



भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन एवं राजमार्ग मंत्रालय)

National Highways Authority of India

(Ministry of Road Transport & Highways)

परियोजना कार्यान्वयन इकाई

Project Implementation Unit - Bengaluru [Expressway]

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BHARATMALA
ROAD TO PROSPERITY

NHAI/12012/STRR/MOE&F(Phase-1)/2/2021/PIU-BNG(Exp.)/03

12.01.2022

To

The Director, IA-III (Infra-1),
Ministry of Environment, Forest & Climate Change,
Impact Assessment Division,
Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj
New Delhi-110003

Sub: Development of Satellite Town Ring Road (STRR) Phase-I of NH-948A from Dobbaspete (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana- **Environmental Clearance- reg [Proposal No. IA/KA/MIS/75227/2018]**

Ref: Terms of Reference granted by MoEF&CC, New Delhi vide Letter No. 10-33/2018-IA.III, dated 23rd January, 2019.

Sir,

The above mentioned project was considered by the Expert Appraisal Committee (EAC) for Industrial Estate/Area, SEZ and Highways projects in its 191st meeting held on 25th June, 2018 and 195th meeting held on 30th - 31st August, 2018 in the Ministry of Environment, Forest and Climate Change, New Delhi for grant of TOR.

The proposed project does not involve any diversion of forest land. The project is neither part of any protected area nor falls in the eco-sensitive zone of any Protected Area under Wildlife Protection Act.

The Karnataka State Pollution Control Board conducted public hearings in 2 districts viz., Ramanagara and Bangalore (Rural) on 09.08.2019 and 16.08.2019 respectively. The final EIA/EMP is amended based on the proceedings of public hearing.

The Soft Copy of EIA/EMP report, have been uploaded on tshe portal. The hard copies of the document shall be submitted with MOEF&CC after receipt of acceptance of the proposal.

It is requested to grant Environmental Clearance for the project at the earliest.

Yours sincerely,

T. Parvateesam
(T.Parvateesam) 12/01/2022

DGM(Tech) & Project Director

Copy to

1. RO, Bangalore – for information
2. Team Leader, M/s LBCPL- for information and necessary co-ordination

**ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND
ENVIRONMENTAL MANAGEMENT PLAN FOR
DEVELOPMENT OF SATELLITE TOWN RING ROAD (STRR) PHASE-I NEWLY DECLARED
NATIONAL HIGHWAY NH-948A FROM DABASPET (km 0.000) TO RAMANAGARA (km
82.200) IN BANGALORE RURAL AND RAMANAGARA DISTRICTS IN KARNATAKA UNDER
BHARATMALA PARIYOJANA (Category-A, GREENFIELD PROJECT)**

File No. : F. No. 10-33/2018-IA.III; Proposal No. IA/KA/MIS/75227/2018

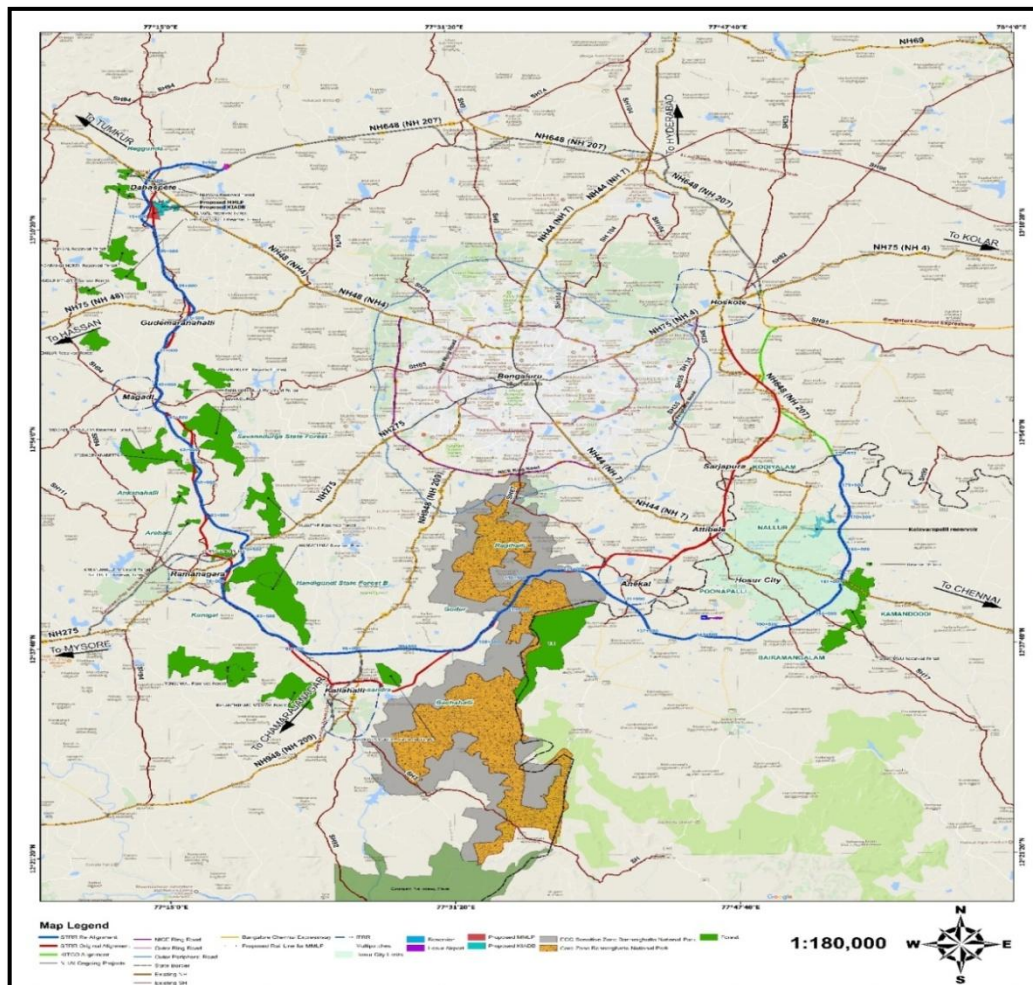
ToR issued: 23rd January, 2019

APPLICANT



**National Highway Authority of India
PIU, Bangalore**

Project or Activity of Schedule 7(f) Highway, Category-A



PREPARED BY

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(Certificate/Ext Letter No.: NABET/EIA/2023/IA0064 (Rev. 01))

(January, 2022)

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Abbreviations

| Abbreviation | Description |
|--------------|---|
| AADT | Annual Average Daily Traffic |
| AAQ | Ambient Air Quality |
| BDL | Below Detectable Level |
| BIS | Bureau of Indian Standards |
| BMRDA | Bengaluru Metropolitan Region Development Authority |
| BNP | Bannerghatta National Park |
| CD | Cross Drainage |
| CO | Carbon Monoxide |
| COI | Corridor of Impact |
| CPCB | Central Pollution Control Board |
| CPR | Common Property Resource |
| DPR | Detailed Project Report |
| dB | Decibel |
| EAC | Environmental Appraisal Committee |
| EIA | Environmental Impact Assessment |
| EMP | Environmental Management Plan |
| FD | Forest Department |
| GoI | Government of India |
| GoK | Government of Karnataka |
| GoTN | Government of Tamil Nadu |
| GWQ | Ground Water Quality |
| Ha | Hectare |
| HMP | Hot Mix Plant |
| HC | Hydrocarbons |
| IC | Independent Consultant |
| IMD | India Meteorological Department |
| IRC | Indian Road Congress |
| ILO | International Labour Organisation |
| KLD | Kilo Liter per Day |
| LAO | Land Acquisition Officers |
| LHS | Left Hand Side |
| Ln | Equivalent Noise Level for Night-time |
| Ld | Equivalent Noise Level for Day-time |
| Leq | Equivalent Sound Pressure Level |
| MoRTH | Ministry of Road Transport & Highways |
| MoEF&CC | Ministry of Environment, Forest & Climate Change |
| NAAQ | National Ambient Air Quality |
| NH | National Highway |
| NHAI | National Highways Authority of India |
| NHDP | National Highways Development Program |
| NICE | Nandi Infrastructure Corridor Enterprises |
| NOC | No Objection Certificate |
| NOx | Oxides of Nitrogen |
| PAH | Project Affected Households |
| PAP | Project Affected Persons |

| Abbreviation | Description |
|---------------------|-----------------------------------|
| PM | Particulate Matter |
| PCU | Passenger Car Unit |
| PIU | Project Implementation Unit |
| PUP | Pedestrian Under Pass |
| PPE | Personal Protective Equipments |
| PRoW | Proposed Right of Way |
| R&R | Rehabilitation and Resettlement |
| RAP | Resettlement Action Plan |
| RHS | Right Hand Side |
| ROB | Railway Over bridge |
| RUB | Railway Under Bridge |
| RoW | Right of Way |
| SC | Scheduled Caste |
| SEF | Seasonal Correction Factor |
| SIA | Social Impact Assessment |
| SO2 | Sulphur Dioxide |
| STRR | Satellite Town Ring Road |
| SPCB | State Pollution Control Board |
| SWQ | Surface Water Quality |
| SQ | Soil Quality |
| ST | Scheduled Tribe |
| SW | Surface Water |
| TPP | Thermal Power Plant |
| KPCB | Karnataka Pollution Control Board |
| VOC | Vehicle Operating Cost |
| VUP | Vehicular Underpass |
| WMM | Wet Mix Macadam |



भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन और राजमार्ग मंत्रालय)

National Highways Authority of India

(Ministry of Road Transport and Highways)

कर्नाटक क्षेत्र, क्षेत्रीय कार्यालय, बेंगलुरु

Karnataka Region, REGIONAL OFFICE, BENGALURU

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NHA/RO-BNG/11042/2/2018/ 1894

Date: 20.09.2018

TO WHOM IT MAY CONCERN

This is to certify that National Highways Authority of India (NHAI) proposes to implement the project of construction of Satellite Town Ring Road (West Side) under Bharathmala for which preparation of Detailed Project Report is underway.

The proposed Ring Road passes through the states of Karnataka and Tamilnadu.

In order to obtain necessary clearances for the above project, the Project Director, NHAI, Project Implementation Unit, Bangalore (Expressway) is the Competent Authority for submission of proposals and requisite documents to the concerned Departments/ Agencies and he is authorised to sign and submit such papers on behalf of NHAI.

Yours faithfully,

(R.K Suryawanshi)
Regional Officer,

Copy to: Shri Akil Ahamad, General Manager(T),Karnataka, NHAI HQ - for favour of kind information.

Annexure-VII (as per NABET format)

Declaration by consultants

DECLARATION BY EXPERTS CONTRIBUTING TO THE EIA

Declaration by Expert contributing to the Environmental Impact Assessment study for Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana



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

Signature:

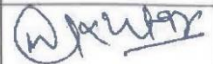


Name of EIA Coordinator : Mohammad Akhtar
Date : 18.01.2022
Period of Involvement : March, 2019 to till date
Contact Information : Mohammad Akhtar
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Louis Berger Consultant Pvt. Ltd
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Haryana|122001|India.

Functional Area Expert:

| S. No | Functional Areas | Name of the experts with duration of Employment with organization. | Task | Signatures |
|-------|--|--|---|---|
| 1. | Air Pollution Monitoring, Prevention and Control-AP | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none">Review of EIA ReportReview of Air Monitoring dataImpact Examination and Mitigation Measures.Report Preparation |  |
| 2. | Water Pollution, Monitoring, Prevention and Control-WP | Sridhar Janaswamy (Mar 2018 to till date) | <ul style="list-style-type: none">Preparation of Scope for baseline studyReview of water monitoring dataImpact assessment for water qualityMitigation measures for water pollution |  |

| | | | | |
|----|---|---|--|--|
| 3. | Meteorology, Air Quality and Modeling and Prediction-AQ | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none"> • Study of wind pattern and weather conditions. • Preparation of Meteorology Report • Air quality Modelling • Impact identification and mitigation measures • Report Preparation |  |
| 4. | Ecology and Biodiversity -EB | Mohammad Shabbir Ali (August 2019 to till date)/ Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none"> • Ecology & biodiversity survey of the study area • Consultation with Forest officials and local people. • Joint survey of forest and trees with forest department and revenue department • Examine Impact and mitigation measures • Preparation of Ecological Report. |   |
| 5. | Land Use-LU | K.Mohan (March 2011 to till date) | <ul style="list-style-type: none"> • Preparation Land Use Maps • Examine impact of land use • Mitigation Measures. |  |
| 6. | Socio-Economic-SE | PDV Ramana Kumar (April 2018 to till date)/ Rajesh Kumar Verma (November 2019 to till date) | <ul style="list-style-type: none"> • Socio-economic and Census survey of the area • Impact of PAP • Review of R&R Framework • RAP and SIA Preparation |  |
| 7. | Soil Conservation-SC | D.M. Godbole (November 2003 to till date)/ Vivek Anand (March 2017 to till date) | <ul style="list-style-type: none"> • Preparation of Scope for baseline study • Review of soil monitoring data • Impact assessment for soil quality • Mitigation measures for soil conservation • Report Preparation. |  |
| 8. | Noise and Vibration-NV | Imtiyaz Mallick (April 2018 to till date) | <ul style="list-style-type: none"> • Noise monitoring scoping • Noise impact analysis • Preparation of Management plan |  |
| 9. | Hydrology, Ground Water and Water Conservation-HG | Dr. Navin Kumar Singh (Aug 2016 to till date) | <ul style="list-style-type: none"> • Review of Hydro-geological pattern of the area • Assessment of impact |  |

| | | | | |
|-----|-------------------------------|---|--|---|
| | | | <ul style="list-style-type: none">• Mitigation Measures• Report Preparation | |
| 10. | Risk and Hazard Management-RH | Manjunath K.B (Apr 2018 to till date) | <ul style="list-style-type: none">• Assessment of Construction related risks and hazards.• Report Preparation |  |
| 11. | Municipal Solid Waste-MSW | Imtiyaz Mallick (Apr 2018 to till date) | <ul style="list-style-type: none">• Quantitative assessment of municipal waste likely to be generated• Development of waste management plan |  |
| 12. | Solid and Hazardous Waste-SHW | Sridhar Janaswamy (March 2018 to till date) | <ul style="list-style-type: none">• Impact assessment for SHW• Mitigation measures for water SHW• Preparation of SHW Report |  |
| 13. | EIA Expert & Report Reviewer | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none">• Project Management• Report Review |  |

Declaration by the Head of the Accredited Consultant Organization/ Authority

I, Kshitish V Nadgauda, hereby, confirm that the above-mentioned experts prepared the EIA for Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana. I also confirm that I shall be fully accountable for any mis-leading information mentioned in this statement.



Name: Sh. Kshitish V Nadgauda

Designation: SVP & MD (Asia)

Name of the EIA Consultant Organization: Louis Berger Consultant Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/EIA/2023/IA0064 (Rev. 01) dated July 28, 2021.

ToR Compliance

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|---------------------------------------|---|--|---|
| A. Project Specific Conditions | | | |
| (i) | Cumulative Impact Assessment to be carried out along Phases I, II and III. | Cumulative Impact Assessment has been carried out for STRR Phase-I, II & III combined. | Refer Annexure 3 of EIA Report. |
| (ii) | Water bodies along proposed alignment needs to be surveyed for their conservation and sustainability. Each water body should be clearly identified with its size, any important and threatened species associated with it, its usage by local community along with shape file of each of water body. Impact of proposed project on these water bodies to be identified along with mitigation measures. Emphasis should be given to avoid alignment passing through/over water bodies. | The proposed alignment is crossing Arkavathi River at design km 78.100. Other than this, it also passes through ponds/water bodies at km 8.800, km 12.800, km 27.300 and km 73.500 for that suitable structures have been proposed to maintain the natural drainage pattern of these water bodies. | |
| (iii) | Source of water availability to be ascertained for construction and domestic need. Necessary permissions to be obtained from State Authority/ CGWA if any. | It is estimated that approx. 31,33,233 KL (3436 KLD) of water would be requiring during the construction stage. The requirement would be sourced through water tanker. The water would purchase through water tankers from the approved empanelled agencies as finalized by NHAI in respective districts. All required permissions shall be obtained by the contractor in prior to construction activity from the Competent Authority. | Refer Chapter-2, Section 2.8, Page No. 2-14. |
| (iv) | In consultation and agreement with Chief Wildlife Warden the passages of Elephants along Phase-I and Phase-II shall be identified' | A joint inspection consisting DCF, RFO, officials of EAC's sub-committee Project Director-NHAI and DPR Consultant as require by CWW was carried out on 03.10.2018 and 04.10.2018. (may refer Joint Inspection Report attached as Annexure 4) During the visit viable locations along the alignment keeping in view the engineering aspect of the terrain | Refer Annexure-4 and 5 of Final EIA/EMP Report. |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|--------|---|---|--|
| | | <p>geometry, seasonal drainage, pattern of terrain, and location of actual animal movement/crosses, the proposed animal underpasses structures of 25 x 5.5m were identified at five locations at km 33.654, km 52.960, km 72.420, km 79.995 and km 84.300.</p> <p>The details are furnished in Wildlife Management Plan. Please refer Annexure-5.</p> | |
| (v) | <p>NHAI to develop a comprehensive Environmental Management Plan (EMP) with specific focus on elephants in consultation with Chief Wildlife Warden. The EMP should identify the cross over areas and suggest proper mitigation including but not limited to structures (overpasses, underpasses etc.) that need to be designed and constructed for free movement of Elephants along the passages. EMP should also focus on elephant-human conflict that may arise due to the new green field alignment and mitigation strategy. Adequate fund provision be made in consultation with PCCF & HoFF Karnataka for the proposed alignment and the same be provided to forest department through the mechanism as suggested by the PCCF & HoFF or through existing mechanism adopted by the forest department and depositing the funds for this special purpose.</p> | <p>A comprehensive management plan considering the WII guidelines on 'eco-friendly measures to mitigate impact of linear infrastructure on wildlife" is prepared and submitted to Forest department. Wildlife Management Plan is attached as Annexure-5.</p> | <p>Refer Annexure-5 of final EIA/EMP Report.</p> |

| S. No. | ToR Points | Compliance Status | Reference in EIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------|---|--|---|---------------|------------|------------------|-----------|------------|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|
| (vi) | Provide dimension and location structures for conservation of the wildlife as well as safe movement of the animals in consultation with Chief Wildlife Warden. | <p>Five animal underpasses of 25mx5.5m opening are considered in the proposed STRR Alignment. Details are given as below:</p> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Location (km)</th> <th>Span (m)</th> <th>Opening Size (m)</th> <th>Width (m)</th> <th>Height (m)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>33.654</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>2</td> <td>52.960</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>3</td> <td>72.420</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>4</td> <td>79.995</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>5</td> <td>84.300</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> </tbody> </table> <p>The dimension and proposed structure locations for conservation of the wildlife have been jointly identified in consultation with Forest officials during the site visit on 3.10.2018 and 04.10.2018.</p> | S. No. | Location (km) | Span (m) | Opening Size (m) | Width (m) | Height (m) | 1 | 33.654 | 1 | 25 | 15.10 | 5.5 | 2 | 52.960 | 1 | 25 | 15.10 | 5.5 | 3 | 72.420 | 1 | 25 | 15.10 | 5.5 | 4 | 79.995 | 1 | 25 | 15.10 | 5.5 | 5 | 84.300 | 1 | 25 | 15.10 | 5.5 | Refer Annexure-5 of Final EIA/EMP Report. |
| S. No. | Location (km) | Span (m) | Opening Size (m) | Width (m) | Height (m) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 33.654 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 52.960 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 72.420 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 79.995 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 84.300 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (vii) | Adequate fund provision shall be made under CER to support strengthening of vulture conservation in and around the Ramadeverbetta Vulture Sanctuary, which is very near to Phase-I alignment. Also the fund provision be made in consultation with PCCF & HoFF for conservation of vultures and creating vulture safe zone. BNHS Vulture Safe Zone policy may be referred for this purpose. | <p>The project alignment is not passing through the core and Protected Area of Ramadeverbetta Vulture Sanctuary.</p> <p>A sum of INR 25 lakhs has been provisioned under CER to support the strengthening of vulture conservation in and around the Ramadeverbetta Vulture Sanctuary in consultation with PCCF & HoFF during the implementation of the project.</p> | Refer Chapter 10, Section 10.8, Table – 10.5, Page No. 10-31. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (viii) | Provide compilation of road kill data on existing roads (national and state highways) in the vicinity of the proposed project. | The project is entirely on a Greenfield alignment and there is no major road network exist in the vicinity of the project area. Thus, the road kill data is not available. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|------------------------------|--|---|--|
| (ix) | The proposed alignment should be such that the cutting of trees shall be kept at bare minimum and for this the proponent shall obtain necessary permission from the competent authorities. | <p>The tree cutting are proposed only within the construction zone. Approximately 5,401 non-forest trees and 16,806 numbers of poles (girth size less than 30cm are categorized as poles) are likely to get affected in the proposed development. The trees are present in land which is acquired as Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The tree compensation is given to as a part of compensation of land to the titleholders.</p> <p>The proposed alignment finalisation and geometry design endeavoured to conserve the maximum amount of trees especially those are falling outside the construction zone. It is estimated that about 728 trees and 4110 poles would fall outside the construction zone and are likely to get saved from felling.</p> | Refer Chapter-3, Section 3.4.5, Page 3-38 of EIA Report. |
| B. General Conditions | | | |
| (i) | A brief description of the project, project name, nature, size, its importance to the region/state and the country shall be submitted | <p>The proposed project of Satellite Town Ring Road (STRR) Phase-I (NH-948A) is a part of the Bharatmala Project which starts at design km 0.000 (13°14'56.80"N 77°18'29.26" E) in Obalapura village near Dabaspeta and ends at design km 82. 200 (12°40'10.25"N 77°19'50.23"E) near Kailancha village in Ramanagara (km 82.200).</p> <p>The proposed alignment is passing through 61 villages in Bangalore Rural and Ramanagara districts of Karnataka State. The project road intersects the SH-3 at its existing km 52.700 and further connects to Phase-II of Satellite Town Ring Road.</p> | Refer Chapter-1, Section 1.3, page 1-3 of EIA report. |
| (ii) | In case the project involves diversion of forests land, take guidelines under OM dated 20.03.2013 shall be | No forest land diversion is involved. | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|--------|--|--|--|
| | followed and necessary action accordingly. | | |
| (iii) | Details of any litigation(s) pending against the project and/or any directions or orders passed by any court of law/any statutory authority against the project to be detailed out. | There is no such litigation pending in the court. | |
| (iv) | Detailed alignment plan, with details such as nature of terrain (plain, rolling, hilly), land use pattern, habitation, cropping pattern, forest area, environmentally sensitive areas, mangroves, notified industrial areas, sand dunes, sea, rivers, lakes, details of villages, tehsils, districts and states, latitude and longitude for important locations falling on the alignment by employing remote sensing techniques followed by "ground truthing" and also through secondary data sources shall be submitted. | The predominant land use pattern in and around the site is mostly agricultural followed by residential, commercial and mix land use. The details as per these requirements are captured in Topo survey by employing LiDAR survey techniques | Please refer Chapter-3, Figure-3.7 to 3.10 (Stretch 1 to 4), Page no. 3-5 to 3-8 |
| (v) | Describe various alternatives considered, procedures and criteria adopted for selection of the final alternative with reasons. | The analysis of various alternate routes has been carried out based on the engineering, environmental, social and economic criteria. Details are provided in Chapter-5 of the Final EIA/EMP Report. | Refer Chapter-5 of EIA Report. |
| (vi) | Land use map of the study area to a scale of 1: 25,000 based on recent satellite imagery delineating the crop lands (both single and double crop), agricultural plantations, fallow lands, waste lands, water bodies, built-up areas, forest area and other surface features such as railway tracks, ports, airports, roads, and major industries etc. Along with detailed ground survey map on 1:2000 scale showing the existing features falling within the right of way namely trees, structures including archaeological & religious, monuments etc. if any, shall be submitted. | The ground survey maps have been done using LiDAR survey technique. Provided in Chapter-3 of the Final EIA/EMP Report. | Refer Chapter-3, figure 3.7 to 3.10 (Stretch 1 to 4), Page no. 3-5 to 3-8. |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|--------|--|---|---|
| (vii) | If the proposed route is passing through any hilly area, the measures for ensuring stability of slopes and proposed measures to control soil erosion from embankment shall be examined and submitted. | The project alignment is not passing through hilly area and only in plain & rolling terrain. Slopes on embankment height less than 3m shall be turfed and those above this height shall be protected with stone pitching | |
| (viii) | If the proposed route involves tunnelling, the details of the tunnel and locations of tunnelling with geological structural fraction should be provided. In case the road passes through a flood plain of a river, the details of micro drainage, flood passages and information on flood periodicity at least of the last 50 years in the area shall be examined and submitted. | Since the alignment is passing through plain and rolling terrain, no tunnelling is involved in the project. The proposed road does not pass through any flood prone area. | |
| (ix) | If the project is passing through/located within the notified ecologically sensitive zone (ESZ) around a notified National Park/Wildlife Sanctuary or in the absence of notified ESZ, within 10 km from the boundary of notified National Park/Wildlife Sanctuary, the project proponent may simultaneously apply for the clearance for the standing committee of NBWL. The EC for such project would be subject to obtaining the clearance from the standing committee of NBWL. | The project alignment does not passing through/located within the notified ecologically sensitive zone (ESZ) around a notified National Park/Wildlife Sanctuary or within 10 km from the boundary of notified National Park/Wildlife Sanctuary. Hence, ESZ of notified National Park/Wildlife Clearance from NBWL is not required. | |
| (x) | Study regarding the animal bypasses/underpasses etc. across the habitation areas shall be carried out. Adequate cattle passes for the movement of agriculture material shall be provided at the stretches passing through habitation areas. Underpasses shall be provided for the movement of Wild animals. | No wild animal corridor is crossing the alignment. Total 32 underpasses (VUP/VUP with canal crossing/LVUP), 10 overpasses and 4 viaducts in the habitation area are proposed for STRR-I. Details are provided in Chapter-2 of the Final EIA/EMP Report. | Refer Chapter 2, Section 2.5, Table 2.4 to 2.7 and 2.11, Page no. 2-4 to 2-7. |

