsequent frequent watering of summer planted container- grown plants is essential.

5.4. Shrub Planting In Planter Beds

All areas to be planted with shrubs shall be excavated, trenched to a depth of 750mm, refilling the excavated earth after breaking clods and mixing with sludge in ratio 8:1 (8 parts of stacked volume of earth after reduction by 20%: 1 part of stacked volume of sludge after reduction by 8%.)

Tall shrubs may need staking, which shall be provided if approved by the Contracting-consulting engineer, depending upon the conditions of individual plant specimen. For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters.

Positions of planters shall be planted should be marked out in accordance with the Design drawings. When shrubs are set out, precautions should be taken to prevent roots drying. Planting holes 40cm diameter and 40cm deep should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level after settlement will be original soil mark on the stem of the shrub. The holes should be back filled to half of its depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

5.5. Grassing

5.5.1. Preparation

During period prior to planting, the ground shall be maintained free from weeds. Grading and preparation of the area shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the area into portions of approximately 5m squares by constructing small bunds to retain water. These 'bunds' shall be levelled just prior to sowing of grass plants; it shall be ensured that the soil has completely settled.

5.5.2. Soil

The soil itself shall be ensured to the satisfaction of Environmental Specialist / Environmental Engineer to be a good fibrous loam, rich in humus.

5.5.3. Sowing the grass roots

Grass lines will be used to provide a strong surface cover and will be planted over a well prepared surface. Slope treatments using grasses will be allowed to establish properly such that the slopes are not subject to undue stress from erosion and mass movement in its initial stages. The sowing of grasses will create a strengthened surface that will reduce the vulnerability to erosion. Median with a width of 1.5 m will have only grasses to strengthen the surface. The contractor will ensure that the condition of the site is good enough for the successful establishment of grasses.

Grass roots shall be obtained from a grass patch, seen and approved before hand. The grass roots stock received at site shall be manually cleared of all weeds and water sprayed over the same after keeping the stock in place protected from sun and dry winds. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

5.5.4. Execution

Small roots shall be dibbled about 5cms apart into the prepared grounds. Grass will only be accepted as reaching practical



completion when germination has proved satisfactory and all weeds have been removed. The Contractor through the landscape contractor shall supervise all field operations like preparation of surface, sowing of grasses and quality of grasses seeds used.

- Carry out grassing such that a cover of 25 gm of grass seed per sqm of surface is achieved.
- Carry out seed sowing before the onset of monsoon [May & June] so as to achieve the desired results. The watering of the surface will be by tankers till the onset of the monsoon.
- Ensure that a mulch of prepared and dried out herbs is laid over the whole seeded area after sowing, in a thin layer, so that the grass is not affected by direct sunlight and transpiration loss.
- The grasses recommended for are *Cynodon dactylon*, *Cyathoclin purpurea*, *Solanum nigrum*, *Xanthium strumerium* etc.

5.5.5. Maintenance

As soon as the grass is approximately a 3cm high it shall be rolled with a light wooden roller - in fine, dry weather - and when it has grown to 5 to 8cms, above to ground weeds must be removed and regular cutting with the scythe and rolling must be begun. A top-dressing of an ounce of guano to the square yard or well decomposed well broken sludge manure shall be applied when the grass is sufficiently secure in the ground to bear the mowing machine, the blades must be raised an inch above the normal level for the first two or three cuttings. That is to say, the grass should be cut so that it is from 4 to 5cms in length, instead of the 3cm necessary for mature grass.

In the absence of rain, in the monsoon, the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 20cms. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the Landscaping Contractor. Any shrinkage below the specified levels during the contract or defect liability period shall be rectified at the Landscaping Contractor's expense. The Landscaping Contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

5.5.6. Rolling

A light roller shall be used periodically, taking care that the area is not too wet and sodden.

5.5.7. Edging

These shall be kept neat and must be cut regularly with the edging shears.

5.5.8. Fertilising

The area shall be fed once in a month with liquid manure prepared by dissolving 45gms of ammonium sulphate in 5 litres of water.

5.5.9. Watering

Water shall be applied at least once in three days during dry weather. Watering whenever done should be thorough and should wet the soil at least up to a depth of 20cms.

5.5.10. Weeding

Prior to regular mowing the Landscaping Contractor shall carefully remove rank and unsightly weeds.