| S. No. | ToR Points | Compliance Status | Reference in EIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------|---|--|--|---------------|------------|------------------|-----------|------------|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---|--------|---|----|-------|-----|---------------------------------|
| (xi) | Study regarding in line with the recent guidelines prepared by Wildlife Institute of India for linear infrastructure with strong emphasis on animal movement and identifying crossing areas and mitigation measures to avoid wildlife mortality. | <p>In consideration to the joint inspection with forest department, viable location considering the engineering aspect of the terrain and seasonal drainage associated with the terrain five animal crossings with proposed opening size of 25m x 5.5m are proposed. Details are given below as:</p> <table border="1"> <thead> <tr> <th>S. No.</th> <th>Location (km)</th> <th>Span (m)</th> <th>Opening Size (m)</th> <th>Width (m)</th> <th>Height (m)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>33.654</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>2</td> <td>52.960</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>3</td> <td>72.420</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>4</td> <td>79.995</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> <tr> <td>5</td> <td>84.300</td> <td>1</td> <td>25</td> <td>15.10</td> <td>5.5</td> </tr> </tbody> </table> | S. No. | Location (km) | Span (m) | Opening Size (m) | Width (m) | Height (m) | 1 | 33.654 | 1 | 25 | 15.10 | 5.5 | 2 | 52.960 | 1 | 25 | 15.10 | 5.5 | 3 | 72.420 | 1 | 25 | 15.10 | 5.5 | 4 | 79.995 | 1 | 25 | 15.10 | 5.5 | 5 | 84.300 | 1 | 25 | 15.10 | 5.5 | Refer Annexure 5 of EIA Report. |
| S. No. | Location (km) | Span (m) | Opening Size (m) | Width (m) | Height (m) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 33.654 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 52.960 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 72.420 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 79.995 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 84.300 | 1 | 25 | 15.10 | 5.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (xii) | The information shall be provided about the details of the trees to be cut including their species and whether it also involves any protected or endangered species. Measures taken to reduce the number of the trees to be removed should be explained in detail. The details of compensatory plantation shall be submitted. The possibilities of relocating the existing trees shall be explored. | <p>Approx. 5,401 non-forest trees and 16,806 numbers of poles (girth size less than 30m are categorized as poles) are present along the alignment.</p> <p>No protected or endangered species are noted.</p> <p>The proposed alignment finalisation and geometry design endeavoured to conserve the maximum amount of trees especially those are falling outside the construction zone.</p> <p>The Possibilities of relocating of existing trees shall be finalized in consultation with DFO.</p> <p>The compensatory plantation would be carried out in as per the State Forest guidelines.</p> | Refer Chapter 3, Section 3.4.5, Page 3-38 of EIA Report. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (xiii) | Necessary green belt shall be provided on both sides of the highway with proper central verge and cost provision should be made | Approximately 33,215 numbers of trees and 43,796 numbers of plants (mainly shrubs) will be planted along the roadside and in the median | Refer Chapter-10, Table 10.4, and Page No. 10-29. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| | for regular maintenance. | <p>portion respectively.</p> <p>All plantation shall be carried out as per the IRC:SP:21-2009 guidelines and Green Highway Policy-2015.</p> <p>Species for roadside and median plantation is provided in Chapter 10, Table-10.3, page number 10.29.</p> <p>The estimated cost for plantation is INR 149674455/- (or 14.96 Cr.) including maintenance. The Cost provision is already considered in the EMP Budget.</p> | |
| (xiv) | If the proposed route is passing through a city or town, with houses and human habitation on either side of the road, the necessity for provision of bypasses/ diversions/ underpasses shall be examined and submitted. The proposal should also indicate the location of wayside amenities, which should include petrol stations/service centres, rest areas including public conveyance, etc. | <p>This is a Greenfield alignment and therefore it is not passing through any major settlement.</p> <p>However, traffic crossover facilities in the form of interchanges, underpasses, overpasses are provided at nearby of every 3km interval to facilitate the traffic crossover in the entire project length. There are total of 32 underpasses (17 VUP, 6 VUP with canal crossing and 9 LVUP), 10 VOP, 4 Viaducts, 1 Major and 13 Minor bridges, 3 ROBs, 119 culverts and six interchanges are proposed.</p> <p>There is also a provision of a toll plaza, bus bays& bus shelters, truck parking facilities, rest areas etc. are proposed.</p> <p>The details are presented in the Final EIA/EMP Report.</p> | Refer Chapter 2, Tables 2-4 to 2-13. Page nos. 2-4 to 2-10. |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
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| (xv) | Details about measures taken for the pedestrian safety and construction of underpasses and foot-over bridges along with flyovers and interchanges shall be submitted. | As the proposed project is entirely Greenfield and with access control, no major pedestrian crossing are envisaged. However, service/slip road of 29.47 km has been proposed for movement in habitation area. Apart from that, 32 underpasses (17 VUP, 6 VUP with canal crossing and 9 LVUP), 10 VOP, 4 Viaducts, 1 Major and 13 Minor bridges, 3 ROBs, 119 culverts and interchanges at 6 locations are proposed for safe pedestrian and cross-vehicular traffic. The details are presented in the Final EIA/EMP Report. | Refer Chapter 2, Tables 2-4 to 2-13. Page nos. 2-4 to 2-10 |
| (xvi) | The possibility that the proposed project will adversely affect road traffic in the surrounding areas (e.g. by causing increases in traffic congestion and traffic accidents) shall be addressed. | The proposed STRR is connecting the major NH/SH that passes through the Bangalore city and thus, this proposed facility will ease the traffic condition in the Bangalore city and bifurcating the through traffic entering into the city. The project has provided six interchanges and many underpasses at regular intervals to ensure seamless traffic flow in its proposed design life. | |
| (xvii) | The details of use of fly ash in the road construction, if the project road is located within the 100 km from the Thermal Power Plant shall be examined and submitted. | The details of use of fly ash in the road construction shall consider within the 300 km as per latest MOEF&CC notification S.O. 254(E) dated 25/01/2016. The fly ash sources are presented in the Final EIA/EMP Report. | Refer Chapter 2, Section 2.7, Table-2.18, Page no. 2-14. |
| (xviii) | The possibilities of utilizing debris/waste materials available in and around the project area shall be explored. | As this is Greenfield project, minimum debris/waste material would get generated. The possibility of generation of debris/waste material is envisaged where the alignment crosses the existing road. The waste generated due to earthwork excavation may reuse for filling purpose and also in construction of embankment. Further, construction waste will be managed as per C&D Waste Management Rules, 2016. | Refer Chapter 4, Section 4.3.8, Page no. 4-11. |

| S. No. | ToR Points | Compliance Status | Reference in EIA | | | | | | |
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| | | Details are presented in the Final EIA/EMP Report. | | | | | | | |
| (xix) | The details on compliance with respect to Research Track Notification of Ministry of Road, Transport and Highways shall be submitted. | IRC and MoRTH guidelines shall be followed. | Refer Chapter 2, Section 2.4 (x), Table – 2-4, Page 2-4 of EIA Report. | | | | | | |
| (xx) | The details of sand quarry and borrow area as per OM No.2-30/2012-1A-III dated 18.12.2012 on 'Rationalization of procedure for Environmental Clearance for Highway Projects involving borrow areas for soil and earth" as modified vide OM of even No. dated March 19, 2013, shall be examined and submitted. | <p>Eight Borrow area locations have been identified along the project road which are within 5km periphery of project site.</p> <p>Four sand quarries locations have been identified for the proposed project and the same are provided in the Final EIA/EMP Report.</p> | Refer Chapter 2, Section 2.7, Table no. 2.17, Page No. 2-12. | | | | | | |
| (xxi) | Climate and meteorology (max and min temperature, relative humidity, rainfall, frequency of tropical cyclones and snowfall); the nearest IMD meteorological station from which climatological data have been obtained to be indicated. | <p>The site specific meteorology data has been obtained from the nearest IMD station of Bangalore. Climatological data are:</p> <table border="1"> <tbody> <tr> <td>Temperature</td> <td>Max. - 33°C Min. - 15°C</td> </tr> <tr> <td>Relative Humidity</td> <td>Varies between 49% and 76.5%</td> </tr> <tr> <td>Rainfall</td> <td>824 mm</td> </tr> </tbody> </table> | Temperature | Max. - 33°C Min. - 15°C | Relative Humidity | Varies between 49% and 76.5% | Rainfall | 824 mm | Refer Chapter 3, Section 3.3.7.1, page 3-13 of EIA report |
| Temperature | Max. - 33°C Min. - 15°C | | | | | | | | |
| Relative Humidity | Varies between 49% and 76.5% | | | | | | | | |
| Rainfall | 824 mm | | | | | | | | |
| (xxii) | The air quality monitoring shall be carried out as per the notification issued on 16th November, 2009. Input data used for Noise and Air quality modelling shall be clearly delineated. | Air Quality Monitoring has been carried out as per the guidelines and the results are provided in the Final EIA/EMP Report. | Refer Chapter 3, section 3.3.7.2, Table no. 3-12 to 3-13, page no. 3-20 to 3-21. | | | | | | |
| (xxiii) | The project activities during construction and operation phases, which will affect the noise levels and the potential for increased noise resulting from this project, shall be identified. Discuss the effect of noise levels on nearby habitations during the construction and operational phases of the proposed highway. Identify noise reduction measures and traffic management strategies to be | Noise modelling has been carried out at 7 locations using Dhvani Pro software in order to predict the future noise level of the project area. It is observed from predicted values that, the resultant noise levels for operation phase of the project will increase slightly at receptor locations near proposed road. Results of the same are provided in the Final EIA/EMP Report. | Refer Chapter 4, section 4.4.1.1, Table no. 4.10, Page no. 4-12 to 4-13. | | | | | | |

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| | deployed for reducing the negative impact if any. Prediction of noise levels shall be done by using mathematical modelling at different representative locations. | | |
| (xxiv) | The impact during construction activities due to generation of fugitive dust from crusher units, air emissions from hot mix plants and vehicles used for transportation of materials and prediction of impact on ambient air quality using appropriate mathematical model, description of model, input requirement and reference of derivation, distribution of major pollutants and presentation in tabular form for easy interpretation shall be examined and carried out. | Air quality modelling has been carried out as per the MoEF&CC requirements and CPCB guidelines. The details are provided in the Final EIA/EMP Report. | Refer Chapter 4, Section 4.2.2, Page no. 4-5. |
| (xxv) | The details about the protection to existing habitations from dust, noise, odour etc. during construction stage shall be examined and submitted. | This is a Greenfield alignment and thus the entire earthworks and construction activities would be carried out by fencing the construction zone to control fugitive dust. Water sprinkling will be carried out to prevent dust emission. Noise barriers will be provided to prevent noise near sensitive areas along the alignment. The mitigation measures to minimize the impact of dust, noise, odour etc., have been provided in Chapter 4 of the Final EIA/EMP Report. | Refer Chapter 4, section 4.4, Page no. 4-12 of EIA Report. |
| (xxvi) | If the proposed route involves cutting of earth, the details of area to be cut, depth of cut, locations, soil type, volume and quantity of earth and other materials to be removed with location of disposal/ dump sites along with necessary permission. | Total 8 locations of borrow area for STRR-I have been identified that are within 5 km periphery of project site. The excavation from these areas would be carried out after having agreement with the owner. The rehabilitation of borrow area would be carried out after construction as per IRC and MoRT&H guidelines. | Refer Chapter 2, Section 2.7, Table no. 2.17, Figure no. 2.1, Page No. 2-12. |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
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| (xxvii) | If the proposed route is passing through low-lying areas, details of filling materials and initial and final levels after filling above MSL, shall be examined and submitted. | The proposed highway does not pass through any low lying area | |
| (xxviii) | The water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality and likely impacts on them due to the project along with the mitigation measures shall be examined and submitted. | The proposed alignment is crossing Arkavathi River at design km 78.100. Other than this, it also passes through ponds/water bodies at km 8.800, km 12.800, km 27.300 and km 73.500 for that suitable structures have been proposed to maintain the natural drainage pattern of these water bodies. | Refer Chapter 4 for mitigation measures |
| (xxix) | The details of water quantity required and source of water including water requirement during the construction stage with supporting data and also classification of ground water based on the CGWA classification, shall be examined and submitted. | It is estimated that approx. 31,33,233 KL (3436 KLD) water will be required during the construction stage. It will be sourced through water tanker. NHAI will purchase water tankers from the approved empanelled agencies of respective districts. If required, surface/ground water will be utilized after obtaining permission from competent authority by the contractor. | Refer Chapter 2, Section 2.8, Table no. 2.20, Page no.2-14. |
| (xxx) | The details of measures taken during constructions of bridges across rivers/ canals/major or minor drains keeping in view the flooding of the rivers and the life span of the existing bridges shall be examined and submitted. Provision of speed breakers, safety signals, service lanes and footpaths shall be examined at appropriate locations throughout the proposed road to avoid accidents. | Since it is a Greenfield project, there are no existing bridges. In this project, 1 Major and 13 Minor bridges, and 119 no. of culverts are proposed. The life spans of the structures are considered as per the relevant IRC standards. The details are presented in the Final EIA/EMP Report. No speed breaker is envisaged, as it is fully access-controlled road with National Highways standards. However, keeping the view of safety aspect, safety signals, service lanes etc. are proposed to avoid road accidents. | Refer Chapter 2, Table no. 2.8, 2.9 and 2.13, Page no. 2-6 and 2-8 |
| (xxxi) | If there will be any change in the drainage pattern after the proposed activity, details of changes shall be examined and submitted. | There is no change in existing drainage pattern due to the proposed activity. | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
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| (xxxii) | Rainwater harvesting pit shall be at least 3 - 5 m above the highest ground water table. Provisions shall be made for oil and grease removal from surface runoff. | Rainwater harvesting pit will be provided on either side of road at 500 m interval subject to the first aquifer below 10m. Therefore, 100 ground water recharge pits have been proposed as rainwater harvesting structures. The design of RWH pits will be as per IRC: SP: 50-2013. In addition, the oil interceptors will be considered in design to avoid water contamination. | Refer Chapter 4, Section 4.5.2.5, and Page No. 4- 18. |
| (xxxiii) | If there is a possibility that the construction/widening of road may cause an impact such as destruction of forest, poaching or reduction in wetland areas, examine the impact and submit details. | The construction of road would not cause any impact such as destruction of forest, poaching or reduction in wetland areas. | |
| (xxxiv) | The details of road safety, signage, service roads, vehicular under passes, accident prone zones and the mitigation measures, shall be submitted. | Service roads of 29.47 km length have been proposed in this phase. There are 32 underpasses (17 VUP, 6 VUP with canal crossing and 9 LVUP), 10 VOP and 4 Viaducts are proposed. The proposed highway is an access controlled and accordingly adequate road signing, road marking are considered in the entire project road length including all proposed interchanges locations. The details of proposed structures are provided in the Final EIA/EMP Report. | Refer Chapter 2, Tables 2-4 to 2-13. Page nos. 2-4 to 2-10. |
| (xxxv) | IRC guidelines shall be followed for widening & up-gradation of roads. | The entire road design has been carried out based on IRC/MORTH guidelines. | |
| (xxxvi) | The details of social impact assessment due to the proposed construction of the road shall be submitted. | During the socio-economic survey, it has been found that total 310 nos. of structures (268 private, 10 government, 31 community properties and 1 Panchayat), 224 nos. Of families (PAFs), 1170 nos. of persons (PAPs) and 260 households are getting affected due to the proposed project. | Refer Chapter-7, Section 7.4, Page no, 7-97. |

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| | | The R&R plan has been prepared based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The LA and R&R cost is INR 2034.54 Cr. | |
| (xxxvii) | Examine the road design standards, safety equipment specifications and Management System training to ensure that design details take account of safety concerns and submit the traffic management plan. | <p>The design safety audits have been carried out in various stages of design works as well as it would be carried out during different stages of construction stage to ensure that the design and construction safety are fully complied.</p> <p>In addition, health and safety meeting will also be programmed periodically during the construction phase ensuring implementation of safety concerns.</p> <p>The traffic management plan shall be prepared by the Contractor and will be approved by the EO-CSC before implementation.</p> <p>The construction work will be carried out by the contractor in such a manner of creating least interference to the free flow of traffic as per the approved Traffic Management Plan.</p> | Refer Chapter 7, Section 7.2.7, page 7-83 of EIA Report. |
| xxxviii) | Accident data and geographic distribution shall be reviewed and analyzed to predict and identify trends - in case of expansion of the existing highway and provide Post accident emergency assistance and medical care to accident victims. | The proposed project is a Greenfield and not an expansion of the existing highway. Therefore, analysis to predict and identify trends after reviewing the accident data and geographic distribution shall not applicable. | |
| (xxxix) | If the proposed project involves any land reclamation, details shall be provided of the activity for which land is to be reclaimed and the area of land to be reclaimed. | The proposed project does not involve any land reclamation. | |
| (xl) | Details of the properties, houses, business activities etc. likely to be effected by land acquisition and an estimation of their financial losses, | The total land required for the proposed project is 685.367 hectare. Out of which, 66.073 hectare are of Government land and 619.294 | Refer Chapter 7, Section 7.4, page 7-97 of EIA report. |

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| | shall be submitted. | hectares of private land. In this project, there are 172 minor assets, 260 households, 468 PAFs and 1170 PAPs are affected due to the development of proposed project. The R&R plan has been prepared based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The LA and R&R cost is INR 2034.54 Cr. | | | | | | | | | | | |
| (xli) | Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment and rehabilitation of the displaced people, civil and housing amenities being offered, etc. and the schedule of the implementation of the specific project, shall be submitted. | The R&R plan has been prepared based on Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. Detailed RAP is presented in Chapter 7 of final EIM-EMP Report. | Refer Chapter-3, Section 3.5, Page no. 3-43 and Chapter 7, Section 7.4, Page no. 7-97. | | | | | | | | | | |
| (xlii) | The environment management and monitoring plan for construction and operation phases of the project shall be submitted. A copy of your corporate policy on environment management and sustainable development shall also be submitted. | Environmental Monitoring and Management Plan for construction and operation phases of the project are provided in the final EIA/EMP Report. There is no provision of CSR policy as per NHAI laws & regulations available. | Refer Chapter 6, Table 6.1, Page no. 6-59 for Environmental Monitoring Programme Chapter 10, Table no. 10.2, Page no. 10-6 for EMP. | | | | | | | | | | |
| (xliii) | Estimated cost of the project including that of environment management plan (both capital and recurring) and source of funding. Also, the mode of execution of the project, viz, EPC, BOT, etc, shall be submitted. | The estimated EMP cost (both capital and recurring) is INR 17.58 Cr. <table border="1"> <tr> <td>Total Project Cost (INR.)</td> <td>4221 Cr.</td> </tr> <tr> <td>Civil Cost</td> <td>2077.66 Cr.</td> </tr> <tr> <td>R&R cost including LA</td> <td>2034.54 cr.</td> </tr> <tr> <td>Environmental Monitoring Cost</td> <td>37.57 lakh</td> </tr> <tr> <td>Environmental Management Cost</td> <td>17.58 Cr.</td> </tr> </table> | Total Project Cost (INR.) | 4221 Cr. | Civil Cost | 2077.66 Cr. | R&R cost including LA | 2034.54 cr. | Environmental Monitoring Cost | 37.57 lakh | Environmental Management Cost | 17.58 Cr. | |
| Total Project Cost (INR.) | 4221 Cr. | | | | | | | | | | | | |
| Civil Cost | 2077.66 Cr. | | | | | | | | | | | | |
| R&R cost including LA | 2034.54 cr. | | | | | | | | | | | | |
| Environmental Monitoring Cost | 37.57 lakh | | | | | | | | | | | | |
| Environmental Management Cost | 17.58 Cr. | | | | | | | | | | | | |

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| | | The project is executed on HAM mode. | |
| (xliv) | A copy of your CSR policy and plan for meeting the expenditure to address the issues raised during Public Hearing shall be submitted. | The Public Hearing has been conducted in Ramanagara & Bangalore Rural districts on 09.08.2019 and 16.08.2019 respectively as per the MoEF&CC guidelines. The budgetary amount INR 1626.74 lakh is allocated for CER activity. | Refer Chapter 7, Section 7.1.5, page 7-69 of EIA Report. |
| (xlv) | Details of blasting if any, methodology/technique adopted, applicable regulations/permissions, timing of blasting, mitigation measures proposed keeping in view mating season of wildlife. | No blasting work involved in this project | |
| (xlvi) | In case of river/ creek crossing, details of the proposed bridges connecting on either banks, the design and traffic circulation at this junction with simulation studies | Bridges and culverts are proposed on all stream crossings and water bodies falling across the alignment. Details of proposed bridges and culverts are provided in Chapter-2 of the Final EIA/EMP Report. | Refer Chapter 2, Table 2.8, 2.9 and 2.1, Page no. 2-6 and 2-8. |
| (xlvii) | Details to ensure free flow of water in case the alignment passes through water bodies/river/streams etc. | The proposed alignment is crossing Arkavathi River at design km 78.100. Other than this, it also passes through ponds/water bodies at km 8.800, km 12.800, km 27.300 and km 73.500 for that suitable structures have been proposed to maintain the natural drainage pattern of these water bodies. | |
| (xlviii) | In case of bye passes, the details of access control from the nearby habitation/habitation, which may come up after the establishment of road. | This is a Greenfield project, thus no bypass is applicable. | |
| (xlix) | Bridge design in eco sensitive area /mountains be examined keeping in view the rock classification hydrology etc. | The proposed alignment does not pass through any eco-sensitive area or mountains. | |
| I | Details of litigation pending against the project, if any, with direction/order passed by any Court of Law against the Project should be given. | There is no such litigation with the court. | |

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| ii | The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out. | Details are given as: <table border="1" style="margin-left: 20px;"> <tr> <td>Total Project Cost (INR.)</td> <td>4112 Cr.</td> </tr> <tr> <td>Civil Cost</td> <td>2077.66 Cr.</td> </tr> <tr> <td>R&R cost including LA</td> <td>2034.54 cr.</td> </tr> <tr> <td>Environmental Monitoring Cost</td> <td>37.57 lakh</td> </tr> <tr> <td>Environmental Management Cost</td> <td>17.58 Cr.</td> </tr> </table> | Total Project Cost (INR.) | 4112 Cr. | Civil Cost | 2077.66 Cr. | R&R cost including LA | 2034.54 cr. | Environmental Monitoring Cost | 37.57 lakh | Environmental Management Cost | 17.58 Cr. | |
| Total Project Cost (INR.) | 4112 Cr. | | | | | | | | | | | | |
| Civil Cost | 2077.66 Cr. | | | | | | | | | | | | |
| R&R cost including LA | 2034.54 cr. | | | | | | | | | | | | |
| Environmental Monitoring Cost | 37.57 lakh | | | | | | | | | | | | |
| Environmental Management Cost | 17.58 Cr. | | | | | | | | | | | | |
| iii | In case of alignment passing through coastal zones | The alignment does not pass through any coastal zones. | | | | | | | | | | | |
| a) | HTL/LTL map prepared by authorized agencies superimposed with alignment and recommendation of Coastal Zone Management Authority | Not applicable | | | | | | | | | | | |
| b) | Details of CRZ-I (I) areas, mangroves required to be removed for the project along with the compensatory afforestation, area and location with budget | Not applicable | | | | | | | | | | | |
| c) | Details of road on stilt in CRZ-I areas, design details to ensure free tidal flow | Not applicable | | | | | | | | | | | |
| d) | Details of Labour camps, machinery location | Not applicable | | | | | | | | | | | |
| liii | Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website " http://moef.nic.in/Manual/Highways ". | Noted | | | | | | | | | | | |
| 5. General Guidelines | | | | | | | | | | | | | |
| (i) | The EIA document shall be printed on both sides, as far as possible. | Already Compiled | | | | | | | | | | | |
| (ii) | All documents should be properly indexed, page numbered. | Compiled as per the instructions | | | | | | | | | | | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
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| (iii) | Period/date of data collection should be clearly indicated. | Environmental Baseline data is presented in Chapter -3 of Final EIA-EMP Report. | Refer Chapter-3, Section 3.3.5, 3.3.6, 3.3.7 and 3.3.8 |
| (iv) | Authenticated English translation of all material provided in Regional languages. | Executive Summary of the Draft EIA Report along with requisite documents was provided in both Kannada (Regional language) and English languages during the public hearing. | |
| (v) | The letter/application for EC should quote the MoEF&CC File No. and also attach a copy of the letter prescribing the TOR. | Complied | |
| (vi) | The copy of the letter received from the Ministry on the TOR prescribed for the project should be attached as an annexure to the final EIA-EMP Report. | TOR Letter received from MoEF&CC is attached as Annexure-1 . | |
| (vii) | The final EIA-EMP report submitted to the Ministry must incorporate the issues in TOR and that raised in Public Hearing. The index of the final EIA-EMP report, must indicate the specific chapter and page no. of the EIA-EMP Report where the specific TOR prescribed by Ministry and the issue raised in the P.H. have been incorporated. Questionnaire related to the project (posted on MoEF&CC website) with all sections duly filled in shall also be submitted at the time of applying for EC. | It is included in Final EIA report. | |
| (viii) | Grant of TOR does not mean grant of EC. | Noted | |
| (ix) | Grant of TOR/EC to the present project does not mean grant of approvals in other regulations such as the Forest (Conservation) Act 1980 or the Wildlife (Protection) Act, 1972. | Noted | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|--------|--|--|------------------|
| (x) | Grant of EC is also subject to Circulars and Office Memorandum issued under the EIA Notification 2006 and subsequent amendments, which are available on the MoEF&CC website: www.envfor.nic.in. | Noted | |
| (xi) | The status of accreditation of the EIA consultant with NABET/QCI shall be specifically mentioned. The consultant shall certify that his accreditation is for the sector for which this EIA is prepared. | The letter of NABET accreditation enclosed as Annexure-8 of Final EIA-EMP Report. | |
| (xii) | On the front page of EIA/EMP reports, the name of the consultant/consultancy firm along with their complete details including their accreditation, if any shall be indicated. The consultant while submitting the EIA/EMP report shall give an undertaking to the effect that the prescribed TOR (TOR proposed by the project proponent and additional TOR given by the MoEF) have been complied with and the data submitted is factually correct (Refer MoEF office memorandum dated 4 th August, 2009). | Noted | |
| (xiii) | While submitting the EIA/EMP reports, the name of the experts associated with/involved in the preparation of these reports and the laboratories through which the samples have been got analysed should be stated in the report. It shall clearly be indicated whether these laboratories are approved under the Environment (Protection) Act, 1986 and the rules made there under (Please refer MoEF office memorandum dated 4 th August, 2009). The project Coordinator of the | Noted | |

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|--------|--|--|------------------|
| | EIA study shall also be mentioned. | | |
| (xiv) | All the TOR points as presented before EAC shall be covered. | Noted | |
| 6. | A detailed draft EIA/EMP report shall be prepared in terms of the above additional TOR and should be submitted to the State Pollution Control Board for Public Hearing. Public Hearing to be conducted for the project in accordance with the provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The Public Hearing shall be conducted based on the TOR letter issued by the Ministry and not on the basis of Minutes of the Meeting available on the website. | Final EIA-EMP report is prepared after considering the issues of public during public hearing. | |
| 7. | The project proponent shall submit the detailed final EIA/EMP report prepared as per TOR including issues raised during Public Hearing to the Ministry for considering the proposal for environmental clearance within 3 years as per the MoEF&CC OM No J-11013/41/2006-IA-11(1) (Part) dated 29th August, 2017. | Noted | |
| 8. | The consultants involved in preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc. vide notification of the MoEF dated 19 th July, 2013. | The letter of NABET accreditation enclosed as Annexure-8 of Final EIA-EMP Report. | |

Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana.

| S. No. | ToR Points | Compliance Status | Reference in EIA |
|---------------|--|--------------------------|-------------------------|
| 9. | The prescribed TOR would be valid for a period of three years for submission of the EIA/EMP Reports. | Noted | |

CHAPTER : 1 INTRODUCTION

1.1 PURPOSE OF THE PROJECT

The Ministry of Road, Transport and Highways (MORTH), Government of India through National Highways Authority of India (NHAI) has decided to take up the development of new National Highways in order to ensure safe, smooth, efficient, and high speed transport corridor under Bharatmala Pariyojana (Lot-3), an Umbrella scheme of the road development project.

In pursuance of the above program, NHAI is undertaking “Satellite Town Ring Road (West Side)” under the Bharatmala Pariyojana (Lot-3). The proposed road is a newly declared highway as NH-948A vide MoRTH Gazette Notification S.O. 06(E) dated 1st January, 2018 (enclosed as **Annexure-2**). The proposed project starts from km. 0.000 in Dabaspeta and ends at km. 179.969 near Devarapalli village in Tamil Nadu/Karnataka Border. The project road is entirely a new Greenfield highway. The entire project road is falling in two states viz. Karnataka (length 134.942km) and Tamil Nadu (length 45.027km).

NHAI vide its letter no NHAI/12012/BM/Pkg.STRR/1/2017/PIU-NG (EXP)/92 dated 04.05.2018 and NHAI/12012/BM/Pkg.STRR/1/2018/PIU-NG (EXP)/325 dated 13.07.2018 has categorised the project in 3 phases for speedy expeditious implementation of the project. The entire corridor is proposed to be taken up in 3 phases as given in **Table 1.1** and **Figure 1.2**.

Table 1-1: Phase wise details of Project Corridor STRR

| Phases | Description (Design km) | Length (km) | District | Length (km) | State |
|--------------|----------------------------|-------------|-----------------|----------------|------------------------|
| Phase-I | km. 0.000 to km. 82.200 | 82.200 | Bangalore Rural | 19.500 | Karnataka |
| | | | Ramanagara | 62.700 | |
| Phase-II | km. 82.200 to km. 140.000 | 57.800 | Ramanagara | 37.700 | Karnataka & Tamil Nadu |
| | | | Bangalore Urban | 15.042 | |
| | | | Krishnagiri | 5.058 | |
| Phase-III | km. 140.000 to km. 179.969 | 39.969 | Krishnagiri | 39.969 | Tamil Nadu |
| Total | | | | 179.969 | |

During the Feasibility study, the STRR alignment was divided into three Phases. These phases are based on considering the 10km radius of the eco-sensitive zone (Core & Buffer) of the Bannerghatta National Park (BNP).

Changes of termination points

During project progression, the termination points of all three phases were reconsidered to ensure the accessibility and connectivity with the existing road network after implementation to serve as stand alone project. The changes proposed by NHAI accordingly are as follow.

Phase I

The end location of Phase 1 is reduced to km 79.000 from km 82.200 (as per the environment TOR issued) by NHAI, considering in case if Phase 2 implementation are delayed due to Environment, Forest and Wildlife Clearances to Phase II. Therefore, the length terminated in the

existing road connectivity location at km 79.000 and accordingly keeping this aspect, the Phase 1 was considered from km 0.000 to km 79.000 in two contract packages for the bid purposes.

Phase II

The end chainage was modified from km. 144.480 (as per the environment TOR issued) to km. 140.000 considering in case, if Phase-II implementation is delayed due to Environment, Forest and Wildlidge Clearances, the Phase 3 portion of road constructed must serve the connectivity to the road user and thus, it was terminated at km 140.000 in the existing SH-17A. The Phase II is considered in 3 contract packages.

Phase III

The Environmental Clearances for Phase 3 from km 140.000 to km 179.969 was already obtained in the 237th meeting on 29.06.2020. This Phase was considered in one contract package.

This report is for Phase-I of the Satellite Town Ring Road (hereinafter refer "STRR-I") starting from km. 0.000 to km. 82.200. The total length of this phase is 82.200 km

Table 1-2: Details of STRR Phase-I

| National Highway No. | Project Road Stretch | State | Districts en-route | Taluks en-route | Length (km) |
|----------------------|--|-----------|--------------------|-----------------|-------------|
| NH-948A | From Dabaspete to Ramanagara (km. 0.000 to km. 82.200) | Karnataka | Bangalore Rural | Nelamangala | 19.675 |
| | | | Ramanagara | Magadi | 36.359 |
| | | | | Ramanagara | 26.166 |

1.2 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

The proposed STRR Phase-I of NH-948A is located in Karnataka State only passing through two districts namely Ramanagara and Bangalore Rural districts of Karnataka. The total length of this phase is 82.200 Km. The proposed main carriageway is 6 lanes configuration and RoW is 70m throughout the corridor except at interchange, toll plaza, truck parking, grade separated structures etc. The proposed project is developed by the National Highway Authority of India under Bharatmala Pariyojna (Lot-3).

The National Highways Authority of India, an autonomous agency, was constituted by an act of Parliament, the National Highways Authority of India Act, 1988 for development, maintenance and management of National Highways entrusted to it and for matter connected or incidental thereto. In the proposed development project, the National Highways Authority of India (NHAI) has been entrusted to implement and monitor the development of new National Highway NH-948A under Bharatmala Pariyojana (Lot-3) which is presently administered by NHAI's Project Implementation Unit (PIU) Bangalore, Bangalore in Karnataka.

The NHAI has appointed M/s Louis Berger Consulting Private Limited for providing Consultancy Services for the preparation of Detailed Project Report including Environmental and Social Impact Assessment for development of Satellite Town Ring Road (STRR) Phase-I of NH-948A under Bharatmala Pariyojana (Lot-3).

Project Proponent

The Registered office of NHAI is:

National Highway Authority of India (NHAI)
 G 5&6, Sector-10, Dwarka,
 New Delhi - 110 075
 Phone: 91-011-25074100 & 25074200
 Fax: 91-011-25093507, 25093514
 Website: www.nhai.gov.in

The project is being administered by NHAI's Project Implementation Unit (PIU) Bangalore, Bangalore in Karnataka.

1.3 BRIEF DESCRIPTION AND LOCATION OF THE PROJECT

The Satellite Town Ring Road (West Side) Phase-I of NH-948A starts from km. 0.000 in Obalapura village near Dabbaspeta and terminates at km. 82.200 in Kailancha village near Ramanagara. The proposed alignment is passing through 61 villages of Bengaluru rural and Ramanagara districts of Karnataka. The salient features of the project are presented in **Table 1.3**.

Table 1-3: Salient Features of STRR-I

| S. No. | Particulars | Details |
|--------|--|--|
| 1. | Project Name | Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana. |
| 2. | Project Length | 82.200 Km |
| 3. | Configuration | 6-lanes carriageway with a raised median of 5 m width |
| 4. | PRoW | 70 m except for interchanges, toll plaza, truck parking |
| 5. | Shoulder | Paved Shoulder – 1.50 mtr. Earthen Shoulder – 2 mtr. |
| 6. | Category (as under EIA Notification, 2006) | Category-A |
| 7. | Project Location | The Phase-I of Satellite Town Ring Road (STRR-I) starts at km. 0.000 in Obalapura village near Dabbaspeta, ends at km. 82.200 near Kailancha village in Ramanagara. |
| 8. | Geographical Co-ordinates | Start: 13°14'56.80"N 77°18'29.26"E End: 12°40'10.25"N 77°19'50.23"E |
| 9. | Land details | Plain and rolling terrain |
| 10. | Land acquisition area | Total land acquired = 685.367 ha. Private land = 619.294 ha. Govt. land = 66.073 ha. |
| 11. | Details of affected trees | About 5,401 non-forest trees and 16,806 numbers of poles (girth size having less than 30 m are categorized as poles) are falling under Corridor of Impact. |
| 12. | Water requirement | Approx. 31,33,233 KL or 3436 KLD |
| 13. | Source of water | Water tanker. NHAI will purchase water tankers from the approved empanelled |

| S. No. | Particulars | Details |
|--------|---|---|
| | | agencies of respective districts. |
| 14. | Employment | 2000 no. of employees during construction and 250 no. of employees during operation phase will be required. |
| 15. | Estimated Solid waste generation during construction phase | 560 Kg/day municipal solid waste is expected to be generated during construction considering 2000 labourers. |
| 16. | No. of structures affected | 310 |
| 17. | Household affected (PAHs) | 260 |
| 18. | No. of project affected families and persons (PAFs & PAPs) | PAFs = 468 PAPs = 1170 |
| 19. | No. of villages affected by land acquisition | 61 |
| 20. | Major Bridge | 1 |
| 21. | Minor Bridge | 13 |
| 22. | Viaducts | 4 |
| 23. | Culverts | 119 |
| 24. | Interchange | At 6 locations |
| 25. | ROB | At 3 locations (km. 8.940, 29.265, 70.695) |
| 26. | Flyover | VOP - 10 |
| 27. | Underpass Box/VUP/LVUP | VUP - 17 VUP with canal crossing - 6 LVUP - 9 |
| 28. | Subway | Nil |
| 29. | Service/Slip Road | 29.47 Km |
| 30. | Toll Plaza/Toll Booth | As per IRC:SP:87-2019 |
| 31. | Bus-Bay Shelter | As per IRC:80-1981 |
| 32. | Truck parking areas | As per IRC:SP:87-2019 |
| 33. | Safety Measure | Crash Barriers |
| 34. | Lighting | Lighting including High Mask at Toll plazas, interchanges, major bridges and Amenities Areas |
| 35. | Nearest Railway Station | Ramanagara Railway Stations - approx. 2.00 Km in West direction. |
| 36. | Nearest airport | Kempegowda International Airport (Bengaluru) - 41.45 Km in East direction |
| 37. | Nearest NH/SH | NH-207 (Bangalore-Dabaspet), NH-4 (Bangalore/Pune road), NH-48 (Bangalore-Mangalore road), SH-85 (Bangalore-Nagamangala Road), NH-275/SH-17 (Bangalore-Mysore Road) |
| 38. | Seismic Zone | Zone-II as per IS 1893 (Part 1) : 2002 |
| 39. | R&R Cost including LA budget | INR 2034.54 crores |
| 40. | Project Civil Cost | INR. 2077.66 Cr. |
| 41. | Total project cost (including LA, R&R, utility shifting etc.) | INR. 4112 Cr. |
| 42. | Environmental Management Cost | INR 17.58 crores |

Project Location

The Phase-I of Satellite Town Ring Road (STRR-I) starts at km. 0.000 (13°14'56.80"N 77°18'29.26"E) in Obalapura village near Dabbaspete, ends at km. 82.200 (12°40'10.25"N 77°19'50.23"E) near Kailancha village in Ramanagara (km 82.200). The project road intersects the SH-3 at its existing km 52.700 and further connects to Phase-II of Satellite Town Ring Road. The location of the STRR Phase-I stretch is shown in **Figure 1.2**.

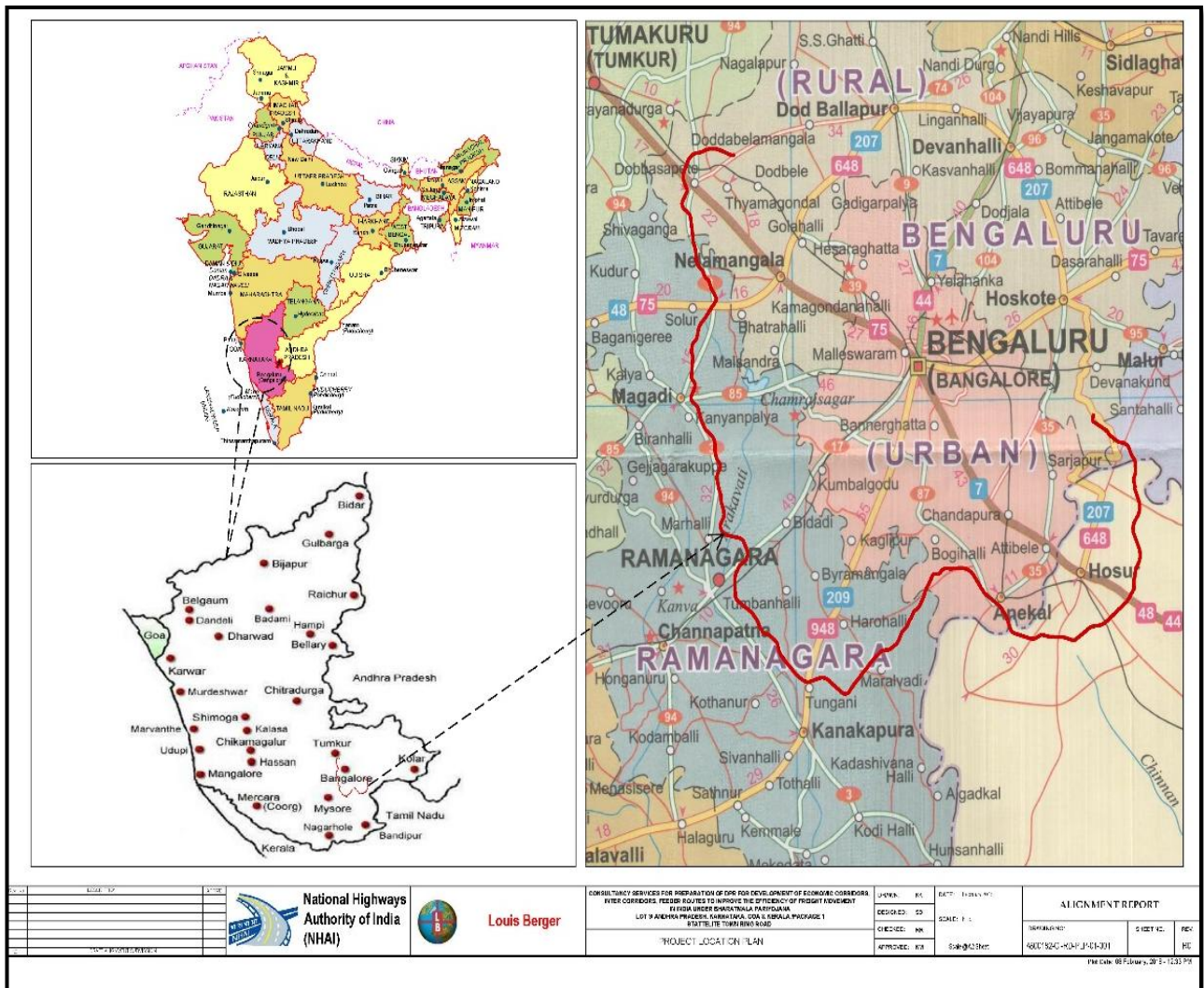


Figure 1-1: Location Map of Entire STRR alignment



Figure 1-2: Location Map of STRR Phase-I

1.4 SCOPE OF THE STUDY

The proposed project falls under Category-A as per EIA Notification, 2006 and its subsequent amendments. Accordingly, Environmental Impact Assessment report is required to prepare which constitutes a detailed study right from beginning of the project till the operation phase. The environmental assessment is different at different phases of the project. The main purpose of the study is to collect the baseline data and then assesses the anticipated environmental impact with suggestions of appropriate mitigation measures and mechanism for ensuring effective implementation of the environmental safeguard measures at different phases of the project. The detailed study for the project STRR Phase-I has been carried out as per the approved Terms of Reference (ToR) issued by MoEFCC vide their letter no. F. No. – 10-33/2018-IA.III dated 23rd January, 2019. Approved ToR is attached as **Annexure-1**.

1.5 ENVIRONMENTAL POLICIES AND LEGISLATION

The Government of India has formulated various policies, guidelines, acts and regulations aimed at the protection and enhancement of environmental resources. The following **Table 1.4**

summarizes the environmental regulations and legislations pertaining to this project, for implementation of which a number of government agencies are responsible.

Table 1-4: Summary of Relevant Environmental Laws & Regulations

| Sl. No | Law/Regulation/Guide lines | Objectives | Implementing/Responsible Agency |
|--------|---|--|---|
| 1. | The Environmental (Protection) Act 1986, and its rules | The Umbrella Act for protection and improvement of the environment. Establishes the standards for emission of noise in the atmosphere. | MoEF&CC; GoI; Department of Forest of State Government; CPCB; KPCB, |
| 2. | Environmental Impact Assessment Notification (2006) and amendments made thereafter | To provide environmental clearance to new developmental activities following environmental impact assessment | MoEF&CC; GoI; CPCB; KPCB, |
| 3. | Notification for use of Flyash, 2016 | Promoting the utilization of flyash in the manufacture of building materials and in construction activity with in a specified radius of 300 kilometers from coal or lignite based thermal power plants | MoEF&CC, KPCB |
| 4. | The Water (Prevention and Control of Pollution) Act, 1974 | To control water pollution by controlling the discharge of pollutants as per prescribed standards | CPCB; KPCB |
| 5. | The Air (Prevention and Control of Pollution) Act, 1981 | Empowers to control air pollution by controlling emission of air pollutants as perprescribed standards, SPCB to set and monitor air quality standards and to prosecute offenders, excluding vehicular air and noise emission. | CPCB; KPCB & Transport Department; State Govt. |
| 6. | Noise Pollution (Regulation and Control) Act, 1990. Noise Pollution (Regulation and Control) Rules (2000) The Noise Pollution (Regulation and Control) Amendment Rules (2006) | To regulate and control noise producing and generatings our ces with the objective of maintaining the ambient air quality standards in respect of noise. | CPCB; KPCB, & Transport Department of State Government |
| 7. | Indian Forest Act 1927, The Forest (Conservation) Act. 1980, Forest (conversion) Rules 1981, Forest Conservation Rules (Notification) | To consolidate the laws related to forest, the transit of forests produces and the duty livable on timber and other forest produce. Conservation of Forests, Judicious use of forest land for non-forestry purposes; and to replenish the loss of | MoEF&CC;Departm entofForest,StateGo vernment |

| Sl. No | Law/Regulation/Guide lines | Objectives | Implementing/Responsible Agency |
|--------|--|--|--|
| | 2003 | forest cover by Compensatory Afforestation on degraded forest land and non-forest land. Procedure for submission of the proposals seeking approval by the Central Government for diversion of forest land to non-forest purposes. | |
| 8. | National Forest Policy 1952 National Forest Policy (Revised) 1988 | To maintain ecological stability through preservation and restoration of biological diversity. | Forest Department, GoI and State Government of Karnataka |
| 9. | The National Highway Act (1956) | For Land Acquisition | NHAI; Revenue Department of State Government |
| 10. | The Land Acquisition Act 1894 | Set out rule for acquisition of land by government | Revenue Department State Government. |
| 11. | The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (also Land Acquisition Act, 2013) | For payment of compensation and assistance, different entitlements payment of compensation and Assistance, resettlement and rehabilitation of the project affected population due to acquisition of lands and structures. | NHAI, Competent Authority (Revenue Department) |
| 12. | Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989 | To consolidate and amend the laws related to motor vehicles. Licensing of driving of motor vehicles, registration of motor vehicles, with emphasis on road safety standards and pollution control measures, standards for the transportation of hazardous and explosive materials. To check vehicular air and noise pollution. | RTO Office of State Government |
| 13. | Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 | Protection to the general public against improper handling and disposal of hazardous wastes | SPCB |
| 14. | Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 | Protection against chemical accidents while handling any hazardous chemicals resulting. | District & Local Crisis Group headed by the DM and SDM |
| 15. | Construction and Demolition Waste Management Rules 2016 | To promote an integrated approach, whereby environmental management of construction and demolition waste is | MoEF&CC, SPCB |

| Sl. No | Law/Regulation/Guide lines | Objectives | Implementing/Responsible Agency |
|--------|----------------------------|--|---------------------------------|
| | | given due consideration throughout the duration of the project | |

1.5.1 Environmental Legal Framework of Karnataka State

The environment legal framework in Karnataka State is summarized in Table below:

Table 1-5: Environmental Legal Framework of Karnataka State

| S.No. | Applicable Acts | Year | Objective | Applicability |
|-------|---|------|--|----------------|
| 1. | Karnataka State Environment Policy (Draft) | 2017 | Sustainable development of the State | Direct |
| 2. | Karnataka State Water Policy | 1994 | To protect and conserve water resources | Direct |
| 3. | Karnataka Water (Prevention and Control of Pollution) Rules | 1983 | To control water pollution by controlling emission & Water pollutants as per the prescribed standard | Direct |
| 4. | Karnataka Air (Prevention and Control of pollution) Rules | 1983 | To control air pollution by controlling emission and air pollutants according to a prescribed standard | Direct |
| 5. | Karnataka Ground water (Development and Management) Bill | 2000 | To protect ground water resources, to provide safeguards against hazards of its over exploitation and to ensure its planned development and management in the State of Karnataka and for matters connected there with or incidental there to | Direct |
| 6. | Karnataka Aquaculture (Regulation) Act | 1995 | For regulation of coastal aquaculture in the State | Indirect |
| 7. | EIA Notification by MOEF&CC | 2006 | Establishment of the State level environmental impact assessment authority for Environmental Clearance of Category B projects. | Not Applicable |
| 8. | Fly Ash Notification | 2016 | Promoting the utilization of fly ash in the manufacture of building materials and in construction activity within a specified radius of three hundred kilo metres from coal or lignite based thermal power plants | Direct |
| 9. | Karnataka Forest Act | 1882 | Protection of wildlife (wild animals, defined plants and birds) and to control poaching, smuggling and illegal trade in wildlife and its derivatives. | Direct |

1.5.2 Environmental Permits/Approvals Required

The proposed road development project of NH-948A is a New National Highway with ROW of 70 m. Hence, as per EIA notification 2006, the proposed project falls under “Category A” and attracts the conditions of obtaining prior Environmental Clearance from the Ministry of Environment, Forest & Climate Change (MoEF&CC).

The summary of clearances & NOCs required during pre-construction and construction stage along with the responsible agency is given in **Table1.6** and **1.7**.

Table1-6: Summary of Clearances & NOC’s applicable during pre-construction/design

| S. No. | Type of clearance | Statutory Authority | Applicability |
|--------|-------------------------------|------------------------------------|----------------------|
| 1 | Prior Environmental Clearance | Expert Appraisal Committee, MoEFCC | Category ‘A’ project |

Table 1-7: Summary of Clearances & NOC’s applicable during the construction stage

| S. No. | Type of clearance | Statutory Authority | Applicability | Project stage |
|--------|---|--|--|--|
| 1. | Prior Environmental Clearance | Expert Appraisal Committee, MoEFCC | Category ‘A’ project | Pre-construction |
| 2. | Tree felling permission | State Department of Environment & Forest | For tree cutting along the project corridor | Pre-construction |
| 3. | NOC and Consents Under Air, Water, EPA acts & Noise rules of SPCB | State Pollution Control Board | Forest abolishing plants | Construction (Prior to work initiation) |
| 4. | NOC And Consents Under Air, Water, EP Acts & Noise rules of SPCB | State Pollution Control Board | For operating Hot mix plants and batching plants | Construction (Prior to work initiation) |
| 5. | Permission to store Hazardous Materials | State Pollution Control Board | Storage & Transportation of Hazardous Materials and Explosives | Construction (Prior to work initiation) |
| 6. | PUC certificate for use of vehicles for construction | Department of Transport | For all construction vehicles | Construction (Prior to work initiation) |
| 7. | NOC for water extraction for construction and allied works | Ground Water Authority | Ground water extraction | Construction (Prior to work initiation) |
| 8. | Permission for storage of hazardous chemical | SPCB | Manufacture storage and Import of Hazardous Chemical | Construction stage (Prior to initiation of any work) |

| S. No. | Type of clearance | Statutory Authority | Applicability | Project stage |
|--------|---|---------------------------------------|---------------------|---|
| 9. | Labor license | Labor Commissioner Office | Engagement of Labor | Construction stage (Prior to initiation of any work) |
| 10. | Quarry Lease Deed and Quarry License from | State Department of Mines and Geology | Quarry operation | Construction stage (Prior to initiation of Quarrying) |

1.6 REPORT STRUCTURE

The EIA report has been structured in to the following chapters:

Chapter 1 - Introduction: This chapter consists of purpose of EIA, Project proponent and capacity, description of the project, and its importance.

Chapter 2 - Project Description: This chapter provides information on project and capacity; need for the project; location; maps showing project layout, component of projects etc.

Chapter 3- Description of the Environment: This chapter consists of the baseline environmental condition of the project area and corridor of impact.

Chapter 4 - Anticipated Environmental Impacts and Mitigation Measures: This chapter consists of an examination of environmental impacts which will be induced due to proposed project interventions and the mitigation measures.

Chapter 5 - Analysis of Alternatives (Technology and Site): This chapter consists of various site and technological alternatives for the proposed project.

Chapter 6 - Environmental Monitoring Program: This chapter consists of monitoring indicators, monitoring frequency and reporting mechanism.

Chapter 7 - Additional Studies: This chapter consists of public consultation, public hearing and issues raised during public hearing and traffic management.

Chapter 8 - Project Benefits: This chapter consists of regional and local benefits to society and the environment.

Chapter 9 - Environmental Cost Benefit Analysis: This chapter includes environmental value enhancement (biodiversity, crop productivity, ecotourism etc.)

Chapter 10 - Environmental Management Plan: This chapter consists of generic and site specific impacts and mitigation measures, implementation and responsibilities and cost estimates for EMP.