5.6. Maintenance of Plants

5.6.1. Cultivating

The Contractor through the Landscaping Contractor shall maintain all planted areas within contract boundaries for one year until the area is handed over in whole or in phases. Maintenance shall include replacement of dead plants, watering, weeding, cultivating, control of insects, fungus and other diseases by means of spraying with an approved insecticide or fungicide, pruning, and other horticulture operations necessary for proper growth of the plants and for keeping the sub-contract area neat in appearance

5.6.2. Pruning and Repairs

Upon completion of planting work of the sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the result of the transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of trees.

5.6.3. Tree Guards and Protective Fencing

According to local environment, shrubs shall be protected adequately from vandalism until established. Where the tree guards



are necessary, care should be taken to ensure that they do not impede natural movement or restrict growth. The specifications of the tree guard proposed are given below:

- The tree guards shall normally be brick in urban and bamboo guards in rural and semi urban areas. The specifications of the cement guards should be as per the relevant IS specification. In certain cases, if required by the IE Circular Iron Tree Guard with Bars shall be provided. The specifications of such tree guard shall be as per relevant IS specification. The IE shall spell out in details about the cases where such exception shall be. In absence of any proper specification the decision of the Engineer and or PWD shall be binding.

5.7. Nursery Stack

Planting should be carried out as soon as possible after reaching the site. Where planting must be a necessity and / or be delayed, care should be taken to protect the plants from pilfering or damage from people / animals. Plants with bare-roots should be heeled-in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting is to be delayed for more than a week, packaged plants should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

5.8. Completion

On completion, the ground shall be formed over and left tidy.

6. SPECIAL CONDITIONS AND PARTICULAR SPECIFICATIONS.

- Wherever applicable, work shall be done according to specifications in vogue, at the time of invitation of tender.
- The Plantation area should avoid the stretches within the settlement area and the Ecological Sensitive area.
- The stretches identified should be free from encumbrances and should not lead to impact on any private or community asset. No fresh land acquisition shall be made under the project for the purpose of plantation.
- Contractor through the Landscaping Contractor shall make his own arrangement for drawing water from there.
- The work included in the schedule of Quantities includes grassing as well as planting of trees and shrubs. The quoted rates shall include execution of these works at different levels and nothing extra shall be paid for any item, for working at these levels
- The Landscaping Contractor shall not be entitled to any compensation for any losses suffered by him and/or revision in the rates originally quoted by him.
 - On account unforeseen delay in commencing the work, whatever the cause of such delays is.
 - On account of reduction in the scope of work.
 - On account of suspension of work, or abandon after award of work.
- The Contractor shall provide all facilities to Environmental Specialist / Project Engineer and / or his authorized representatives to make frequent inspection of their Nursery and ascertain the process / quality of various categories of trees / plants etc., grown by them.
- The quote rate shall include the cost of transportation of tools and plants to and from the site, sales tax, excise duty, octroi, etc. It shall be clearly understood that no claim for any extra payment on account of sales tax, excised duty, octroi etc., shall be entertained after the opening of the tender.
- The safe custody and up-keep of various categories of plants brought to site is the sole responsibility of the Contractor and he shall employ sufficient supervisory personnel to ensure the safety of these items.
- The site of work may be handed over to the Contractor in phases, as soon as the same are available and the Contractor in turn shall work in these areas forthwith. Nothing extra shall be payable for such phased execution of work.
- While excavating / executing the work the Contractor shall ensure that the existing cables / pipe lines / structures / fittings are not damaged and if due to his negligence, these are damaged, the same shall be set right with no extra cost to the clients.
- The Contractor shall co-ordinate his work with other agencies employed by the Clients and ensure that the works of other agencies are not hampered in any way during the duration of contract.
- The Contractor shall keep the site of works neat and clean during the execution of the work. Any debris found at or near the site of work shall be moved immediately as and when so required by the Environmental Specialist / Project Engineer.
- On completion of the work, the site of work shall be thoroughly cleaned and all debris removed before the work is handed

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over satisfactorily.

- The Contractor shall, without any additional charge to the clients, renew or replace any dead or defective plants/grass for a period of 12 months after the certified date of completion.
- "General condition of contract and standard contract Forms of shall also form part of the contract.
- All Tree saplings should be two years (2) years old before they are planted. The numbers of the plants shall be as specified in the schedule of quantities and shall be straight and symmetrical with a crown and having a persistent main stem. The size of crown shall be in good overall proportion to the height of the tree.
- Small trees and shrubs shall be well formed with the crown typical of the species or variety.