Chapter 11 - Summary & Conclusion: This chapter consists of summary of Environmental Impact Assessment.

Chapter 12 - Disclosure of Consultants Engaged: This chapter includes the name of the consultants engaged in preparation of EIA and nature of consultancy rendered.

CHAPTER : 2 PROJECT DESCRIPTION

2.1 INTRODUCTION

The Government of Karnataka took steps to improve and augment the road network within and the neighboring area of the city to match with its space of development. Bangalore Metropolitan Regional Development Authority (BMRDA) had a planned Satellite town ring road consisting a length of 204 km to match these requirements around Bangalore city. The STRR connects the important towns namely Dabaspet, Doddaballapura, Devanahalli, Sulibele, Hoskote, Sarjapur, Attibele, Anekal, Tattakere, Kanakapura, Ramanagara and Magadi. BMRDA assigned M/s SECON for the consultancy services to undertake the topographical & cadastral surveys, finalize the proposed alignment and to prepare the land acquisition report in the year 2006. Subsequently, the same agency was engaged to carry out the consultancy for Techno –Economic Feasibility Report in 2007. The notification for land acquisition for STRR & Individual Town Ring Road (ITRR) was issued on 12/09/2007 and the project report was approved by BMRDA on 10/06/2008. The proposed STRR alignment is declared as State Highway (special) -2 as per the provisions of Karnataka Highways Act, 1964 and the SE, PWD, Bangalore circle nominated as 'The Highway Authority'. Land acquisition processes initiated vide notification NO. 4017-07-08 dated 19/10/2007. However, the project shelved due to the paucity of funds within the State government.

Therefore, reviving the STRR project, considering current development in the region is absolutely necessary on a priority basis. Thus, it is proposed to consider a six lanes carriageway configuration throughout a minimum requirement. Further Hosur, an automobile industry town is located in the vicinity, about 7 km away from the Karnataka state border. This city generates a huge amount of traffic and currently experiencing massive traffic congestion. Therefore, it was also envisaged connecting Hosur city with the proposed STRR alignment to improve overall connectivity in the region.

2.2 NEED OF THE PROJECT

As the majority of State Highways SH 3, SH 85, & SH 35 and National Highways NH 648 (NH 207), NH 48 (NH 4), NH 275, NH 948, NH 209 & NH 75 (Hassan road), pass through the Bangalore city comprising heavy commercial traffic movement resulting huge traffic jams. In addition, the NICE ring road currently has only four lanes configuration with a very congested traffic level. In order to decongest the traffic of Bangalore city, the STRR is proposed to ensure a safe, smooth, efficient, and high-speed transport corridor to this city.

The STRR will function as an alternative and there is huge potential for the traffic to get diverted to the proposed STRR facility. It will ensure high-speed connectivity primarily to Bangalore International airport and to the proposed Bangalore - Chennai Expressway.

2.3 LOCATION OF THE PROJECT

The Phase-I of Satellite Town Ring Road (STRR-I) starts at km. 0.000 (13°14'56.80"N, 77°18'29.26"E) in Obalapura village near Dabaspet, ends at km. 82.200 (12°40'10.25"N, 77°19'50.23"E) near Kailancha village in Ramanagara (km 82.200). The proposed project road intersects the SH-3 at its existing km 52.700 and further connects to Phase-II to Satellite Town

Ring Road. The phase-I of STRR is located 200m away from the ESZ of Ramadevarabetta Vulture Sanctuary in Ramanagara. The STRR Phase-I location is shown in **Figure 1.1**.

2.4 PROJECT FEATURES

The proposed alignment is a green-field highway with 6-lane configuration along with paved and earthen shoulders and shall follow the IRC: SP: 87-2019 along with other relevant IRC codes, guidelines and special publications, and MORTH circulars as applicable to National Highway. For the development of the proposed highway, various aspects of the design have been considered i.e. geometry of highway, cross-sections, interchange design, pavement design, drainage design, structures design for the underpass, bridge, culvert etc. Design features of the proposed highway are described in brief as;

i. Proposed Right of Way (RoW)

The proposed RoW for STRR Phase-I is 70 m throughout the corridor except at interchange, toll plaza/toll booth, grade-separated structures, wayside amenities locations etc.

ii. Design Speed

The proposed project corridor passes through plain and rolling terrain. The design speed adopted for the design of the highway is 100 kmph throughout the stretch. Minimum Design Speed shall be adopted where site conditions are restrictive and adequate land width is not available. Design speed for various terrains is given below.

Table 2-1: Design Speed

| Terrain Classification | % Cross slope of the ground | Design Speed (kmph) | |
|------------------------|-----------------------------|---------------------|---------|
| | | Ruling | Minimum |
| Plain & Rolling | Up to 25 | 100 | 80 |

iii. Access Controlled

The proposed highway with fully access controlled facilities as per NHA guidelines. All major cross roads will be provided with grade-separated structures to ensure uninterrupted free flow through traffic and to provide safety to local traffic.

iv. Proposed Pavement

The highway is designed with both flexible and rigid pavement options. Flexible pavement for new carriageways will be designed in accordance with the guidelines of IRC: 37-2018 for a minimum design period of 20 years.

New rigid pavement will be plain-jointed type and shall be designed in accordance with the method prescribed in IRC: 58 -2015, "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways". Rigid pavement shall be designed for a minimum design period of 30 years. The Pavement Quality Concrete (PQC) shall rest over Dry Lean Concrete (DLC) and Granular sub-base of 150mm thickness.

v. Wayside Amenities/Toll Plaza

Bus-Bays & Shelter -The layout, design and location of the bus stops in rural areas shall be as per relevant IRC. Typical Layout is given in IRC: SP: 87- 2019 will also be considered while developing the Layout. The bus stop layout shall provide safe entry and exit of buses from the main highway.

Truck Parking Areas - The proposed layout of the truck lay bye is generally based on the recommendations of "Planning Norms and Guidelines on Wayside and Terminal Facilities" and as per guidelines given in IRC: SP: 87-2019.

Toll Plaza/Toll Booth - It shall be design based on the guidelines given in IRC: SP: 87-2019 and as per circulars of MoRTH.

vi. Embankment Slope

The slope shall be designed for embankment height greater than 6.0m using software for High Embankment design and as per IRC: 75-2015. For earthen embankments the side slopes are recommended for consideration of the safety of the trafficas per IRC: 36-2010.

Slopes on embankment height less than 3m shall be turfed and those above this height shall be protected with stone pitching.

vii. Roadside drainage

An effective drainage system shall be planned for the roadway as per stipulations offIRC SP: 42-2014 and IRC SP: 50-2013 for maintaining structural soundness and functionality ofthe project road.

viii. Traffic Control Devices/ Road Safety Devices/ Road Furniture

Indian Road Congress (IRC) codes are followed in proposing and designing road safety features.These features include safety barriers,road signs, road markings, road lighting, route markers, kilometer and hectometer stones, roaddelineators, ROW pillars, parking areas & rest areas, bus stops/bays, and landscaping.Pavement markings are proposed for traffic, edge lines and hatching.Thermoplastic road marking standards and retro-reflective road signs standards shall be as per IRC: 35-2015 and IRC: 67-2012, respectively. Road lighting is proposed to provide at toll plazas area, rest area, truck lay bays, bus bays, grade separated structures, flyovers, underpass and built-up sections. Cautionary signs shall be provided as per IRC 67:2012.

ix. Typical Cross Section

Based on traffic considerations, geometric standards and considering the site condition and economy, the typical cross sections have been proposed for different stretches ofthe project road and the same is attached as **Annexure-9**. The main components are as given in **Table 2.2**.

Table 2-2: Details of proposed Cross Sections

| Cross Section Elements | Width (m) | Total Width (m) |
|------------------------|-----------|-----------------|
| Main Carriage way | 3x3.50 | 10.50 |
| Paved shoulder | 2x1.50 | 3.00 |
| Earthen Shoulder | 2x2.00 | 4.00 |
| Raised Median | 0+5+4+0.5 | 5.00 |

x. Standards and Specifications Adopted

The General Technical Specifications shall be as per MoRTH Specifications for Road and Bridge works (Fifth revision, April 2013) issued by the Ministry of Road Transport and Highways, Govt. of India and published by the Indian Roads Congress along with its updating/amendments/addendum issued from time to time. Ministry of Shipping, Road Transport & Highways, Government of India prepared "Manual of Specifications and Standards for Six Laning of National Highways through IRC:SP:87-2019 shall be used as main guidelines along with other relevant IRC codes.

Table 2-3: List of IRC Codes/MoRTH Publications

| S. No. | IRC Code | Title of Publications |
|--------|----------------|--|
| 1. | IRC: 5-2015 | Standard Specifications and Code of Practice for Road Bridges, Section I -General Features of Design (Eighth Revision) |
| 2. | IRC: 6-2017 | Standard Specifications and Code of Practice for Road Bridges, Section-II Loads and Load Combinations (Seventh Revision) |
| 3. | IRC:8-1990 | Type design for Highway Kilometre stone (Second Revision) |
| 4. | IRC:22-2015 | Standard Specifications and Code of Practice for Road Bridges, Section VI - Composite |
| 5. | IRC:24-2010 | Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method)Third Revision) |
| 6. | IRC:35-2015 | Code practice for Road markings (First Revision) |
| 7. | IRC:37-2012 | Guidelines for the design of Flexible Pavements (Second Revision) |
| 8. | IRC:67-2012 | Code of Practice for Road Signs (First Revision) |
| 9. | IRC:78-2014 | Standard Specifications and Code of Practice for Road Bridges, Section VII- Foundations and Substructure (Second Revision) |
| 10. | IRC:83-201 5 | (Part II)Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings |
| 11. | IRC:89-1997 | Guidelines for Design and Construction of River Training and Control Woks for road bridges (First Revision) |
| 12. | IRC:104-1988 | Guidelines for Environmental Impact Assessment |
| 13. | IRC:108-2015 | Guidelines for Traffic prediction on Rural Highways |
| 14. | IRC:SP:19-2001 | Manual for Survey, Investigation and Preparation for road project (Second Revision) |
| 15. | IRC:SP:21-2009 | Guidelines on Landscaping and Tree Plantation (First Revision) |
| 16. | IRC:SP:42-2014 | Guidelines on Road Drainage |
| 17. | IRC:SP-87-2019 | Manual of Specification & Standards for Six Laning of Highways |
| 18. | IRC:SP:90-2010 | Manual for Grade Separators & Elevated Structures |

2.5 DETAILS OF THE STRUCTURES PROPOSED

The details of proposed structures provided are given as below:

Table 2-4: Location of Vehicular Underpass (VUP)

| S. No. | Location (km) | Span (m) |
|--------|---------------|----------|
| 1. | 5.212 | 1 X 20 |
| 2. | 17.500 | 1 X 20 |

| | | |
|-----|--------|--------|
| 3. | 23.548 | 1 X 20 |
| 4. | 33.654 | 1 X 20 |
| 5. | 34.711 | 1 X 20 |
| 6. | 36.342 | 1 X 20 |
| 7. | 39.738 | 1 X 20 |
| 8. | 43.206 | 1 X 20 |
| 9. | 46.400 | 1 X 20 |
| 10. | 57.400 | 1 X 20 |
| 11. | 60.971 | 1 X 20 |
| 12. | 64.981 | 1 X 20 |
| 13. | 72.420 | 1 X 20 |
| 14. | 77.786 | 1 X 20 |
| 15. | 79.381 | 1 X 20 |
| 16. | 79.996 | 1 X 20 |
| 17. | 81.658 | 1 X 20 |

Table 2-5: Location of VUP and canal cross-locations

| S. No. | Location (km) | Span | Structure |
|--------|---------------|--------|-----------------------|
| 1. | 7.103 | 2 X 20 | VUP + Canal Crossing |
| 2. | 14.859 | 1 X 20 | VUP + Canal Crossing |
| 3. | 21.375 | 1 X 20 | VUP + Nallah Crossing |
| 4. | 27.607 | 1 X 20 | VUP + Nallah Crossing |
| 5. | 52.960 | 1 X 25 | VUP + Canal Crossing |
| 6. | 60.170 | 1 X 20 | VUP + Nallah Crossing |

Table 2-6: Location of Light Vehicular Underpasses (LVUP)

| S. No. | Location (km) | Span |
|--------|---------------|--------|
| 1. | 24.819 | 1 X 12 |
| 2. | 25.540 | 1 X 12 |
| 3. | 35.080 | 1 X 12 |
| 4. | 49.960 | 1 X 12 |
| 5. | 49.960 | 1 X 12 |
| 6. | 51.365 | 1 X 12 |
| 7. | 69.135 | 1 X 12 |
| 8. | 70.937 | 1 X 12 |
| 9. | 75.812 | 1 X 12 |

Table 2-7: Location of Vehicular Overpasses (VOP)

| S. No. | Location (km) | Span (m) |
|--------|---------------|----------------------|
| 1. | 10.528 | 2x23.5+1x19+1x23.5 |
| 2. | 12.108 | 2x23.5 |
| 3. | 15.780 | 1x23.5+1x17.5+2x23.5 |
| 4. | 41.570 | 2 X 23.5 |
| 5. | 52.115 | 2 X 23.5 |
| 6. | 54.159 | 2 X 23.5 |
| 7. | 58.714 | 2 X 23.5 |
| 8. | 62.909 | 2 X 23.5 |
| 9. | 65.724 | 2 X 23.5 |

| | | |
|-----|--------|----------|
| 10. | 74.318 | 2 X 23.5 |
|-----|--------|----------|

Table 2-8: Major Bridge

| S. No. | Location (km) | Span |
|--------|---------------|--------|
| 1. | 78.090 | 3 X 25 |

Table 2-9: Minor Bridge

| S. No. | Location (km) | Span |
|--------|---------------|--------|
| 1. | 13.275 | 1 X 20 |
| 2. | 18.500 | 1 X 25 |
| 3. | 19.610 | 1 X 12 |
| 4. | 20.400 | 1 X 12 |
| 5. | 23.400 | 1 X 15 |
| 6. | 24.480 | 1 X 30 |
| 7. | 31.640 | 1 X 30 |
| 8. | 39.350 | 1 X 30 |
| 9. | 40.930 | 1 X 20 |
| 10. | 51.530 | 1 X 17 |
| 11. | 57.045 | 1 X 15 |
| 12. | 60.780 | 1 X 35 |
| 13. | 78.440 | 1 X 20 |

Table 2-10: Details of ROBs

| S. No. | Location (km) | Span (number x m) | Remark |
|--------|---------------|-------------------|---|
| 1. | 8.940 | 1x25+1x32+1x30 | Additional Spans on Slip Lanewith 10.8m is also required |
| 2. | 29.265 | 1x25+1x51+1x25 | Additional Spans on Slip Lanewith 10.8m is also required |
| 3. | 70.695 | 1x25+1x51+1x25 | Additional Spans on Slip Lanewidth 10.8m is also required |

Table 2-11: Location of Viaducts

| S. No. | Location (km) | Span (number x m) | Remark |
|--------|---------------|-------------------|---|
| 1. | 8.940 | 4x30+ROB+1x30 | Additional Spans on Slip Lane with 10.8m is also required |
| 2. | 29.265 | ROB+12x30 | Additional Spans on Slip Lane with 10.8m is also required |
| 3. | 57.882 | 3 X 30 | - |
| 4. | 65.250 | 3 X 30 | - |

Table 2-12: List of Proposed Grade Separator

| S.No. | Location (km) | Size | Structure Type | Existing Road Details |
|-------|---------------|----------|--------------------|---|
| 1. | 0.500 | 5x30x5.5 | Interchange | Connection with NH-207 (Hoskote Dabaspet) |
| 2. | 5.212 | 1X20X5.5 | VUP | - |
| 3. | 7.103 | 2X20X5.5 | VUP+ CanalCrossing | - |

| | | | | |
|-----|--------|----------------------|---------------------|---|
| 4. | 8.894 | 2x30x5.5 | Interchange | NH-4 (Bangalore - Pune road) |
| 5. | 10.528 | 2x23.5+1x19+1x23.5 | VOP | - |
| 6. | 12.108 | 2x23.5 | VOP | - |
| 7. | 12.961 | 5x30x5.5 | Interchange | MMPL Interchange |
| 8. | 14.859 | 1X20X5.5 | VUP+ CanalCrossing | - |
| 9. | 15.780 | 1x23.5+1x17.5+2x23.5 | VOP | - |
| 10. | 17.500 | 1X20X5.5 | VUP | - |
| 11. | 21.375 | 1X20X5.5 | VUP+ NallahCrossing | - |
| 12. | 23.548 | 1X20X5.5 | VUP | - |
| 13. | 24.819 | 1x12x4.0 | LVUP | - |
| 14. | 25.540 | 1x12x4.0 | LVUP | - |
| 15. | 27.607 | 1X20X5.5 | VUP+ NallahCrossing | - |
| 16. | 30.381 | 2x30x5.5 | Interchange | NH-48 Bangalore- Mangalore road |
| 17. | 33.654 | 1X20X5.5 | VUP | - |
| 18. | 34.711 | 1X25X5.5 | VUP | - |
| 19. | 35.080 | 1x12x4.0 | LVUP | - |
| 20. | 36.342 | 1X20X5.5 | VUP | - |
| 21. | 39.738 | 1X20X5.5 | VUP | - |
| 22. | 41.570 | 2x23.5 | VOP | - |
| 23. | 43.206 | 1X20X5.5 | VUP | - |
| 24. | 44.576 | 2x30x5.5 | Interchange | SH-85 (Bangalore- Nagamangala road) Magadi road |
| 25. | 46.440 | 1X20X5.5 | VUP | - |
| 26. | 49.960 | 1x12x4.0 | LVUP | - |
| 27. | 49.960 | 1x12x4.0 | LVUP | - |
| 28. | 51.365 | 1x12x4.0 | LVUP | - |
| 29. | 52.115 | 2x23.5 | VOP | - |
| 30. | 52.960 | 1x25x5.5 | VUP+ CanalCrossing | - |
| 31. | 54.159 | 2x23.5 | VOP | - |
| 32. | 57.400 | 1X20X5.5 | VUP | - |
| 33. | 58.714 | 2x23.5 | VOP | - |
| 34. | 60.170 | 1X20X5.5 | VUP+ NallahCrossing | - |
| 35. | 60.971 | 1X20X5.5 | VUP | - |
| 36. | 62.909 | 2x23.5 | VOP | - |
| 37. | 64.981 | 1X20X5.5 | VUP | - |
| 38. | 65.724 | 2x23.5 | VOP | - |
| 39. | 69.135 | 1x12x4.0 | LVUP | - |
| 40. | 70.032 | 2x30x5.5 | Interchange | NH-275/SH-17 Bangalore Mysore Road |
| 41. | 70.937 | 1x12x4.0 | LVUP | - |
| 42. | 72.420 | 1X25X5.5 | VUP | - |

| | | | | |
|-----|--------|----------|------|---|
| 43. | 74.318 | 2x23.5 | VOP | - |
| 44. | 75.813 | 1x12x4.0 | LVUP | - |
| 45. | 77.786 | 1X20X5.5 | VUP | - |
| 46. | 79.381 | 1X20X5.5 | VUP | - |
| 47. | 79.996 | 1X25X5.5 | VUP | - |
| 48. | 81.658 | 1X20X5.5 | VUP | - |

Table 2-13: Location of Culverts

| S. No. | Location (km) | Structure | Span |
|--------|---------------|-------------|---------|
| 1. | 0.150 | Box Culvert | 3 X 2.5 |
| 2. | 0.675 | Box Culvert | 3 X 2.5 |
| 3. | 0.982 | Box Culvert | 4 X 2.5 |
| 4. | 1.300 | Box Culvert | 2 X 2 |
| 5. | 1.486 | Box Culvert | 3 X 2.5 |
| 6. | 2.000 | Box Culvert | 3 X 2.5 |
| 7. | 2.338 | Box Culvert | 3 X 2.5 |
| 8. | 2.462 | Box Culvert | 4 X 2.5 |
| 9. | 3.000 | Box Culvert | 3 X 2.5 |
| 10. | 3.130 | Box Culvert | 3 X 2.5 |
| 11. | 3.620 | Box Culvert | 3 X 2.5 |
| 12. | 5.056 | Box Culvert | 3 X 2.5 |
| 13. | 5.254 | Box Culvert | 3 X 2.5 |
| 14. | 5.616 | Box Culvert | 4 X 2.5 |
| 15. | 6.850 | Box Culvert | 3 X 2.5 |
| 16. | 9.350 | Box Culvert | 3 X 2.5 |
| 17. | 11.140 | Box Culvert | 3 X 2.5 |
| 18. | 11.200 | Box Culvert | 3 X 2.5 |
| 19. | 11.600 | Box Culvert | 3 X 2.5 |
| 20. | 11.950 | Box Culvert | 3 X 2.5 |
| 21. | 12.600 | Box Culvert | 3 X 2.5 |
| 22. | 13.850 | Box Culvert | 3 X 2.5 |
| 23. | 14.120 | Box Culvert | 3 X 2.5 |
| 24. | 14.780 | Box Culvert | 4 X 2.5 |
| 25. | 16.050 | Box Culvert | 3 X 2.5 |
| 26. | 17.075 | Box Culvert | 3 X 2.5 |
| 27. | 17.350 | Box Culvert | 4 X 2.5 |
| 28. | 17.900 | Box Culvert | 3 X 2.5 |
| 29. | 18.650 | Box Culvert | 4 X 2.5 |
| 30. | 19.500 | Box Culvert | 3 X 2.5 |
| 31. | 19.675 | Box Culvert | 4 X 2.5 |
| 32. | 19.772 | Box Culvert | 4 X 2.5 |
| 33. | 21.227 | Box Culvert | 3 X 2.5 |
| 34. | 23.160 | Box Culvert | 3 X 2.5 |
| 35. | 23.960 | Box Culvert | 3 X 2.5 |
| 36. | 25.050 | Box Culvert | 3 X 2.5 |
| 37. | 26.200 | Box Culvert | 4 X 2.5 |

| | | | |
|-----|--------|-------------|---------|
| 38. | 27.180 | Box Culvert | 3 X 2.5 |
| 39. | 27.300 | Box Culvert | 4 X 2.5 |
| 40. | 27.450 | Box Culvert | 4 X 2.5 |
| 41. | 28.100 | Box Culvert | 3 X 2.5 |
| 42. | 31.050 | Box Culvert | 3 X 2.5 |
| 43. | 31.075 | Box Culvert | 4 X 2.5 |
| 44. | 32.738 | Box Culvert | 4 X 2.5 |
| 45. | 33.270 | Box Culvert | 3 X 2.5 |
| 46. | 33.720 | Box Culvert | 3 X 2.5 |
| 47. | 35.045 | Box Culvert | 3 X 2.5 |
| 48. | 35.650 | Box Culvert | 3 X 2.5 |
| 49. | 35.800 | Box Culvert | 4 X 2.5 |
| 50. | 36.325 | Box Culvert | 3 X 2.5 |
| 51. | 36.425 | Box Culvert | 3 X 2.5 |
| 52. | 36.850 | Box Culvert | 3 X 2.5 |
| 53. | 39.155 | Box Culvert | 3 X 2.5 |
| 54. | 39.650 | Box Culvert | 4 X 2.5 |
| 55. | 41.020 | Box Culvert | 4 X 2.5 |
| 56. | 42.150 | Box Culvert | 3 X 2.5 |
| 57. | 42.650 | Box Culvert | 3 X 2.5 |
| 58. | 43.420 | Box Culvert | 3 X 2.5 |
| 59. | 45.480 | Box Culvert | 4 X 2.5 |
| 60. | 47.940 | Box Culvert | 4 X 2.5 |
| 61. | 48.050 | Box Culvert | 4 X 2.5 |
| 62. | 48.250 | Box Culvert | 3 X 2.5 |
| 63. | 48.490 | Box Culvert | 6 X 2.5 |
| 64. | 48.925 | Box Culvert | 6 X 2.5 |
| 65. | 49.250 | Box Culvert | 3 X 2.5 |
| 66. | 50.800 | Box Culvert | 3 X 2.5 |
| 67. | 51.940 | Box Culvert | 3 X 2.5 |
| 68. | 53.300 | Box Culvert | 3 X 2.5 |
| 69. | 53.860 | Box Culvert | 4 X 2.5 |
| 70. | 54.850 | Box Culvert | 4 X 2.5 |
| 71. | 55.010 | Box Culvert | 3 X 2.5 |
| 72. | 55.090 | Box Culvert | 4 X 2.5 |
| 73. | 55.290 | Box Culvert | 3 X 2.5 |
| 74. | 55.450 | Box Culvert | 3 X 2.5 |
| 75. | 56.220 | Box Culvert | 3 X 2.5 |
| 76. | 56.550 | Box Culvert | 3 X 2.5 |
| 77. | 57.350 | Box Culvert | 3 X 2.5 |
| 78. | 58.260 | Box Culvert | 4 X 2.5 |
| 79. | 59.560 | Box Culvert | 3 X 2.5 |
| 80. | 60.535 | Box Culvert | 3 X 2.5 |
| 81. | 61.020 | Box Culvert | 3 X 2.5 |
| 82. | 61.625 | Box Culvert | 4 X 2.5 |
| 83. | 61.910 | Box Culvert | 3 X 2.5 |
| 84. | 62.090 | Box Culvert | 3 X 2.5 |

| | | | |
|------|--------|-------------|---------|
| 85. | 62.385 | Box Culvert | 4 X 2.5 |
| 86. | 62.410 | Box Culvert | 4 X 2.5 |
| 87. | 63.982 | Box Culvert | 3 X 2.5 |
| 88. | 64.090 | Box Culvert | 3 X 2.5 |
| 89. | 64.830 | Box Culvert | 3 X 2.5 |
| 90. | 66.050 | Box Culvert | 3 X 2.5 |
| 91. | 66.185 | Box Culvert | 3 X 2.5 |
| 92. | 66.330 | Box Culvert | 3 X 2.5 |
| 93. | 66.375 | Box Culvert | 3 X 2.5 |
| 94. | 66.500 | Box Culvert | 4 X 2.5 |
| 95. | 66.990 | Box Culvert | 3 X 2.5 |
| 96. | 68.500 | Box Culvert | 4 X 2.5 |
| 97. | 69.050 | Box Culvert | 4 X 2.5 |
| 98. | 69.280 | Box Culvert | 4 X 2.5 |
| 99. | 69.600 | Box Culvert | 3 X 2.5 |
| 100. | 71.060 | Box Culvert | 3 X 2.5 |
| 101. | 71.440 | Box Culvert | 4 X 2.5 |
| 102. | 71.800 | Box Culvert | 4 X 2.5 |
| 103. | 72.440 | Box Culvert | 3 X 2.5 |
| 104. | 72.650 | Box Culvert | 3 X 2.5 |
| 105. | 73.310 | Box Culvert | 4 X 2.5 |
| 106. | 73.780 | Box Culvert | 3 X 2.5 |
| 107. | 74.810 | Box Culvert | 3 X 2.5 |
| 108. | 75.040 | Box Culvert | 3 X 2.5 |
| 109. | 75.350 | Box Culvert | 3 X 2.5 |
| 110. | 75.750 | Box Culvert | 4 X 2.5 |
| 111. | 76.480 | Box Culvert | 4 X 2.5 |
| 112. | 76.835 | Box Culvert | 3 X 2.5 |
| 113. | 77.330 | Box Culvert | 3 X 2.5 |
| 114. | 77.635 | Box Culvert | 3 X 2.5 |
| 115. | 77.950 | Box Culvert | 3 X 2.5 |
| 116. | 78.560 | Box Culvert | 3 X 2.5 |
| 117. | 78.770 | Box Culvert | 3 X 2.5 |
| 118. | 79.090 | Box Culvert | 3 X 2.5 |
| 119. | 79.300 | Box Culvert | 3 X 2.5 |

Table 2-14: Service Road/Slip Road

| S. No. | Location (km) | | Length (m) | Sides |
|--------|---------------|---------|------------|-------|
| | From (km) | To (km) | | |
| 1. | 0.000 | 1.485 | 1485 | Both |
| 2. | 1.485 | 2.495 | 1010 | LHS |
| 3. | 3.970 | 4.360 | 390 | LHS |
| 4. | 4.890 | 5.330 | 440 | LHS |
| 5. | 7.100 | 8.000 | 900 | RHS |
| 6. | 12.050 | 12.150 | 100 | RHS |
| 7. | 15.800 | 19.700 | 3900 | LHS |
| 8. | 15.700 | 15.900 | 200 | RHS |

| | | | | |
|-----|--------|--------|------|------|
| 9. | 16.550 | 17.050 | 500 | RHS |
| 10. | 17.500 | 17.700 | 200 | RHS |
| 11. | 18.900 | 20.950 | 2050 | RHS |
| 12. | 20.800 | 22.200 | 1400 | LHS |
| 13. | 25.600 | 27.400 | 1800 | RHS |
| 14. | 26.200 | 27.600 | 1400 | LHS |
| 15. | 32.250 | 33.650 | 1400 | LHS |
| 16. | 35.060 | 35.400 | 340 | Both |
| 17. | 36.800 | 38.700 | 1900 | LHS |
| 18. | 39.500 | 40.600 | 1100 | LHS |
| 19. | 36.300 | 37.000 | 700 | RHS |
| 20. | 39.500 | 40.200 | 700 | RHS |
| 21. | 41.150 | 42.200 | 850 | RHS |
| 22. | 52.100 | 52.750 | 650 | RHS |
| 23. | 56.200 | 56.900 | 700 | LHS |
| 24. | 60.150 | 60.400 | 250 | Both |
| 25. | 60.900 | 62.300 | 1400 | LHS |
| 26. | 60.900 | 61.700 | 800 | RHS |
| 27. | 70.895 | 71.200 | 305 | Both |
| 28. | 74.250 | 74.360 | 110 | Both |

2.6 LAND ACQUISITION

The total land required for the proposed project is 685.367 hectare out of which 66.073 hectare in Government and 619.294 hectare in Private land.

Table 2-15: Land Acquisition details

| S. No. | Name of the Taluk | kmaininge (km) | | Length (km) | No. of Villages | Land to be Acquired (Ha.) | | | Agriculture | Non-Agriculture |
|--------------|-------------------|----------------|--------|---------------|-----------------|---------------------------|---------------|----------------|----------------|-----------------|
| | | From | To | | | Private | Government | Total | | |
| 1 | Nelamangala | 0.000 | 19.675 | 19.675 | 16 | 168.432 | 9.311 | 177.743 | 154.636 | 23.107 |
| 2 | Magadi | 19.675 | 56.034 | 36.359 | 29 | 261.267 | 35.003 | 296.270 | 257.755 | 38.515 |
| 3 | Ramanagara | 56.034 | 82.200 | 26.166 | 16 | 189.595 | 21.759 | 211.354 | 183.878 | 27.476 |
| Total | | | | 82.200 | 61 | 619.294 | 66.073 | 685.367 | 596.269 | 89.098 |

2.7 MATERIALS REQUIREMENT

A number of sources of natural soil deposits, moorum, gravel, sand, GSB and potential quarries for the production of crushed rock aggregate to be used in the construction of pavement layers and highway structures has been identified. The expected quantity of materials required during the construction phase of the project is given in **Table 2.16**. During the investigations soil borrow areas and quarries for fine and coarse aggregates were identified. 8 borrow areas have been identified along the project road. The location of the identified borrow areas is as given in **Table2.17**.

Table2-16: Construction Material

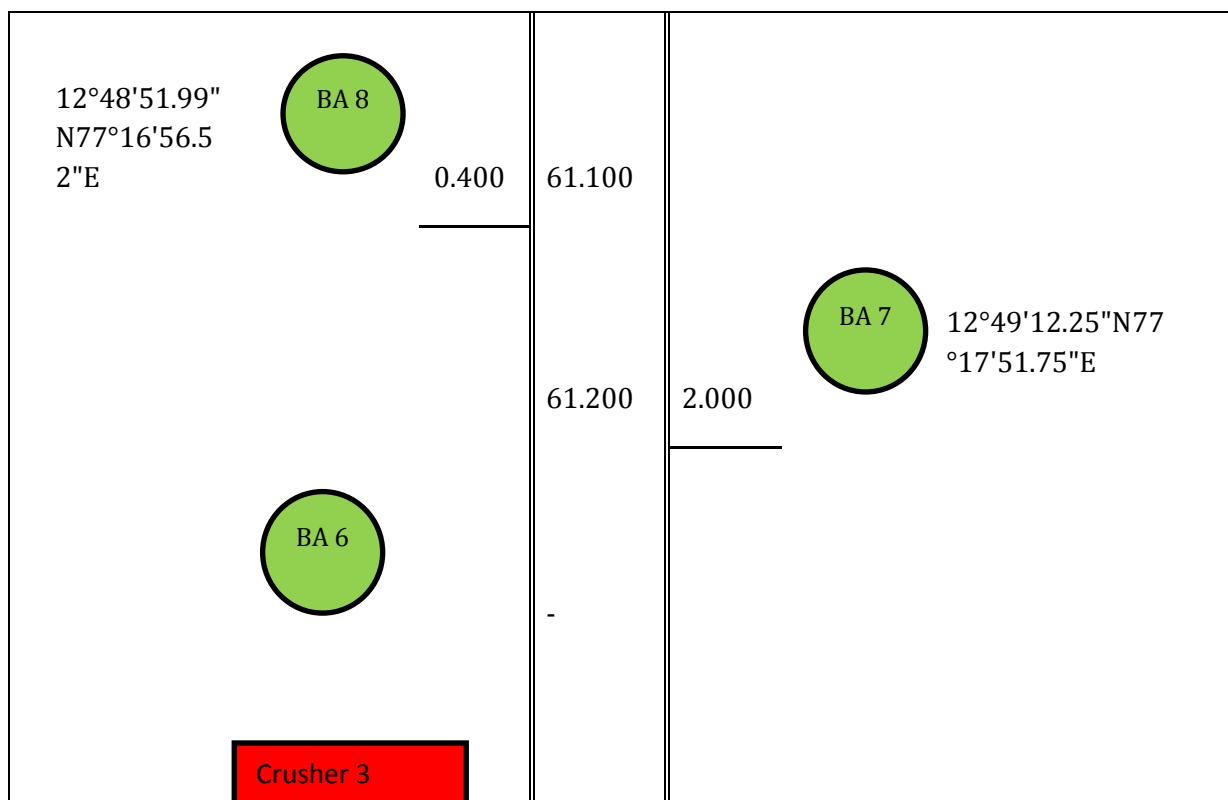
| S. No. | Item | Quantity | Source |
|--------|-----------|---------------|-----------------------------------|
| 1 | Aggregate | 2,760,907 Cum | Identified Quarries |
| 2 | Soil | 9,781,942 Cum | Identified Borrow Areas |
| 3 | Sand | 781,870 Cum | Identified Sand Quarries |
| 4 | Cement | 229,976 Tons | Identified nearest Cement Factory |
| 5 | Bitumen | 40041Tons | Approved Refinery |
| 6 | Steel | 50138 Tons | Identified Steel Plants |
| 7 | Fly ash | 778305 cum | Nearby Thermal Power Station |

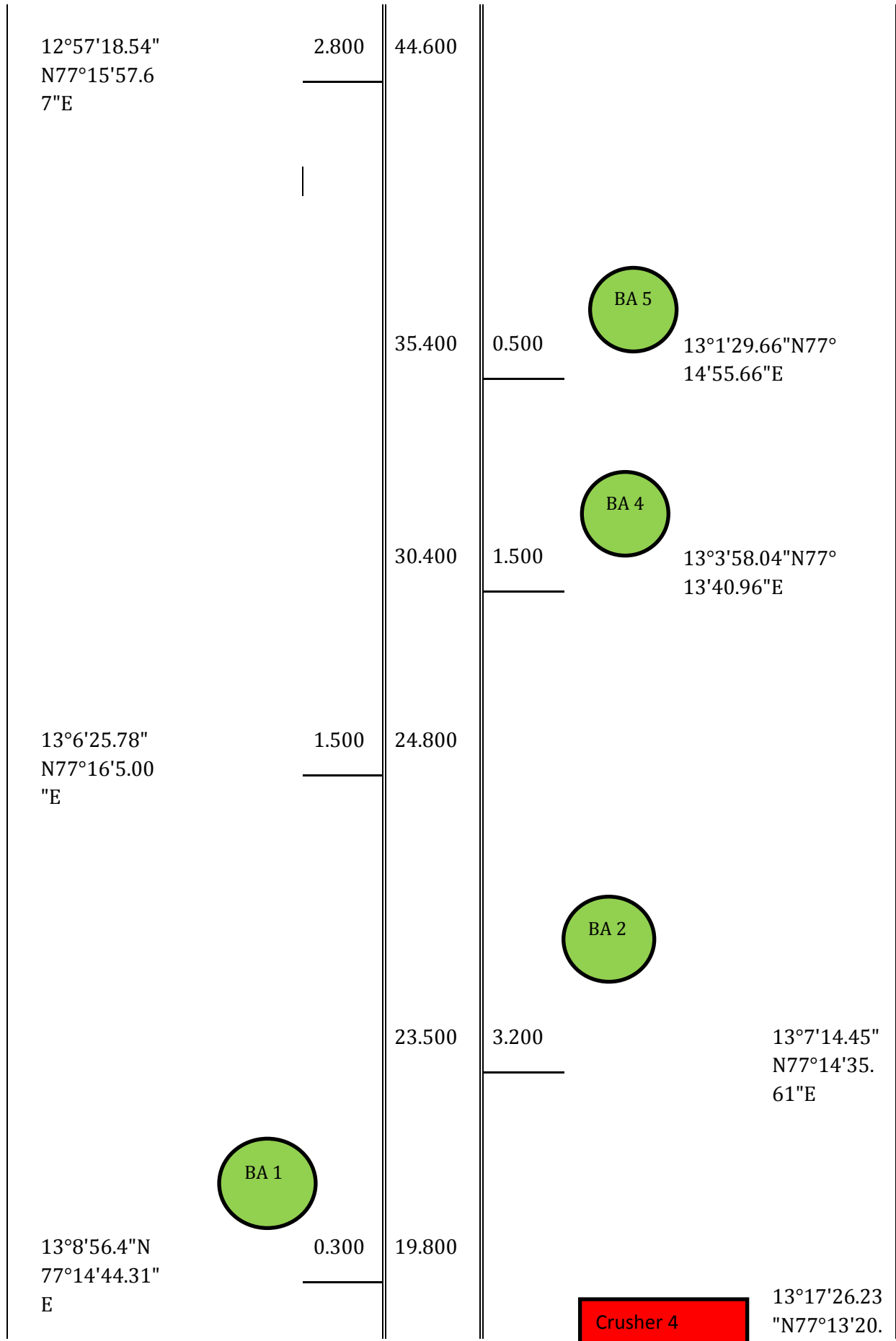
Table 2-17: Location of identified Borrow Areas

| Borrow Area | Loation (km) | Coordinates | LHS/ RHS | Distance from Project Road (km) |
|-------------|--------------|------------------------------|----------|---------------------------------|
| BA-1 | 19.800 | 13°8'56.4"N, 77°14'44.31"E | LHS | 0.300 |
| BA-2 | 23.500 | 13°7'14.45"N, 77°14'35.61"E | LHS | 3.200 |
| BA-3 | 24.800 | 13°6'25.78"N, 77°16'5.00"E | LHS | 1.500 |
| BA-4 | 30.400 | 13°3'58.04"N, 77°13'40.96"E | LHS | 1.500 |
| BA-5 | 35.400 | 13°1'29.66"N, 77°14'55.66"E | LHS | 0.500 |
| BA-6 | - | - | LHS | - |
| BA-7 | 61.200 | 12°49'12.25"N, 77°17'51.75"E | RHS | 2.000 |
| BA-8 | 61.100 | 12°48'51.99"N, 77°16'56.52"E | LHS | 0.400 |

*Includes Soil, GSB and Moorum

The strip chart of the identified borrows areas along NH-948A project sections is as shown in **Figure: 2.1**





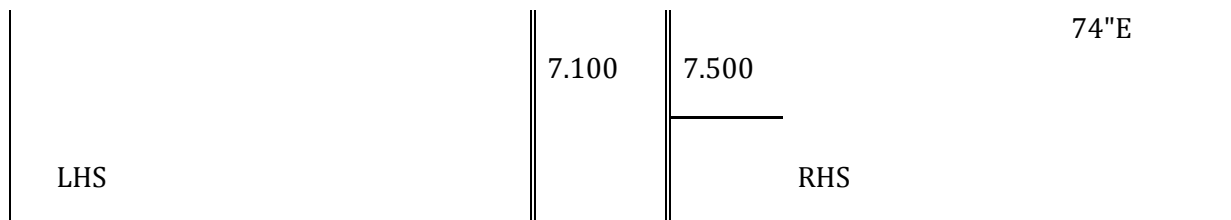


Figure 2-1: Borrow area locations

Source of Fly Ash

As per the Notification No. S.O. 763 (E), dated 14.09.1999 and its amendment on 27.08.2003 and notification S.O.254(E) dated 25th January, 2016 by the Ministry of Environment and Forest & Climate Change, it is mandatory to use flyash within a radius of 300 kilometres of coal or lignite based Thermal Power Plant. The fly ash shall conform to IRC:SP:58-2001.

The list of coal or lignite based Thermal Power Plants within a radius of 300km from the proposed project is given in **Table 2.18**.

Table 2-18: List of coal or lignite based Thermal Power Plant

| Power Plant Name | State | Location | Capacity of Power Plant (MW) | Aerial Distance from Project Road (km) |
|--------------------------------|----------------|-----------|------------------------------|--|
| Udupi Thermal Power Plant | Karnataka | Padubidri | 1200 | 264 |
| Mettur Thermal Power Plant | Tamil Nadu | Salem | 1440 | 115 |
| Rayalseema Thermal Power Plant | Andhra Pradesh | Kadapa | 1230 | 205 |

Stone Metal and Sand Quarries

The potentially identified quarries along the entire stretch are provided in **Table 2.19**.

Table2-19: Quarries identified for the proposed project

| S.No | Stone Quarry Name | Coordinates |
|------|---------------------------------------|-----------------------------|
| 1. | V. V. Granite | 12°39'47.09"N,77°48'31.97"E |
| 2. | Shri Bharat Blue Metals & Enterprises | 12°43'37.65"N,77°54'58.88"E |
| 3. | Trinate Exparts (Eco Sand) | 12°57'18.54"N,77°15'57.67"E |
| 4. | Sri Lakshmi Narayana Swamy | 13°17'26.23"N,77°13'20.74"E |

2.8 WATER REQUIREMENTS

It is estimated that approx. 31,33,233 KL (3436 KLD) water will be required during the construction stage. It will be sourced through water tanker. NHAI will purchase water tankers from the approved empanelled agencies of respective districts. It will be assure that no public water sources will be used for construction purpose. The water required during construction is given in **Table 2.20**.

Table2-20: Water Requirement during the construction phase

| Purpose | Water requirement (KL) | Source |
|----------------------------|------------------------|--|
| Road construction | 3132000 | Water Tanker. NHAI will purchase water tankers from the approved empanelled agencies of respective districts. In case of ground and surface water utilization, contractor will obtain necessary permission from the CGWB/concerned department prior to start of the construction. |
| Dust suppression | 1083 | |
| Domestic and other purpose | 150 | |
| Total | 31,33,233 KL | |

2.9 TRAFFIC ANALYSIS AND FORECASTS

This section presents the traffic studies and analyses carried out for addressing various objectives and issues pertaining to the design of Balance Portion of Satellite Town Ring Road of Bangalore (West Side) including connection to Hosur town. The results of this analysis will form inputs for forecasting future traffic, forecasting toll traffic and toll revenue, deciding tolling strategy, planning and designing the pavement, developing capacity augmentation proposals, designing the toll plaza and design of interchanges along the project road.

Thorough knowledge of the travel characteristics of the traffic using an existing network is essential for future traffic estimation on the proposed project road. Hence, detailed traffic surveys have been carried out to assess the traffic characteristics on existing routes followed for travel between Dobbaspet and Hosur within the vicinity of the proposed STRR. Based on the reconnaissance survey and study of road network, the project road corridor was divided into different homogeneous sections for the purpose of traffic analysis. The homogeneous sections are presented in **Table 2.21** below:

Table 2-21: Homogeneous sections for traffic study

| Homogeneous sections | From | To |
|----------------------|-------------------------------------|-------------------------------------|
| HS 1 | Junction NH 4 - SH 3 | Junction Hassan Road - SH 3 |
| HS 2 | Junction Hassan Road - SH 3 | Junction SH 85 - SH 3 |
| HS 3 | Junction SH 85 - SH 3 | Junction Mysore Road - SH 3 |
| HS 4 | Junction Mysore Road - SH 3 | NH 209 (Chamarajanagar Road) - SH-3 |
| HS 5 | NH 209 (Chamarajanagar Road) - SH-3 | Junction SH 85/SH35 (Anekal) |
| HS 6 | Junction SH 85/SH35 (Anekal) | Junction NH 7 (Hosur Road) - SH 87 |
| HS 7 | Junction NH 7 (Hosur Road) - SH 87 | Junction NH 7 (Hosur Road) - NH 648 |

The various types of vehicle having different sizes and characteristics were converted into Equivalent Passenger Car Units. The Passenger Car Unit (PCU) factors recommended by Indian Road Congress in "Guidelines for Capacity of Roads in Rural Areas" (IRC-64-1990) have been used for conversion, and are presented in **Table 2.22**.

Table 2-22: Passenger car equivalency factors

| S. No. | Vehicle Type | PCU Factors |
|--------|--------------------------|-------------|
| 1. | Two Wheeler | 0.50 |
| 2. | Auto-rickshaw | 1.00 |
| 3. | Car / Jeep / Van / Tempo | 1.00 |

| | | |
|-----|---|------|
| 4. | Mini Bus | 1.50 |
| 5. | Standard Bus | 3.00 |
| 6. | Light Commercial Vehicle (LCV),Agricultural Tractor | 1.50 |
| 7. | Two Axle Truck | 3.00 |
| 8. | Three Axle Truck | 3.00 |
| 9. | Truck Trailer | 4.50 |
| 10. | Agriculture Tractor-trailer | 4.50 |
| 11. | Animal Drawn | 6.00 |
| 12. | Cycle | 0.50 |
| 13. | Hand Cart | 3.00 |
| 14. | Cycle Rickshaw | 2.00 |

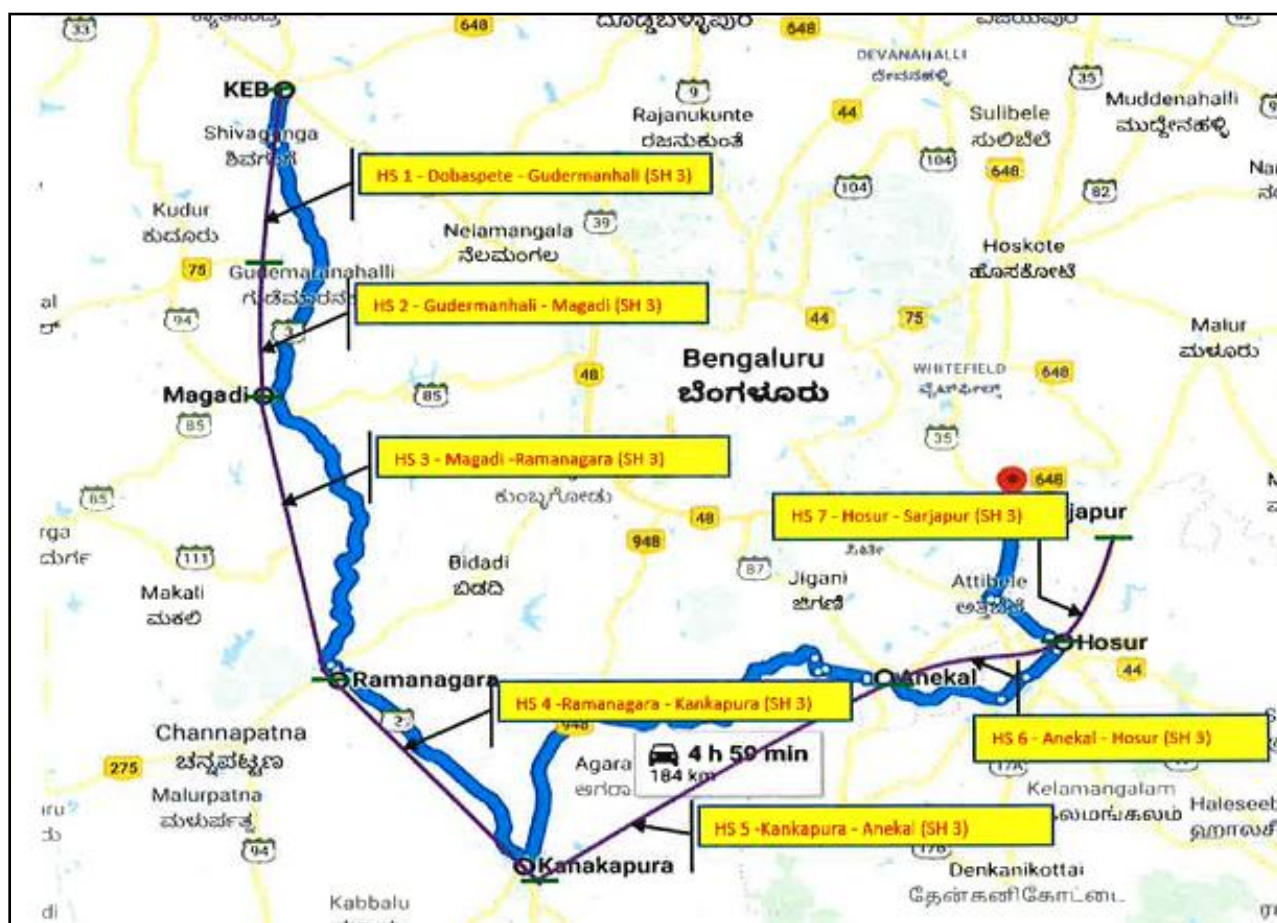


Figure 2-2: Homogeneous sections for traffic study

2.9.1 Average Daily Traffic (ADT)

Traffic volume counts for 7 days at 6 locations and 3 days at seven locations were carried out to determine Average Daily Traffic (ADT). The summarized ADT by vehicle type is presented in below in Table 2.23 & 2.24.