General requirements of plants

- Plants shall be typical of their species and variety, well-developed branches, and well foliated with fibrous root system. Plants shall be free from defects and injuries. Plants shall not be pruned before planting.
- Plants shall be free from defects and injuries.
- Plants shall not be freshly dug and nursery grown.
- Nursery grown plants shall have been at least once transplanted
- Bark shall be free from abrasion.
- All trees, soon after planting, shall be properly supported with bamboo stocks to ensure their safety against winds or any other factor, which may affect it adversely.

Protection of "tree to be preserved"

- The Contractor through the Landscaping Contractor shall be responsible for the protection of tops, trunks and roots of existing trees on site. Existing trees subject to the construction damage shall be boxed, fenced or otherwise protected before any work is started.

General Requirements of Earth Manure and Fertilisers

- EARTH: Good earth shall be agricultural soil of loamy texture, free from kankar, morrum, shingles, rocks, stones, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 50mm in any direction. It shall have pH ranging in between 6.5 to 7.5.
- MANURE: Manure shall be of well-decayed organic matter obtained in dry state from the Municipal dump or other similar source approved by the Environmental Engineer/ Project Engineer. The manure shall be free from earth, stone or other extraneous matter. Manure shall be supplied, at site well screened.
- FERTILISER: If the soil tests indicate pH value not as per the above specification namely in between 6.5 to 7.5, following measures need to be taken.
- If pH exceeds 7.5, aluminium sulphate or equivalent fertilizer should be added at the rate of 1 kg per cubic metre to lower the pH by one full point.
- If pH is below 6.5, add ground limestone or equivalent fertilizer at the rate of 1 kg per cubic metre to raise pH by one full point.

7. TEAM FOR THE ASSIGNMENT

The Contractor is free to recommend a team commensurate with the requirements of the project.

8. DATA TO BE PROVIDED BY THE CLIENT

Client will provide to the Contractor the map showing settlements and the forest areas

Annexure 8.7: Traffic Control and Safety during Construction

A. TRAFFIC MANAGEMENT PRACTICES

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

- (i) Make traffic safety an integral and high priority element of every project
- (ii) Avoid inhibiting traffic as much as possible
- (iii) Guide drivers in a clear and positive way
- (iv) Perform routine inspection of traffic control elements and traffic operations
- (v) Give care and attention to roadside safety

B. TRAFFIC CONTROL DEVICES

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

- (i) **Comprehension:** All traffic control devices should be capable of being easily understood. A particular device must convey one and only one meaning. Good and clean condition of the device aids comprehension.
- (ii) **Visibility and Stability:** Devices should be within the cone of vision of the driver and be placed such that it allows adequate time at the average approach speed or the desired speed through the traffic control zone. All traffic control devices should be clearly visible by day and night, at these speeds and under the usually prevailing climatic conditions. They should be kept properly aligned and legible at all times. Foliage or any other obstruction should not be allowed to impede the view of these devices, nor should wind, road dirt or the like be allowed to obscure their face. The traffic control devices must be able to resist the local wind pressure, rain and the vibrations etc. of the passing traffic but these should not act as rigid obstacles in the event of a collision;
- (iii) **Installation and Removal:** All traffic control devices should be installed for the minimum required time. Traffic control devices by their nature are a hindrance to the normal traffic flow and should be removed immediately after the need, being met by these is fulfilled. Existing devices like signs or lane markings should be removed during the temporary works and reinstated thereafter or covered while the temporary devices are in operation. The installation and removal of the temporary traffic control devices and the reinstatement of the pre-existing or new (where the scheme improves the road) traffic control devices must, therefore, be meticulously supervised to ensure the minimum period when there are no signs or markings

C. SIGNS

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

Annexure 8.8: Guidelines for Siting & Layout of Construction Camp

SITING

Based on the following guidelines Patel Infra shall identify the location of the construction site. The construction site shall be located:

- The construction camps will be located at least 500 m away from habitations at identified sites. The living accommodation and ancillary facilities for labour shall be erected and maintained to standards and scales approved by the resident engineer.
- On non agricultural lands, as far as possible
- Not within 1000m of either side of locations of Forest areas.
- All sites used for camps must be adequately drained. They must not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures.
- The camps must be located such that the drainage from and through the camps will not endanger any domestic or public water supply.
- All sites must be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance.

(B) LAYOUT

A conceptual layout of a typical construction site has been presented in Figure A. The Agency during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the Client. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided, and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.

Sanitation Facilities: Construction camps shall be provided sanitary latrines and urinals. Sewerage drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner

Shelter at Workplace: At every workplace, there shall be provided free of cost, four suitable shelters, two for meals and two others for rest, separately for use of men and women labourers. The height of shelter shall not be less than 3m from floor level to lowest part of the roof. Sheds shall be kept clean and the space provided shall be on the basis of at least 0.5m² per head.