Table 2-23: Average Daily Traffic

| Vehicle Type | NH4 CH51 | SH85 | NH-275 Km30.8 | NH209 CH419 | NH48CH 44.200 | NH7CH 49.000 |
|--------------|-------------|------|------------------|----------------|------------------|-----------------|
| Car | 16156 | 2631 | 13040 | 2411 | 11690 | 15470 |

| VehicleType | NH4 CH51 | SH85 | NH-275 Km30.8 | NH209 CH419 | NH48CH 44.200 | NH7CH 49.000 |
|---------------------------|--------------|--------------|------------------|----------------|------------------|-----------------|
| MiniBus | 345 | 48 | 485 | 57 | 275 | 407 |
| Bus | 2855 | 364 | 1223 | 312 | 1528 | 2782 |
| LMV | 2261 | 393 | 1217 | 341 | 908 | 2146 |
| LCV(4Wheels) | 334 | 36 | 116 | 28 | 76 | 125 |
| LCV(6Wheels) | 2755 | 96 | 863 | 78 | 853 | 2866 |
| 2Axle | 1853 | 47 | 619 | 114 | 583 | 1847 |
| 3Axle | 2837 | 54 | 424 | 69 | 339 | 2947 |
| MAV(4to6 Axles) | 4064 | 18 | 179 | 22 | 557 | 3525 |
| MAV(7++Axles) | 1 | 0 | 0 | 0 | 0 | 1 |
| JCB/HCM | 6 | 2 | 2 | 2 | 2 | 3 |
| 3Wheeler | 820 | 1799 | 2057 | 475 | 563 | 114 |
| 2 Wheeler | 9414 | 11499 | 10863 | 4571 | 6640 | 10432 |
| TractorWithoutTraile r | 6 | 8 | 6 | 4 | 7 | 5 |
| TractorWithTrailer | 22 | 58 | 29 | 16 | 22 | 29 |
| Cycle | 3 | 84 | 29 | 22 | 3 | 6 |
| CycleRickshaw | 0 | 1 | 0 | 0 | 0 | 0 |
| AnimalDrawn | 0 | 3 | 1 | 0 | 0 | 0 |
| Car Exempt | 1 | 0 | 2 | 1 | 4 | 3 |
| MiniBus Exempt | 12 | 0 | 4 | 1 | 7 | 9 |
| Bus Exempt | 0 | 0 | 0 | 0 | 0 | 0 |
| LCVExempt | 1 | 0 | 1 | 0 | 3 | 1 |
| TruckExempt | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 43746 | 17142 | 31159 | 8524 | 24061 | 42718 |
| PCU | 70014 | 12648 | 31660 | 7426 | 28247 | 66747 |

Table 2-24: Average Daily Traffic (ADT)

| Vehicle Type | NH-7 CH.31 | SH-3 CH 118 | NH-207 CH.138 | NH-4 NICE Road | NH-7 Before NICE Road | NH -275 NICE Road | SH-3 |
|---------------------|---------------|-------------------|------------------|-------------------|-----------------------------|-------------------------|------|
| Car | 24582 | 462 | 2230 | 48418 | 26163 | 29386 | 817 |
| MiniBus | 1230 | 8 | 119 | 2040 | 1617 | 1834 | 17 |
| Bus | 3889 | 33 | 207 | 6318 | 3144 | 3848 | 117 |
| LMV | 3734 | 78 | 505 | 6679 | 2893 | 3529 | 141 |
| LCV (4 Wheels) | 553 | 12 | 22 | 1732 | 478 | 692 | 12 |
| LCV (6 Wheels) | 4161 | 51 | 412 | 5735 | 1862 | 3961 | 39 |
| 2 Axle | 2530 | 54 | 313 | 1853 | 482 | 1743 | 18 |
| 3 Axle | 3828 | 46 | 409 | 1918 | 787 | 2384 | 13 |
| MAV (4to6 Axles) | 3489 | 47 | 357 | 1818 | 277 | 1116 | 3 |
| MAV (7++ Axles) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| JCB/HCM | 2 | 1 | 3 | 4 | 9 | 7 | 0 |

| Vehicle Type | NH-7 CH.31 | SH-3 CH 118 | NH-207 CH.138 | NH-4 NICE Road | NH-7 Before NICE Road | NH -275 NICE Road | SH-3 |
|-------------------------------|---------------|-------------------|------------------|-------------------|-----------------------------|-------------------------|-------------|
| 3 Wheeler | 482 | 76 | 957 | 5935 | 2910 | 2747 | 151 |
| 2 wheeler | 32099 | 1386 | 6642 | 54862 | 37086 | 25670 | 3527 |
| Tractor Without Trailer | 1 | 4 | 5 | 5 | 2 | 5 | 0 |
| Tractor With Trailer | 15 | 11 | 61 | 39 | 12 | 21 | 16 |
| Cycle | 28 | 2 | 7 | 33 | 35 | 5 | 31 |
| Cycle Rickshaw | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Animal Drawn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Car Exempt | 2 | 0 | 1 | 6 | 3 | 6 | 0 |
| Mini Bus Exempt | 6 | 0 | 0 | 19 | 4 | 15 | 0 |
| Bus Exempt | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| LCV Exempt | 2 | 0 | 0 | 4 | 1 | 2 | 0 |
| Truck Exempt | 1 | 0 | 5 | 0 | 0 | 0 | 0 |
| Total | 80635 | 2273 | 12255 | 137418 | 77766 | 76974 | 4903 |
| PCU | 100041 | 2087 | 12544 | 140565 | 70819 | 87002 | 3517 |

2.9.2 Annual Average Daily Traffic (AADT)

The location wise AADT by vehicle type is presented in Table 2.25 & 2.26.

Table 2-25: Annual Average Daily Traffic at Count Locations

| VehicleType | NH-4 CH. 51 | SH-85 | NH-275 Km 30.8 | NH-209 CH.419 | NH-48 CH 44.200 | NH-7 CH. 49.000 |
|---------------------------|----------------|-------|-------------------|------------------|--------------------|--------------------|
| Car | 16560 | 2697 | 12128 | 2242 | 10871 | 17404 |
| MiniBus | 310 | 43 | 509 | 60 | 289 | 512 |
| Bus | 2570 | 327 | 1284 | 327 | 1604 | 3505 |
| LMV | 2035 | 353 | 1278 | 358 | 954 | 2703 |
| LCV(4Wheels) | 300 | 33 | 122 | 29 | 80 | 158 |
| LCV(6Wheels) | 2480 | 87 | 906 | 82 | 896 | 3611 |
| 2Axle | 1668 | 43 | 650 | 120 | 612 | 2328 |
| 3Axle | 2554 | 48 | 445 | 73 | 356 | 3713 |
| MAV(4to6 Axles) | 3657 | 16 | 188 | 23 | 585 | 4442 |
| MAV(7++Axles) | 1 | 0 | 0 | 0 | 0 | 1 |
| JCB/HCM | 5 | 2 | 2 | 2 | 2 | 3 |
| 3Wheeler | 943 | 2068 | 1666 | 385 | 456 | 113 |
| 2 Wheeler | 10826 | 13224 | 8799 | 3703 | 5378 | 10328 |
| TractorWithoutTraile r | 6 | 7 | 6 | 5 | 7 | 6 |
| TractorWithTrailer | 20 | 53 | 30 | 17 | 23 | 36 |
| Cycle | 3 | 3 | 3 | 22 | 3 | 6 |
| CycleRickshaw | 0 | 0 | 0 | 0 | 0 | 0 |

| VehicleType | NH-4 CH. 51 | SH-85 | NH-275 Km 30.8 | NH-209 CH.419 | NH-48 CH 44.200 | NH-7 CH. 49.000 |
|----------------|----------------|--------------|-------------------|------------------|--------------------|--------------------|
| AnimalDrawn | 0 | 0 | 0 | 0 | 0 | 0 |
| CarExempt | 1 | 0 | 2 | 1 | 4 | 3 |
| MiniBus Exempt | 12 | 13 | 14 | 1 | 7 | 9 |
| Bus Exempt | 0 | 0 | 0 | 0 | 0 | 0 |
| LCVExempt | 1 | 0 | 1 | 0 | 3 | 1 |
| TruckExempt | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 43951 | 19018 | 28033 | 7449 | 22132 | 48884 |
| PCU | 66416 | 13563 | 29877 | 6845 | 27323 | 80568 |

Table 2-26: Annual Average Daily Traffic at Count Locations

| VehicleType | NH-7 Ch. 31 | SH-3 Ch. 118 | NH-207 Ch. 138 | NH-4 NICE Road | NH-7 Before NICE Road | NH -275 NICE Road | SH-3 |
|----------------------------|----------------|-----------------|-------------------|-------------------|-----------------------------|-------------------------|-------------|
| Car | 27655 | 520 | 2319 | 50354 | 27210 | 30561 | 849 |
| Mini Bus | 1550 | 11 | 119 | 2040 | 1617 | 1834 | 17 |
| Bus | 4900 | 42 | 207 | 6318 | 3144 | 3848 | 117 |
| LMV | 4705 | 98 | 505 | 6679 | 2893 | 3529 | 141 |
| LCV (4 Wheels) | 697 | 16 | 22 | 1732 | 478 | 692 | 12 |
| LCV (6 Wheels) | 5242 | 64 | 412 | 5735 | 1862 | 3961 | 39 |
| 2 Axle | 3187 | 68 | 313 | 1853 | 482 | 1743 | 18 |
| 3 Axle | 4823 | 58 | 409 | 1918 | 787 | 2384 | 13 |
| MAV (4to6Axles) | 4396 | 60 | 357 | 1818 | 277 | 1116 | 3 |
| MAV (7++Axles) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| JCB/HCM | 3 | 1 | 3 | 4 | 9 | 7 | 0 |
| 3 Wheeler | 477 | 76 | 1034 | 6409 | 3142 | 2967 | 163 |
| 2 wheeler | 31778 | 1372 | 7173 | 59251 | 40053 | 27724 | 3810 |
| Tractor without Trailer | 1 | 5 | 5 | 5 | 2 | 5 | 0 |
| Tractor with Trailer | 19 | 14 | 61 | 39 | 12 | 21 | 16 |
| Cycle | 28 | 2 | 7 | 33 | 35 | 5 | 31 |
| Cycle Rickshaw | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Animal Drawn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Car Exempt | 2 | 0 | 1 | 6 | 3 | 6 | 0 |
| Mini Bus Exempt | 6 | 0 | 0 | 19 | 4 | 15 | 0 |
| Bus Exempt | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| LCV Exempt | 2 | 0 | 0 | 4 | 1 | 2 | 0 |
| Truck Exempt | 1 | 0 | 5 | 0 | 0 | 0 | 0 |
| Total | 89475 | 2407 | 12952 | 144219 | 82012 | 80422 | 5230 |
| PCU | 118261 | 2359 | 12975 | 145171 | 73582 | 89424 | 3702 |

2.9.3 Traffic Forecast for the study Corridor

Traffic forecast for the next 30 years has been presented in below table:

Table 2-27: Projected Traffic

| | Car | Mini bus | Bus | LCV | 2AT | 3AT | MAV | 2W | 3W | Total |
|-------------------------|--------|----------|------|------|------|------|------|-------|-------|--------|
| 2018 (Baseline Traffic) | 3357 | 32 | 147 | 202 | 244 | 217 | 294 | 1996 | 270 | 6759 |
| 2020 | 4076 | 36 | 166 | 242 | 279 | 249 | 346 | 2426 | 334 | 8154 |
| 2030 | 20364 | 133 | 615 | 1189 | 1149 | 1023 | 1597 | 11779 | 1765 | 39614 |
| 2040 | 51191 | 238 | 1102 | 2624 | 2100 | 1871 | 3275 | 29777 | 4879 | 97057 |
| 2050 | 125215 | 421 | 1948 | 5446 | 3667 | 3267 | 6298 | 73233 | 13086 | 232581 |

2.10 COST ESTIMATES

The estimated project cost for Phase-I (Package 1 and 2) (including LA, R&R, utility shifting etc.) is INR 4112 cr., and the civil cost is INR. 2077.66 Cr. The Package-wise estimated cost for both the packages of STRR Phase-I are presented below:

Table 2-28: Estimated Cost for Package-I

| Package-I (From km. 0.000 Km to km. 46.300 Km) | | | |
|---|---|-----------------------|---------------------|
| S. No. | Description | Amount (In Rs.) | Amount (Rs. in Cr.) |
| 1 | Bill No. 1: Site clearance and Dismantling | 31,881,717 | 3.19 |
| 2 | Bill No. 2 : Earth Work | 1,273,534,257 | 127.35 |
| 3 | Bill No. 3 : Granular Sub Base Courses and Base Courses (Non-Bituminous) | 1,314,482,077 | 131.45 |
| 4 | Bill No. 4 : Bituminous Courses /Rigid Pavement | 1,415,945,677 | 141.59 |
| 5 | Bill No. 5 : Culverts | 354,021,441 | 35.40 |
| 6 | Bill No. 6 : Structures (VUP/ LVUP/ Minor Bridge/ Major Bridge/ Flyover/ ROB) | 2,777,960,518 | 277.80 |
| 7 | Bill No. 6E :Interchange (except Toll Plaza & Structure) | 986,558,241 | 98.66 |
| 8 | Bill No. 7 :Drainage and Protection Works | 1,456,341,142 | 145.63 |
| 9 | Bill No. 8 : Traffic signs, Road markings and other road appurtenances | 54,771,336 | 5.48 |
| 10 | Bill No. 9 : Boundary Wall & Crash Barrier | 563,992,421 | 56.40 |
| 11 | Bill No. 10 : Miscellaneous Works | 238,987,560 | 23.90 |
| 12 | Bill No. 11 : Bus Shelter | 6,600,000 | 0.66 |
| 13 | Bill No. 12: Toll Plaza | 354,821,113 | 35.48 |
| 14 | Bill No. 13 : Wayside Amenities | 0 | 0.000 |
| | Total Civil Cost (In Rs.) | 10,829,897,500 | 1,082.99 |
| | Add 12% GST | 1,299,587,700 | |
| | Total Civil Cost including 12% GST (In Rs.) | 12,129,485,200 | |
| | Total Civil Cost (In Cr.) | 1,212.95 | |
| | Project Length in Km. | 46.300 | |
| | Civil Cost per Km (In Cr.) | 26.20 | |

Table 2-29: Estimated Cost for Package-II

| Package-II (From km. 46.300 Km to km. 79.000 Km) | | | |
|---|---|------------------------|----------------------------|
| S. No. | Description | Amount (In Rs.) | Amount (Rs. in Cr.) |
| 1 | Bill No. 1: Site clearance and Dismantling | 22,723,470 | 2.27 |
| 2 | Bill No. 2 : Earth Work | 530,678,882 | 53.07 |
| 3 | Bill No. 3 : Granular Sub Base Courses and Base Courses (Non-Bituminous) | 799,547,206 | 79.95 |
| 4 | Bill No. 4 : Bituminous Courses /Rigid Pavement | 949,190,431 | 94.92 |
| 5 | Bill No. 5 : Culverts | 278,882,083 | 27.89 |
| 6 | Bill No. 6 : Structures (VUP/ LVUP/ Minor Bridge/ Major Bridge/ Flyover/ ROB) | 1,325,997,127 | 132.60 |
| 7 | Bill No. 6E:Interchange (except Toll Plaza & Structure) | 405,540,472 | 40.55 |
| 8 | Bill No. 7 :Drainage and Protection Works | 1,812,529,568 | 181.25 |
| 9 | Bill No. 8 : Traffic signs, Road markings and other road appurtenances | 33,382,722 | 3.34 |
| 10 | Bill No. 9 : Boundary Wall & Crash Barrier | 359,859,514 | 35.99 |
| 11 | Bill No. 10 : Miscellaneous Works | 316,306,880 | 31.63 |
| 12 | Bill No. 11 : Bus Shelter | 1,200,000 | 0.12 |
| 13 | Bill No. 12: Toll Plaza | 164,792,022 | 16.48 |
| 14 | Bill No. 13 : Wayside Amenities | 0 | 0.00 |
| | Total Civil Cost (In Rs.) | 7,000,630,376 | 700.06 |
| | Add GST 12% | 840,075,645 | |
| | Total Civil Cost including 12% GST (In Rs.) | 7,840,706,022 | |
| | Total Civil Cost (In Cr.) | 784.07 | |
| | Project Length in Km. | 33.00 | |
| | Civil Cost per Km (In Cr.) | 23.76 | |

CHAPTER : 3 DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

In order to assess environmental impacts due to the proposed project, it is essential to monitor the environmental quality prevailing at the project site and its surrounding areas prior to the implementation of the project.

Based on the existing environmental scenario potential impacts of proposed Greenfield road will be identified and accordingly management plan will be proposed in forthcoming sections.

3.2 STUDY AREA AND PERIOD

As a primary requirement of EIA process, the direct influence area has been taken as the proposed RoW (70m) of the project road. Primary baseline data has been collected in the right of way as well as the area falling within 500 meters on either side of the right of way and secondary data has been collected aerial distance of 10 km on either side of proposed project road. Baseline data of prominent environmental attributes like ambient air, water, soil, geology, water use, hydrology, noise, meteorology, socio-economic features, terrestrial ecology, aquatic ecology, land use etc. was collected. The baseline study was conducted during month of June, 2018.

3.3 PHYSICAL ENVIRONMENT

Determination of baseline conditions of natural and physical environmental components along project road is vital for robust impact assessment. The project road section passes through Bangalore Rural and Ramanagra districts of Karnataka State. The components of the environment for which the information has been collected are described in the following subsections.

3.3.1 Physiography and terrain

Physiographical, the project area can be divided into rocky upland, plateau and flat-topped hills at an elevation of about 900 m average mean sea level.

The major part of the project area sloping towards south and South-East forming Padi plain interspersed with hills. The Padi plains form the major part underlain by granites and gneisses with the highest elevation of 658 to 950m average mean sea level.

The start and end Geo-coordinates of the project road section are shown in **Table 3.1**.

Table 3-1: Geo-Coordinates (Longitude and Latitude) of the Project Road

| Start/End | Design Chainage (km) | Section of the Project road of STRR (NH-948A) | |
|-----------|----------------------|---|---------------|
| | | Latitude | Longitude |
| Start | 0.000 | 13°14'56.80"N | 77°18'29.26"E |
| End | 82.200 | 12°40'10.25"N | 77°19'50.23"E |

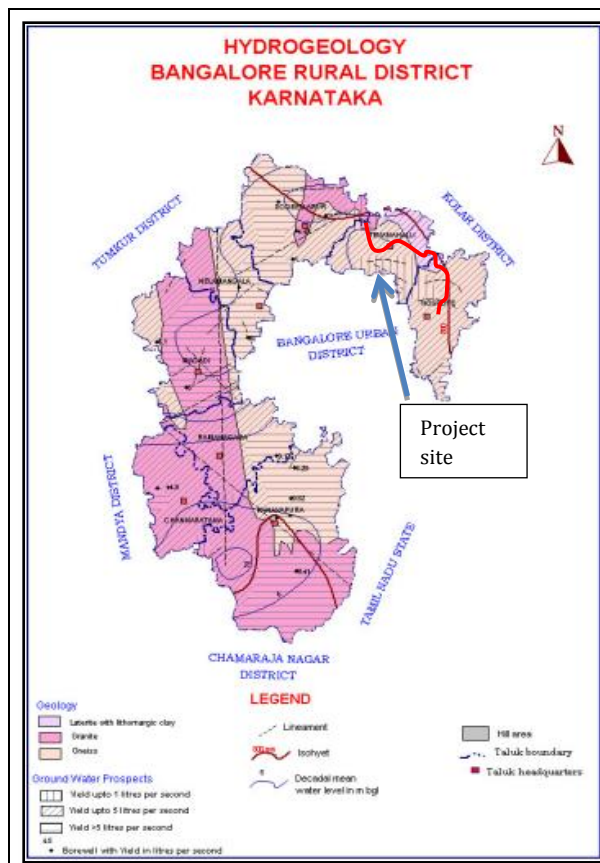
Proposed alignment mostly passes through the agricultural and barren lands. Some settlement areas also located in close vicinity of proposed alignment. The location map of the project road is shown in **Figure 2.2**.

3.3.2 Geomorphology

Bangalore Rural district can be divided into rocky upland, plateau and flat-topped hills at an elevation of about 900m amsl. Flat-topped Laterite hills are seen in the northern part at an elevation of 900m amsl. The pediplains form major part of the district underlain by gneisses and granites with the highest pediplain in the range of 850m and 950m amsl. Rocky upland pediplain and plateau constitute erosional topography. Major part of the pediplain is dissected by streamlets flowing in southerly direction. In northern part of Doddaballpur taluk, the pediplains have northerly slope dissected by various streamlets. The major part of the district lies in Cauvery basin.

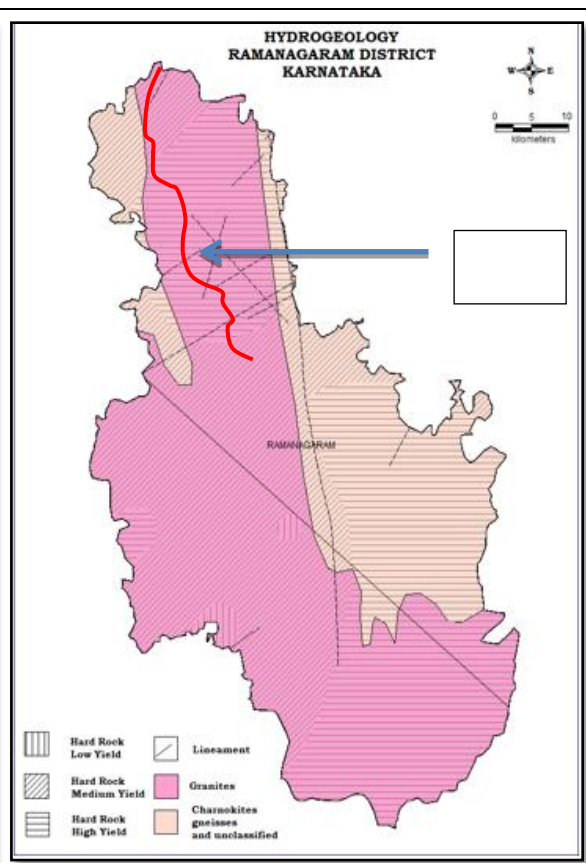
Geomorphologically, Ramanagara district can be divided into rocky upland, plateau and flat-topped hills at an elevation of about 900m amsl. The district with major part sloping towards south and south east forming pediplain interspersed with hills all along the western part with the elevation in the range of 996 m and 1467 m amsl mostly in the granitic terrain. The pediplain form major part of the district underlain by gneisses and granites with the highest pediplain in the range of 850 m to 950 m amsl. Rocky upland pediplain and plateau constitute erosional topography. Major part of pediplain constitutes low relief area having matured dissected rolling topography with erosional landscape covered by layers of red soil of varied thickness. Major parts of the pediplain are dissected by streamlets flowing in southerly direction. An alluvial valley with low relief of 600 – 650 m is in Kanva plain.

The Hydro-Geological map of project districts showing project road sections of NH-948A is presented in **Figure 3.1** and **3.2**.



Source: Ground water information booklet, CGWB, Bangalore Rural district, 2008

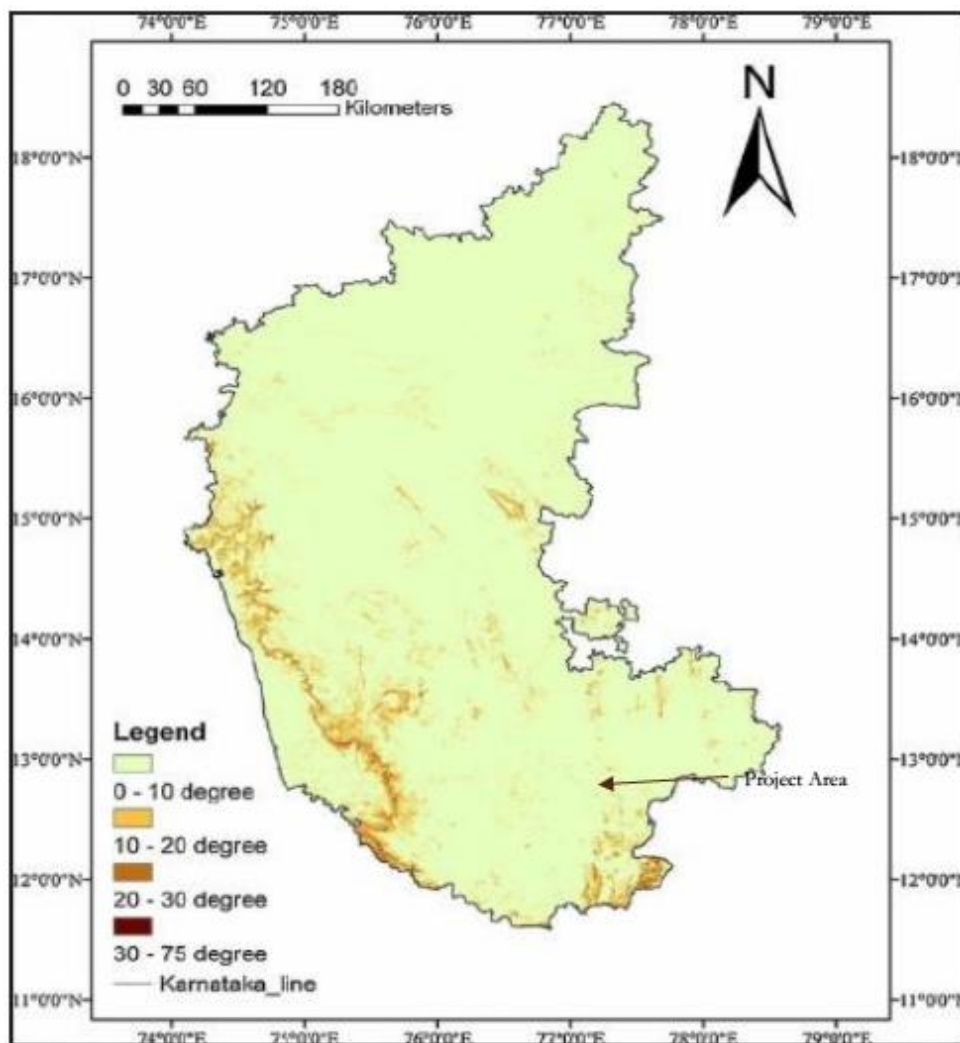
Figure3-1:Hydro-Geological Map of



Source: Ground water information booklet, CGWB, Bangalore Rural district, 2013

Figure3-2:Hydro-Geological Map of

| | |
|---|--|
| Bangalore Rural District (Karnataka State) | Ramanagara District (Karnataka State) |
|---|--|



Source: <https://www.researchgate.net/figure/Topographic-slope-map-of-Karnataka>

Figure 3-3: Slope Map of Karnataka State showing proposed project road sections

The slope map of Karnataka state showing project road sections of STRR (NH-948A) are presented in **Figure 3.4**.

As observed from the above figure, the land slope along the majority of the project road section of NH-948A lies in a low and rolling slope zone.

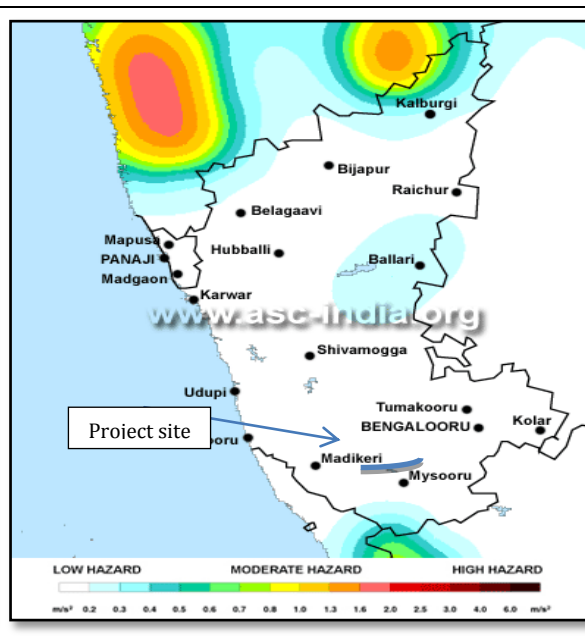
3.3.3 Seismicity

According to the Global Seismic Hazards Assessment Program (GSHP) data, the state of Karnataka falls in a region of low seismic hazard (**Figure 3.4**). As observed from the figure, the entire project stretch falls in low hazard zone. In addition, as per the seismic zoning map of India (2014), the project stretch falls in Zone II, which is least active to moderate in, nature (**Figure 3.5**).

3.3.4 Land Use

The land use map for a buffer length of 500m on either side of the proposed alignment has been prepared and Land Use shows the main land covers including settlements (2.16%),

Agriculture (85.62%), Vegetation (11.5%), waste land (0.14%), water bodies ((0.58%). **Table 3.2** shows the land use area under different land use within 500m buffer of proposal road.



Source: www.mapsofindia.com

Figure 3-4: Seismic Zone Map of India, 2014 (GSHAP)

Figure 3-5: Global Seismic Hazards Assessment Program (GSHAP) Map of Karnataka

Table 3-2: Land Use of 500m of project area

| S.No. | Classes | Area (ha.) | Area in % |
|--------------|--------------|----------------|---------------|
| 1 | Settlement | 178.62 | 2.16 |
| 2 | Agriculture | 7089.76 | 85.62 |
| 3 | Vegetation | 952.24 | 11.50 |
| 4 | Waste Land | 11.64 | 0.14 |
| 5 | Water Bodies | 48.24 | 0.58 |
| Total | | 8280.50 | 100.00 |

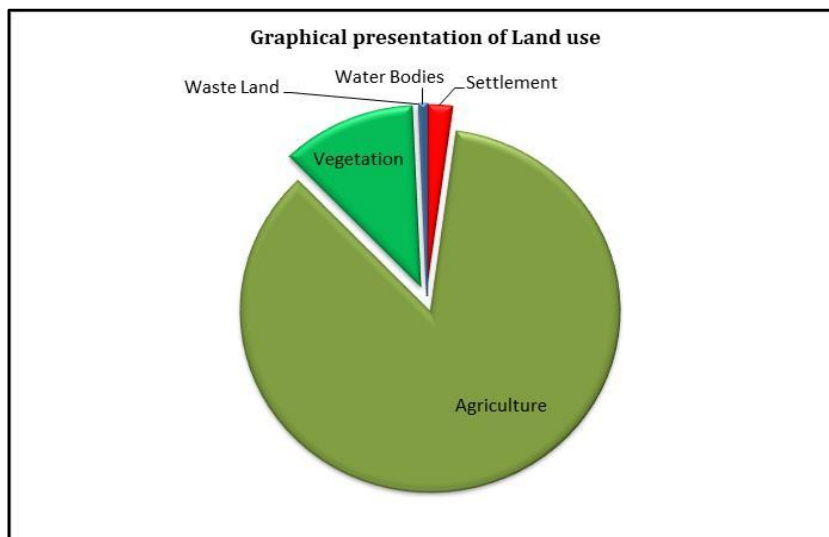


Figure 3-6: Graphical presentation of Landuse

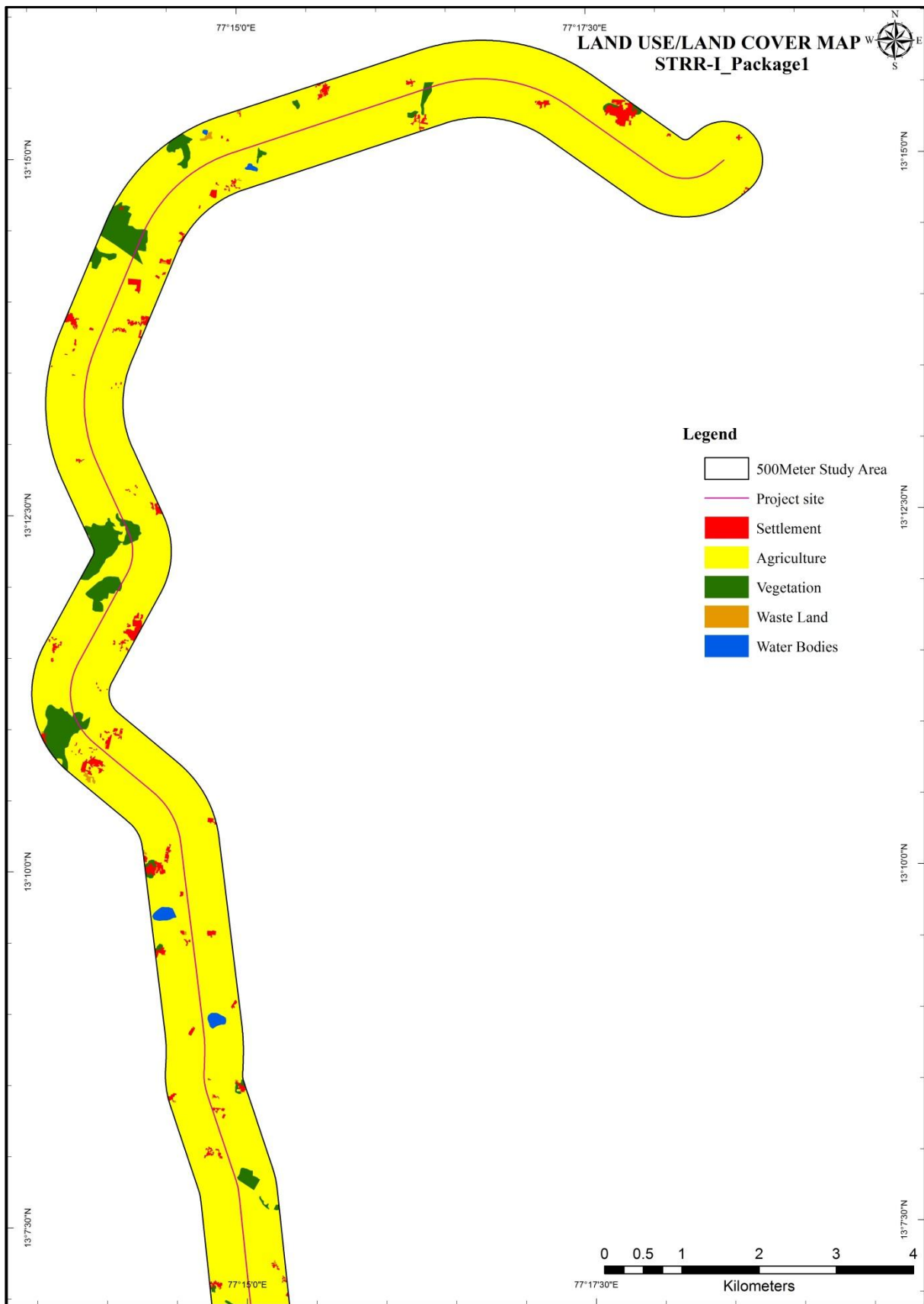


Figure 3-7: Land use of study area (stretch 1)



Figure 3-8: Land use of study area (stretch 2)



Figure 3-9: Land use of study area (stretch 3)

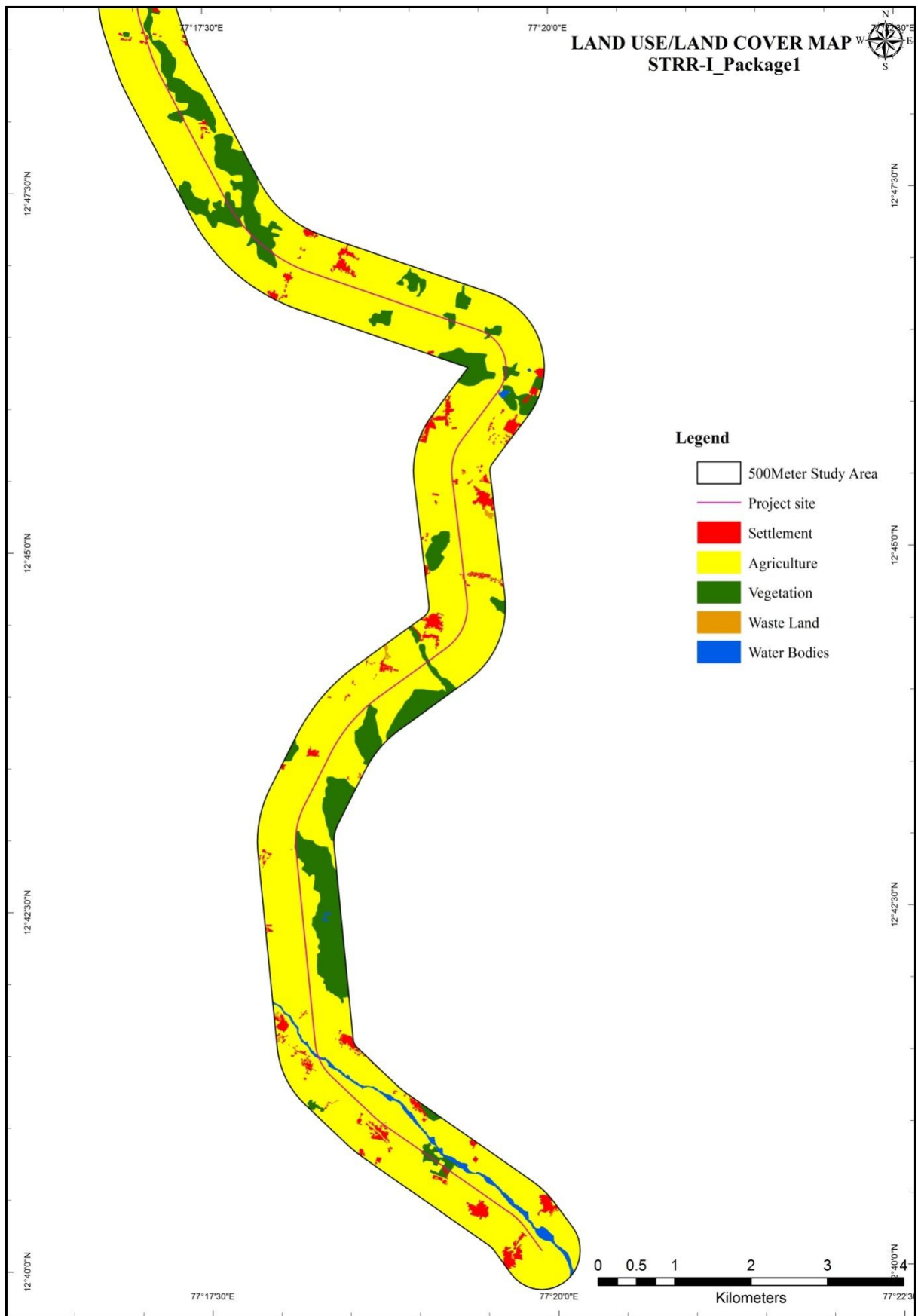


Figure 3-10: Land use of study area (stretch 4)

3.3.5 Soil

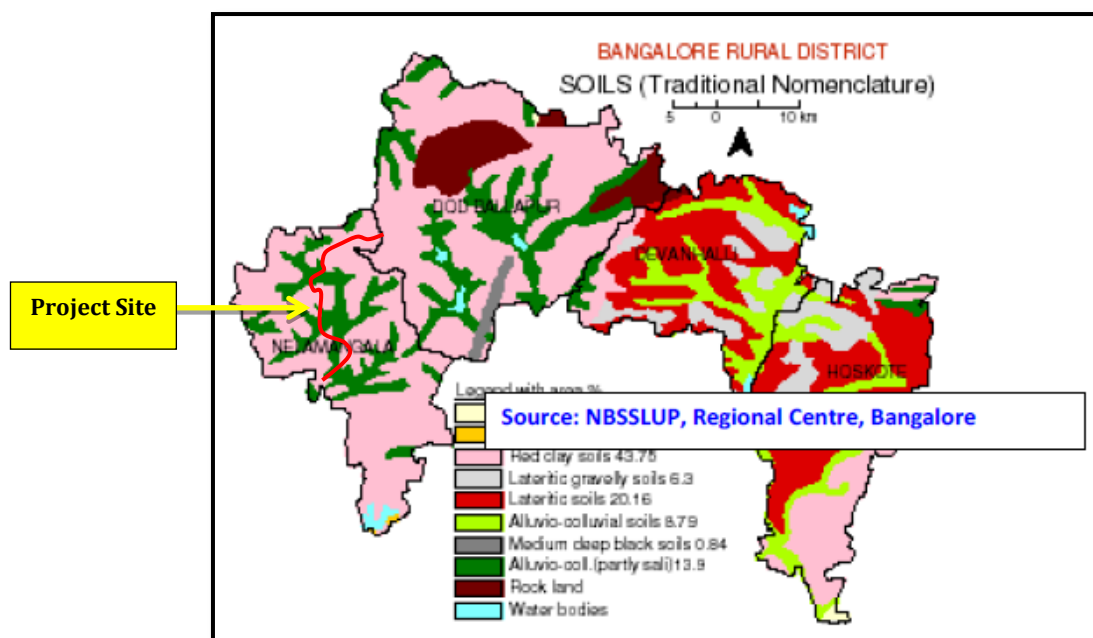
In the state of Karnataka, soils are classified into 7 groups and 11 sub-groups in the hierarchy. The seven groups are red soils, laterite soils, black soils, colluvio-alluvial soils, brown forest soils, coastal laterite and alluvial soils in which red soils have four subgroups, Laterite soils have two subgroups, Black soils have three subgroups and Alluvial soils have two subgroups. Coastal laterite soils, alluvial soils and forest soils have no subgroups.

Soils in Bangalore Rural district are classified into four categories:

- (i) Loamy soil
- (ii) Lateritic soil
- (iii) Lateritic gravelly soil
- (iv) Red sandy soil.

Red loamy soils are generally occurred in hilly to undulating land slope above granite and granite gneisses. Lateritic soil occurs in undulating terrain forming plain to gently sloping topography of peninsular gneiss region. Lateritic gravelly soils occur in upland regions of lateritic soils, Red sandy soil occurs in undulating land slopes. These soils are generally derived from acidic rocks granites and granitic gneiss.

Soil Map of Bangalore Rural district is given in **Figure 3.11**.

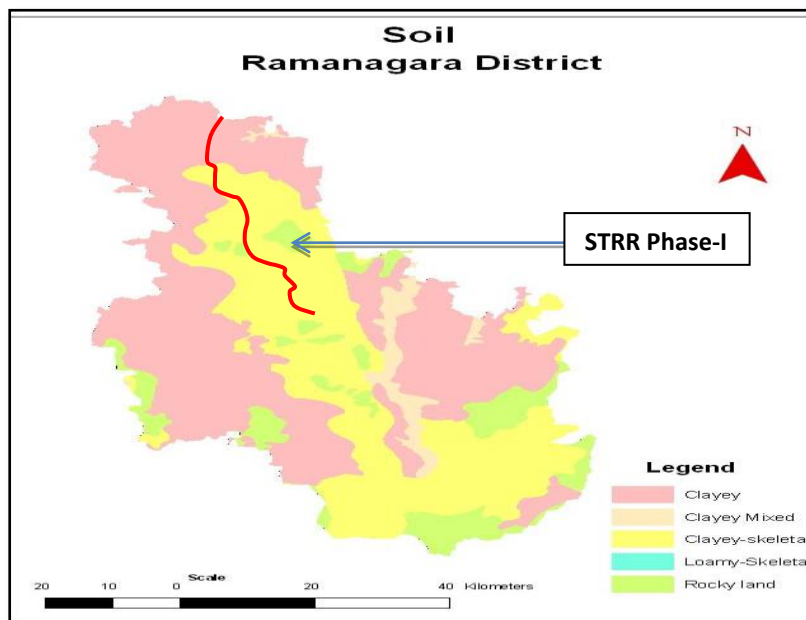


Source: NBSSLUP, Regional Centre, Bangalore

Figure3-11: Soil Map of Bangalore Rural District

Ramanagara district is covered by Clay skeletal soil rocky land in combination at the Central Part. The soil is coarser loamy and coarse loamy silt in the south region. Hilly ranges are present in the eastern part of the district. More clayey and clayey loamy soil is also found in the eastern part. Clayey soil is found in a scattered pattern in the central and northern parts of the district. The district soil is favourable for agriculture except for the few rugged terrains.

The Soil Map of the Ramanagra district is given in **Figure 3.12**.



Source: *Shodhganga Study on Ramanagara District*

Figure 3-12: Soil Map of Ramanagara District

3.3.5.1 Soil Quality

For studying soil quality, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The samples were collected by ramming a core-cutter into the soil. The details of soil sampling locations are provided in **Table 3.3** and presented in **Map-3.1** the Soil Sampling Location map (attached as **Annexure-10**). The collected samples were analysed for physical and chemical characteristics. Field photographs taken during soil sample collection are provided in **Figures 3.13 to 3.16**.

Table 3-3: Details of Soil Sampling Locations

| S.N o. | Sample Code | Sampling Location | GPS Coordinates | Sensitivity indicator | Type of Source |
|--------|-------------|-----------------------------------|--------------------------------|---------------------------|----------------|
| 1 | S1 | Ch.1+000 near to Oblapura Village | 13°14'58.9"N 77°18'37.5"E | Village near project site | Agriculture |
| 2 | S2 | Ch.18+500near Baswapatna Village | 13°09'28.8"N 77°14'36.4"E | Pond | Agriculture |
| 3 | S3 | Ch. 65.500 near to Arkavati River | 12°47'20.40"N 77°18'24.66"E | Arkavati River | Agriculture |
| 4 | S4 | Ch. 78.500 near to Arkavati River | 12°94'81.47"N 77°23'81.65"E | Arkavati River | Agriculture |

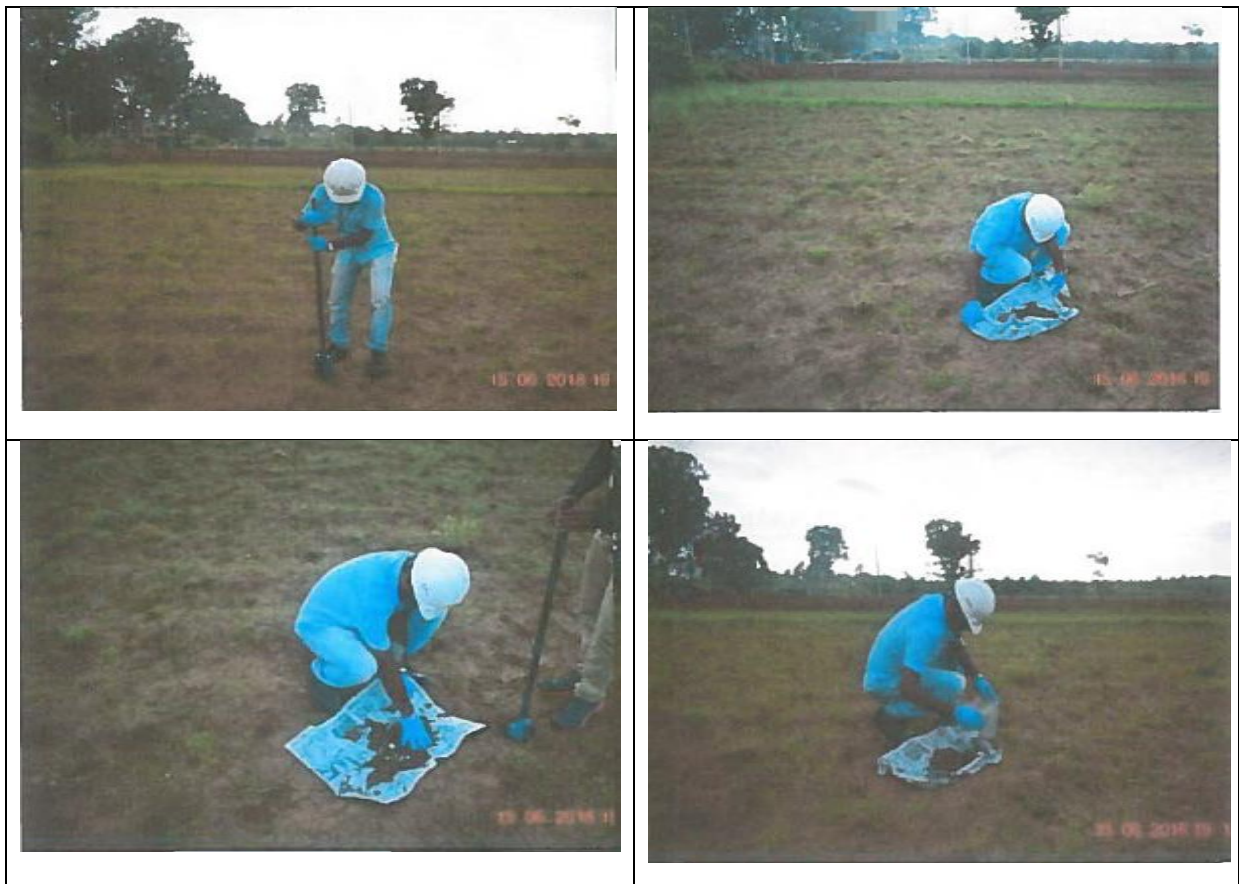


Figure 3-13: Field photographs taken during soil sample collection in Oblapura Village



Figure 3-14: Field photographs taken during soil sample collection in Baswapatna Village



Figure 3-15: Field photographs taken during oil sample collection near Arkavati River



Figure 3-16: Field photographs taken during soil sample collection near Arkavati River

3.3.5.2 Analysis Methodology

The samples of Soil were collected in the month of June, 2018 in the study period. The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in “Soil chemical Analysis” (M.L Jackson) and Department of Agriculture and Cooperation.

3.3.5.3 Results Analysis:

The analytical results for the all locations are provided in **Table 3.4**. As evident from the results the pH values of soils are in the range of 5.57 to 6.70. The soil type varies from loamy sand to sandy loam. The nutrient status of soil is also a key element in agriculture. The results also show that the soils of the study area have good amount of primary nutrients i.e., Nitrogen (N), Phosphorus (P) and Potassium (K) content. From the results, it can be observed that the soil in the project area is fertile with high agricultural productivity with appropriate use of fertilizer.

Table 3-4: Analytical results of Soil sampling of the study area

| Sl.No. | Parameters | Unit | S1 | S2 | S3 | S4 |
|--------|-----------------------------|----------|------------|------------|------------|------------|
| 1 | pH | - | 5.57 | 6.49 | 6.70 | 6.70 |
| 2 | Electrical Conductivity | µs/cm | 63.4 | 142.2 | 101.30 | 209 |
| 3 | Sand | Percent | 81.68 | 79.68 | 74.96 | 74.96 |
| 4 | Silt | Percent | 11.28 | 7.28 | 15.28 | 12.28 |
| 5 | Clay | Percent | 7.04 | 13.04 | 9.76 | 9.76 |
| 6 | Texture | - | Loamy Sand | Sandy Loam | Sandy Loam | Sandy Loam |
| 7 | Moisture Retention Capacity | Percent | 39.25 | 38.32 | 16.05 | 17.56 |
| 8 | Moisture Content | Percent | 19.23 | 8.09 | 5.70 | 11.71 |
| 9 | Organic Matter | Percent | 4.86 | 0.51 | 0.82 | 0.72 |
| 10 | Available Nitrogen | kg/ha | 242.56 | 150.52 | 184.39 | 219.30 |
| 11 | Available Potassium | kg/ha | 58.0 | 62.49 | 44.80 | 89.60 |
| 12 | Available Phosphorus | kg/ha | 456.41 | 192.46 | 151.22 | 151.22 |
| 13 | Sulphate | mg/100gm | 11.57 | 9.11 | 14.31 | 12.05 |
| 14 | Infiltration Rate | mm/hr | 12.40 | 8.60 | 8.40 | 4.50 |
| 15 | Sodium Sulphate as NA | mg/100gm | 8.38 | 4.79 | 2.06 | 2.75 |
| 16 | Calcium | meq/L | 8.30 | 1.80 | 3.20 | 12.1 |
| 17 | Oil & Grease | mg/kg | BDL | BDL | BDL | BDL |
| 18 | Magnesium | meq/L | 2.40 | 1.30 | 0.90 | 1.20 |
| 19 | Sodium Absorption Ratio | - | 0.15 | 1.24 | 0.62 | 0.46 |

Source: *Soil Quality analysis report by M/s EHSRDC, 2018*

3.3.6 Air Environment

The prime objective of baseline air quality survey was to assess the existing air quality of the area. This will also be useful for assessing the conformity to the standards of the ambient air quality. Degradation of ambient air quality is the most commonly identified adverse impact on the natural and biophysical environment during the construction and operation of the road projects. As a part of the Environmental Assessment (EA), climatic component has been studied to establish the benchmarks to understand air quality in the project influence area

3.3.7.1 Meteorology and Climate

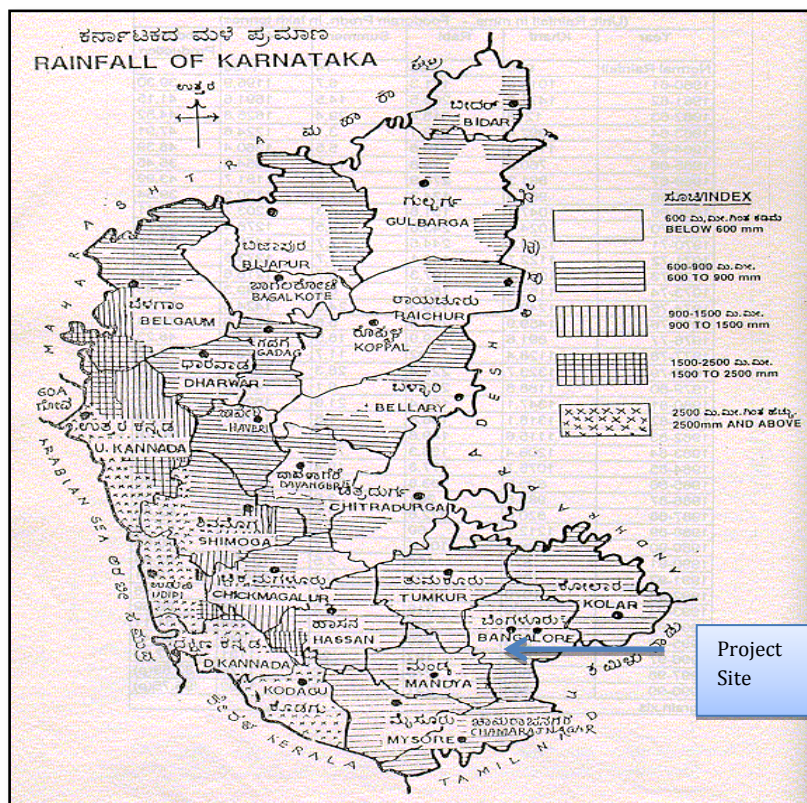
a) Climate

The climate of the project influence area (PIA) is tropical, with distinct wet and dry seasons. The climate may be classified into four distinct seasons: winter (January – February), summer (March – May), south-west monsoons (June – September) and north-east monsoon (October – December).