Canteen Facilities: A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered necessary. The contractor shall conform generally to sanitary requirements of local medical, health and municipal authorities and at all times adopt such precautions as may be necessary to prevent soil pollution of the site.

First aid facilities: At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances will be provided as per the Factory Rules. Workplaces remote and far away from regular hospitals will have indoor health units with one bed for every 250 workers. Suitable transport will be provided to facilitate taking injured and ill persons to the nearest hospital. At every workplace an ambulance room containing the prescribed equipment and nursing staff will be provided.

Health Care Facilities: Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staff, medicines and minimum medical facilities to tackle first-aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

The health centre should have MCW (Mother and Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

Day Crèche Facilities: At every construction site, provision of a day crèche shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean. There shall be two maidservants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, the contractor shall provide with at least one hut and one maidservant to look after the children of women workers. Size of crèches shall vary according to the number of women workers employed.

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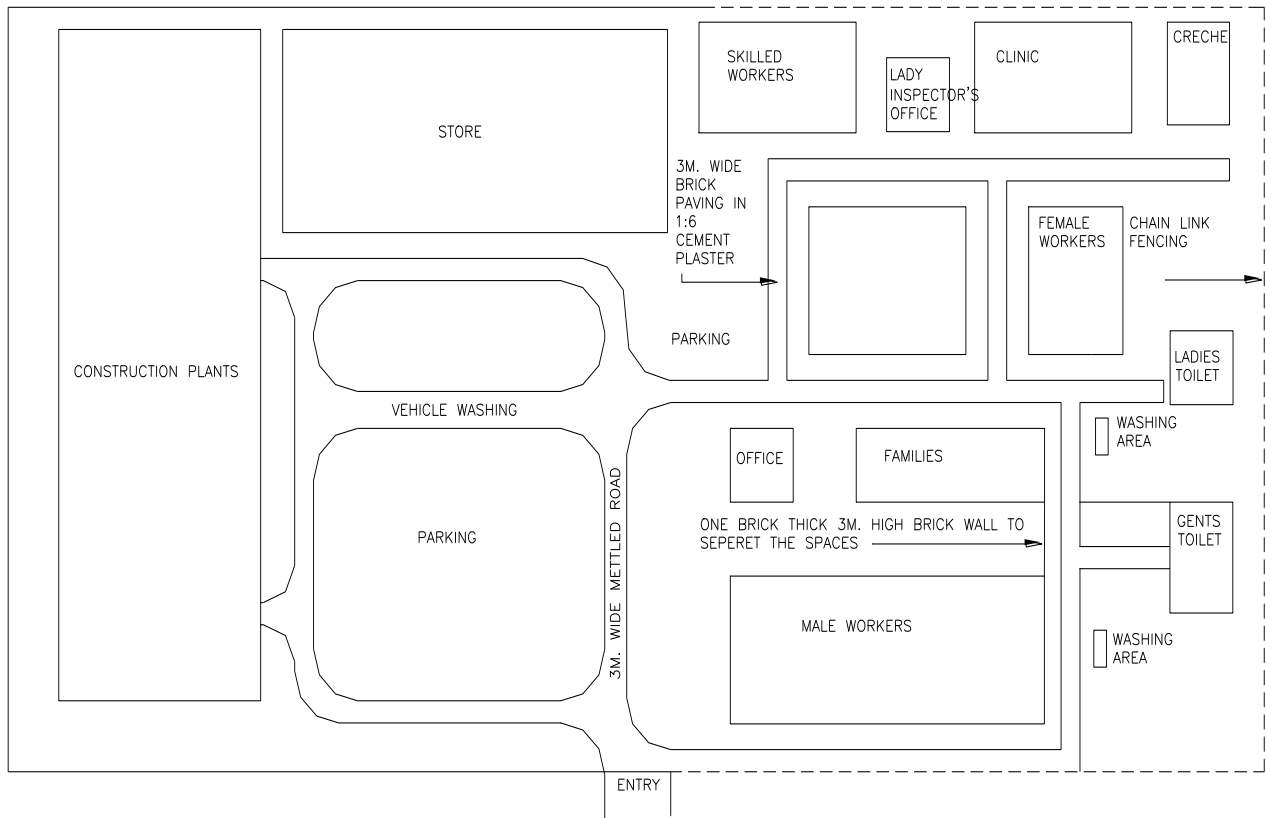


FIGURE A: TYPICAL LAYOUT OF CONSTRUCTION CAMP