The various climatic factors such as rainfall, temperature, and humidity in the project area have been discussed in detail in the following sections.

b) Rainfall

In the State of Karnataka, the project region is located in moderate to moderately low rainfall receiving region. The rainfall distribution map for the State of Karnataka, presented in **Figure 3.17** highlights this aspect very clearly.



Source: raitamitra.kar.nic.in

Figure 3-17: Rainfall Distribution map in the State of Karnataka

In Bangalore Rural district, the mean annual rainfall is 824 mm. Doddaballapur taluk receives the lowest rainfall of 680 mm where as Hoskote and Nelamangala taluk receives the highest rainfall of 776 mm. During the year 2011, the district received an average rainfall of 970mm. However it varies from a lowest 800 mm at Kanakapura to a highest 1130 mm at Magadi station.

The normal rainfall of the district is 854mm and varies from 822 mm at Kanakapura to 868 mm at Magadi. December to March represents very low rainfall months. The rainfall occurs in nearly 49 rainy days. The pre-monsoon period has a normal of 345mm (35%), SW monsoon period has 363 mm (37%) and the NE monsoon period receive 263mm (27%) rainfall. It is observed that there is not much variation in the distribution of rainfall during pre-monsoon, SW monsoon and NE monsoon periods.

The actual rainfall in Bangalore Rural and Ramanagra district for the last five years (2013-17) as provided by the Hydro-met division of the India Meteorological Department is given in **Table 3.5** and **3.6**.

Table 3-5: Rainfall for Bangalore Rural District (mm) for last five years (2013-17)

| Month | Bangalore Rural | | | | |
|--------------|-----------------|--------------|---------------|------------|---------------|
| | 2013 | 2014 | 2015 | 2016 | 2017 |
| January | 0.0 | 0.0 | 19.0 | 8.9 | 0.9 |
| February | 6.9 | 0.1 | 0.0 | 0.0 | 0.0 |
| March | 2.3 | 19.6 | 28.4 | 17.6 | 12.4 |
| April | 38.9 | 11.0 | 112.0 | 2.3 | 36.9 |
| May | 119.6 | 92.5 | 162.1 | 146.8 | 207.6 |
| June | 81.5 | 61.4 | 107.5 | 141.3 | 27.6 |
| July | 83.7 | 90.1 | 55.8 | 226.6 | 36.1 |
| August | 75.8 | 162.6 | 99.9 | 32.3 | 199.1 |
| September | 268.5 | 202.3 | 238.2 | 48.8 | 376.8 |
| October | 130.7 | 267.2 | 78.8 | 51.6 | 335.0 |
| November | 59.8 | 35.4 | 189.4 | 9.1 | 16.2 |
| December | 5.1 | 3.9 | 11.2 | 68.7 | 11.3 |
| Total | 872.8 | 946.1 | 1102.3 | 754 | 1259.9 |

Source:CRIS, Hydromet Division, Indian Metrological Department

Table 3-6: Rainfall for Ramanagara District (mm) for last five years (2013-17)

| Month | Ramanagara | | | | |
|--------------|--------------|--------------|---------------|------------|---------------|
| | 2013 | 2014 | 2015 | 2016 | 2017 |
| January | 0.0 | 0.0 | 1.5 | 2.2 | 1.9 |
| February | 1.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| March | 6.6 | 46.4 | 17.2 | 0.2 | 30.3 |
| April | 61.7 | 32.4 | 139.5 | 3.8 | 39.0 |
| May | 87.5 | 88.8 | 161.3 | 113.4 | 283.9 |
| June | 90.7 | 91.0 | 80.2 | 72.9 | 32.5 |
| July | 48.6 | 32.5 | 28.8 | 184.6 | 23.9 |
| August | 112.8 | 111.4 | 136.0 | 70.7 | 212.8 |
| September | 263.7 | 186.3 | 226.8 | 29.2 | 405.0 |
| October | 88.0 | 189.2 | 81.1 | 49.9 | 229.4 |
| November | 32.9 | 26.9 | 196.5 | 7.6 | 24.7 |
| December | 5.5 | 5.1 | 2.9 | 57.5 | 13.0 |
| Total | 799.0 | 810.3 | 1071.8 | 592 | 1296.4 |

Source:CRIS, Hydro met Division ,Indian Metrological Department

The thirty years (1981 to 2010) actual average rainfall data from Indian Meteorological Department in IMD Bangalore are given below in **Table 3.7**. The past thirty-year rainfall depicts that the project area receives rainfall around 874.6 mm. About 76 percent of the total rainfall is concentrated during the months of July to November.

Table 3-7: Actual Average Rainfall in IMD Bangalore (1981-2010)

| Month | Rainfall (mm) |
|---------|---------------|
| | IMD Bangalore |
| January | 1.4 |

| Month | Rainfall (mm) |
|----------------------------|---------------|
| | IMD Bangalore |
| February | 5.7 |
| March | 15.5 |
| April | 42.7 |
| May | 94.5 |
| June | 91.1 |
| July | 97.7 |
| August | 122.2 |
| September | 183.5 |
| October | 155.9 |
| November | 50.6 |
| December | 13.8 |
| Thirty-year Annual Average | 874.6 |

Source: *Climatological Normals (1981-2010) published by IMD, Government of India*

b) Temperature

The climate in Bangalore rural district is quite salubrious, with three different seasons. The premonsoon starts from January to May. This period can be divided into winter (January to February) and summer (March-May). Winter is characterized by generally clear skies and very little rainfall. From April onwards- erratic thunderstorms occur in the area which increases during May. The temperature is lowest during December and January. Generally, April is the hottest month and December is the coldest month. The maximum temperature rises to 33°C during April-May and minimum temperature 15°C during December-January.

In Ramanagara district, the temperature is lowest during December and January. Generally, April is the hottest month and December is the coldest month. The maximum temperature rises to 33 °C during April-May and minimum temperature 15° C during December-January. The monthly mean maximum and minimum temperatures of Bangalore Observatories (IMD data -1981 to 2010) are presented in **Table 3.8**.

Table3-8: Monthly Mean Maximum and Minimum Temperature in °C (1981-2010)

| Month | IMD Bangalore | |
|-----------|-----------------|-----------------|
| | Average Maximum | Average Minimum |
| January | 27.6 | 14.8 |
| February | 30.3 | 16.2 |
| March | 32.7 | 18.7 |
| April | 33.8 | 21.0 |
| May | 33.1 | 21.2 |
| June | 29.8 | 20.1 |
| July | 28.6 | 19.6 |
| August | 28.1 | 19.5 |
| September | 28.6 | 19.5 |
| October | 28.1 | 19.2 |
| November | 26.9 | 17.5 |
| December | 26.2 | 15.4 |

Source: *Climatological Normals (1981-2010) published by IMD, Government of India*

c) Humidity

Based on IMD observations the relative humidity for Bangalore Rural and Ramanagra district is shown below in **Table 3.9**. It can be observed that project region experiences high humidity during months of June to December. Lowest humidity is experienced in the months of March and April. The average relative humidity in IMD Bangalore varies between 49% and 76.5%. Sub-Humid to Humid conditions are observed in the project region.

Table3-9: Relative Humidity based on 1981-2010 Observations

| Month | Relative Humidity (%) | | |
|---------------------------------|-----------------------|-----------|---------------|
| | IMD Bangalore | | |
| | I | II | Average Total |
| January | 86 | 41 | 63.5 |
| February | 76 | 31 | 53.5 |
| March | 70 | 28 | 49 |
| April | 74 | 35 | 54.5 |
| May | 76 | 46 | 61 |
| June | 83 | 62 | 72.5 |
| July | 85 | 65 | 75 |
| August | 86 | 67 | 76.5 |
| September | 85 | 63 | 74 |
| October | 84 | 65 | 74.5 |
| November | 83 | 61 | 72 |
| December | 86 | 54 | 70 |
| Thirty-yearAnnualAverage | 81 | 52 | 66.5 |

Source: *Climatological Normals (1981-2010) published by IMD, Government of India*

1e) Wind Speed and Direction

Wind speed and wind directions have a significant role on the dispersion of atmospheric pollutants and therefore, the air quality of the area. Ground level concentrations for the pollutants are inversely proportional to the wind speed in the down wind direction, while in upwind direction no effect will be observed and in cross wind directions partial effect due to the emission sources is observed.

Based on thirty year climatologically data (1981-2010) the mean wind speed for Bangalore Rural and Ramanagra district is shown in **Table 3.10**. Mean wind speeds are observed to be highest in the months June to August at IMD Bangalore (11.2-12.9 Kmph). The lowest wind speed was observed in the month of November (4.0 Kmph) at IMD Bangalore.

Table 3-10: Mean Wind Speed in Bangalore Rural and Ramanagara district based on 1981-2010 Observations

| Month | Mean Wind Speed (Kmph) |
|----------|------------------------|
| | IMD Bangalore |
| January | 4.5 |
| February | 4.7 |
| March | 5.3 |
| April | 5.7 |
| May | 8.1 |
| June | 12.9 |

| Month | Mean Wind Speed (Kmph) |
|----------------------------|------------------------|
| | IMD Bangalore |
| July | 12.8 |
| August | 11.2 |
| September | 8.1 |
| October | 5.0 |
| November | 4.0 |
| December | 4.5 |
| Thirty year Annual Average | 7.2 |

Source: *Climatological Normals (1981-2010) published by IMD, Government of India*

f) Meteorological data collected at project site

The observations on meteorological parameters were recorded continuously during the month of June 2018 from 11/6/2018 to 28/06/2018. The Meteorological Station was kept free from obstruction to free flow of wind. Meteorological observations on hourly basis were recorded to measure the data of temperature, relative humidity, wind speed, wind direction and rainfall by using meteorological data collection instrument. The annual wind rose of the project area is shown in figure below, it is clearly evident that predominant wind direction is from west side of the project area.

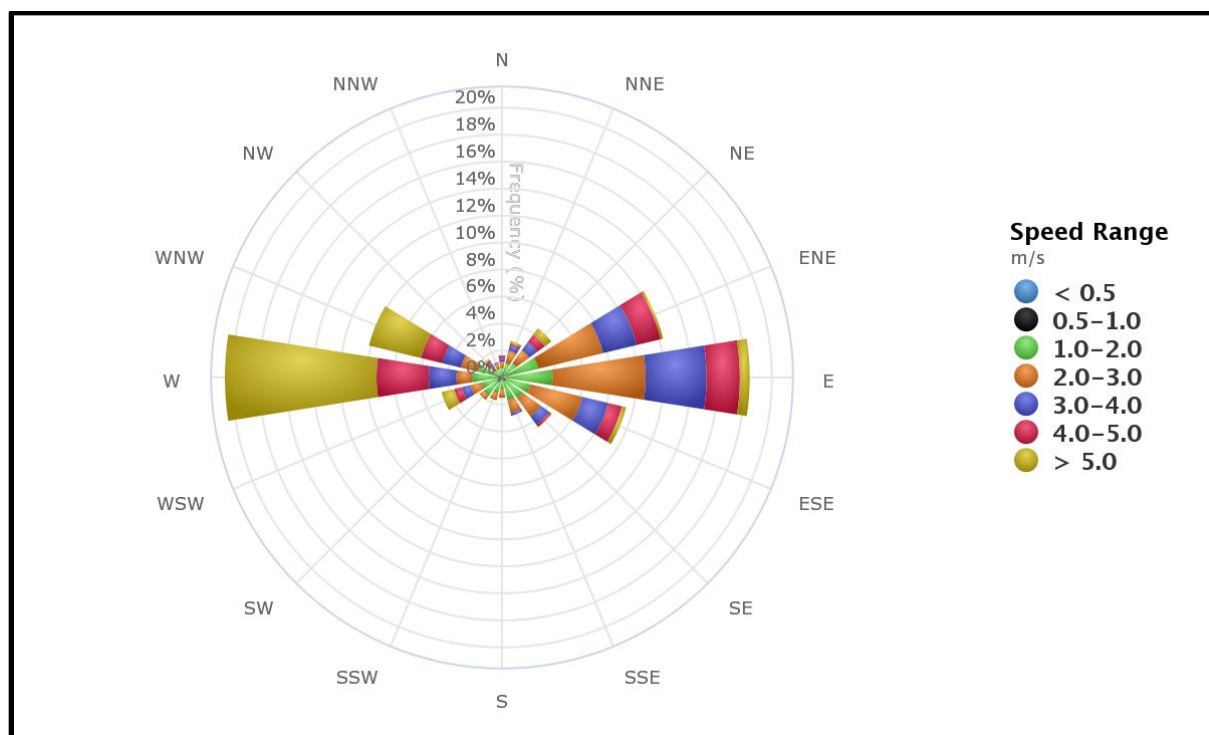


Figure 3-18: Windrose (June, 2018)

3.3.7.2 Ambient Air Quality

Ambient air quality refers to the background air quality levels in a region, characterised by concentrations of various pollutants in the atmosphere. The presence of air pollutants and their concentrations depends on the type of polluting sources, and other factors that influence their flow and dispersion. In most cases vehicular emissions are the predominant source of air pollution. Existing ambient air quality data on various sections of the project corridors was collected to establish a baseline database. The aim was to identify areas that already have

high pollution levels or are expected to experience so, because of the proposed road project, and to design adequate mitigation measures, as applicable.

Ambient air quality standards: Govt. of India’s Air Pollution Control standards, formulated by MoEF & CC, were set in 1981. The statutory bodies that regulate these standards at the central and state levels are the CPCB and the SPCB, respectively. National Ambient Air Quality Standards (NAAQS) for particulate and gaseous pollutants as laid down by the CPCB in year 2009 are given below table:

| S. No. | Pollutant | Time weighted Average | Concentration in air | |
|--------|--|-----------------------|--|---|
| | | | Industrial, residential, rural and other areas | Ecologically sensitive area (notified by Central Govt.) |
| 1. | Sulphur dioxide (SO ₂), µg/m ³ | Annual* | 50 | 20 |
| | | 24 Hours** | 80 | 80 |
| 2. | Nitrogen dioxide (NO ₂), µg/m ³ | Annual* | 40 | 30 |
| | | 24 Hours** | 80 | 80 |
| 3. | Particulate matter PM ₁₀ , µg/m ³ | Annual* | 60 | 60 |
| | | 24 Hours** | 100 | 100 |
| 4. | Particulate matter PM _{2.5} , µg/m ³ | Annual* | 40 | 40 |
| | | 24 Hours** | 60 | 60 |
| 5. | Carbon monoxide (CO), mg/m ³ | 8 Hours** | 02 | 02 |
| | | 1 Hour** | 04 | 04 |

Sample Selection & Monitoring locations

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality-monitoring network and is based on the following considerations:

- Meteorological conditions prevailing in the area;
- Topography of the study area;
- Representatives of background air quality for obtaining baseline status; and
- Representatives of likely impact areas

Ambient air quality monitoring has been under taken at 7 locations with due consideration to the above mentioned points in the months of June, 2018. Following parameters have been measured to prepare the baseline condition:

- Particulate Matter (<PM10)
- Particulate Matter (<PM2.5)
- Sulphur dioxide (SO₂)
- Nitrogen oxide (NO_x)
- Carbon monoxide (CO)

Details of the ambient air quality monitoring locations are given in **Table 3.11** and locations are shown in **Map-3.2** Ambient Air Quality Monitoring Locations (attached as **Annexure-10**).

Table 3-11: Description of Ambient Air Quality Monitoring Locations

| Station Code | Location | Project Area/Study Area | Land Use | Environmental Setting | Co-ordinates of monitoring location |
|--------------|---|-------------------------|------------------|-----------------------|-------------------------------------|
| AAQ1 | Ch. Km 0+000 at NH-648 (NH207) Near Manne Village | Residential | Build-up area | Residential | 13015'08.5"N, 77017'48.1"E |
| AAQ2 | Ch. Km 9+200 at NH-48 (NH-4) near to Junction of Dabaspete | Traffic Junction | Build-up area | Residential | 13013'45.2"N, 77014'31.8"E |
| AAQ3 | Ch. Km 18+500 at SH-3 near to Shivagange Village | Residential | Build-up area | Residential | 13011'05.9"N, 77014'06.5"E |
| AAQ4 | Ch. Km 30+700 at NH-75 (NH-48) near to the Junction of Gudemaranahalli | Traffic Junction | Build-up area | Residential | 13003'51.8"N, 77016'05.2"E |
| AAQ5 | Ch. Km 44+800 at SH-85 near Magadi Taluk | Traffic Junction | Build-up area | Commercial | 12057'25.4"N, 77014'08.1"E |
| AAQ6 | Ch. Km 50+400 Near Kariyana Palya Village (Ecosensitive area) | Residential | Agriculture land | Residential | 12053'33.4"N, 77031'17.3"E |
| AAQ7 | Ch. Km 70+250 at NH-275 Near Madapura Village (Near Ramadevarabetta VS) | Residential | Build-up area | Residential | 12043'57.1"N, 77017'23.8"E |

3.3.7.3 Monitoring Results

The average twice in a week on-site monitoring results are tabulated in the **Table 3.12 & 3.13**. Photographs taken during ambient air quality monitoring sampling are given in **Figure 3.19**.

Table 3-12: Ambient Air Quality Monitoring (Mean Concentrations for PM_{2.5} and PM₁₀)

| Parameters | PM ₁₀ (µg/m ³) - 100 | | | | PM _{2.5} (µg/m ³) - 60 | | | |
|------------|---|----------------|-------|-------|---|----------------|-------|-------|
| | Monitoring Station & Category | No. of Samples | Range | Mean | 98 Percentile | No. of Samples | Range | Mean |
| AAQ1 | 8 | 45.1-64.5 | 55.6 | 59.40 | 8 | 10.1-15.5 | 13.1 | 14.78 |
| AAQ2 | 8 | 60-80 | 79.2 | 87.02 | 8 | 14.6-33.1 | 26.6 | 32.08 |
| AAQ3 | 8 | 30.5-48.7 | 40.0 | 44.10 | 8 | 6.4-11.3 | 9.0 | 11.08 |
| AAQ4 | 8 | 46-68.2 | 56.7 | 63.44 | 8 | 13.1-18.5 | 15.4 | 18.54 |
| AAQ5 | 8 | 37.6-57.7 | 49.7 | 54.23 | 8 | 7.1-14.5 | 10.5 | 14.22 |
| AAQ6 | 8 | 67.1-84.0 | 75.6 | 81.85 | 8 | 11.9-25.8 | 17.3 | 19.17 |
| AAQ7 | 8 | 67-90.2 | 77.9 | 80.44 | 8 | 12.4-43.4 | 20.9 | 30.22 |

Source: Ambient Air Quality Monitoring Report, 2018 by Consultant

Table 3-13: Ambient Air Quality Monitoring-(Mean Concentrations for NO_x, SO₂ and CO)

| Parameters | NO ₂ (µg/m ³)- 80 | | | | SO ₂ (µg/m ³)- 80 | | | | CO (mg/m ³) - 4 | | | |
|------------|--|----------------|-------|-------|--|----------------|-------|------|-----------------------------|----------------|-------|------|
| | Monitoring Station & Category | No. of Samples | Range | Mean | 98 Percentile | No. of Samples | Range | Mean | 98 Percentile | No. of Samples | Range | Mean |
| AAQ1 | 8 | 14.1-24.7 | 16.9 | 23.78 | 8 | 7.2-8.2 | 7.8 | 8.07 | 8 | 0.61-0.85 | 0.72 | 0.84 |
| AAQ2 | 8 | 13.5-21.5 | 17.1 | 18.80 | 8 | 7.1-9.3 | 8.0 | 8.39 | 8 | 0.73-1.05 | 0.86 | 0.91 |
| AAQ3 | 8 | 15.8-23.2 | 18.4 | 19.85 | 8 | 6.5-8.6 | 7.4 | 7.91 | 8 | 0.09-0.48 | 0.22 | 0.32 |
| AAQ4 | 8 | 17.6-20.7 | 19.1 | 20.30 | 8 | 7.5-8.7 | 8.2 | 8.63 | 8 | 0.06-0.36 | 0.12 | 0.19 |
| AAQ5 | 8 | 15.2-20.5 | 17.4 | 18.27 | 8 | 7.2-8.6 | 8.1 | 8.48 | 8 | 0.12-0.43 | 0.26 | 0.40 |
| AAQ6 | 8 | 17.7-28.8 | 20.3 | 24.28 | 8 | 6.6-9.3 | 7.9 | 8.28 | 8 | 0.56-0.89 | 0.71 | 0.82 |
| AAQ7 | 8 | 17.2-21.4 | 19.7 | 21.35 | 8 | 7.3-9.1 | 8.1 | 8.72 | 8 | 0.48-0.79 | 0.64 | 0.72 |

Source: Ambient Air Quality Monitoring Report, 2018 by Consultant.



Figure 3-19: Photographs showing ambient air quality monitoring sampling at project site

3.3.7.4 Results Analysis

The results of ambient air quality in terms of particulate matter (both PM₁₀& PM_{2.5}) in the vicinity of the Greenfield alignment corridor area are found to be much lesser than the prescribed permissible limits of CPCB at all the locations. SO₂, NO₂ and CO levels are also lower and within prescribed permissible limit. These low values of particulate matter near the vicinity of the project side is attributed due to no major activity and low traffic volume plying near the project road.

The results for PM₁₀, PM_{2.5}, SO₂, NO₂ were compared with NAAQS, 2009 for 24hours standard and CO for 8hours

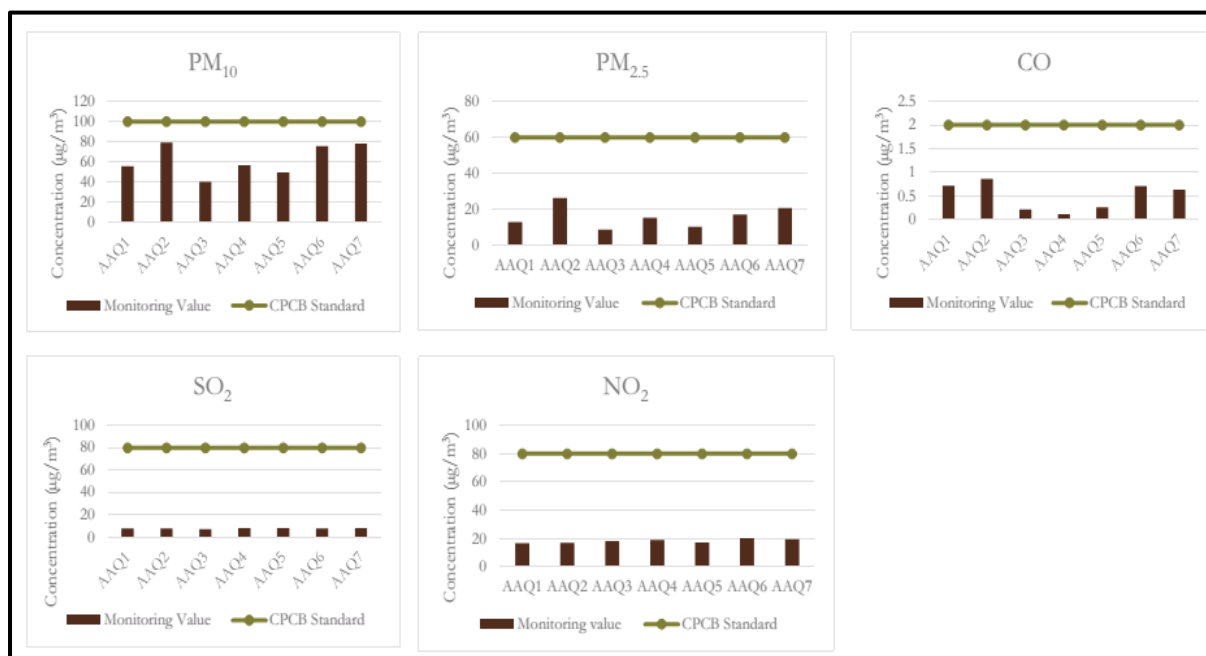


Figure3-20: Graphical Representation of Air Monitoring concentrations at monitoring locations

3.3.7 Noise Environment

The baseline assessment of prevailing noise levels in and around the study area is an important parameter in preparation of impact assessment report. Impact of noise sources on environment depend upon the sources which are generating noise and their respective characteristics. Noise levels are more annoying in the night time particularly in the residential area. The environmental impact of noise can have several effects varying from hearing loss to annoyance depending on loudness of noise levels. In the present study, Sound Pressure Level (SPL) was measured by a sophisticated sound level meter (Integrating Sound Level Meter Cygnet, Model 2031A). Since loudness of sound is important by its effects on people, the dependence of loudness upon frequency must be taken into account in environmental noise assessment. This has been achieved by the use of A-weighting filters in the noise-measuring instrument, which gives a direct reading of approximate loudness.

3.3.7.1 Noise Standards

The Ambient Noise Quality Standards with respect to noise have been stipulated by Govt. of India vide Gazette Notification date. 14.02.2000.

3.3.7.2 Sampling Criteria and Locations

Locations for noise monitoring stations along the project corridor are identified based on the same criteria used for air monitoring but the relative importance of each criteria carries a weighting in arriving at the final set of locations.

Hourly noise levels were recorded at seven locations identified along project roads using sound level meter C-390 (Data logging Sound level meter C-390). Ambient Noise monitoring locations are presented in **Table 3.14** and shown in **Map- 3.3** the of Map Noise Quality Monitoring Station (attached as **Annexure-10**). The hourly noise values were used to calculate day-time and night-time equivalent noise levels. In order to arrive at daytime noise levels, the logarithmic average of hourly values was taken from 6:00 AM to

10:00 PM. The night-time noise levels were derived by taking logarithmic average of hourly values from 10:00 PM to 06:00 AM. The hours of day and night were considered as specified durations for 'day' and 'night' in Noise Rules Published by the MoEF&CC.

Table3-14: Noise Monitoring Locations

| Station Code | Noise Location | Category of Area |
|--------------|---|------------------|
| NQ1 | Km 0.000 at NH-648 (NH207) Near Manne Village | Residential |
| NQ2 | Km 7.100 at SH-3 near Nijgal Kempohalli Village | Residential |
| NQ3 | Km 9.200 at NH-48 (NH-4) near to Junction of Dabaspete | Commercial |
| NQ4 | Km 30.700 at NH-75 (NH-48) near to the Junction of Gudemaranahalli | Residential |
| NQ5 | Km 44.800 at SH-85 near Magadi Taluk | Commercial |
| NQ6 | Km 50.400 Near Kariyana Palya Village (Eco-sensitive area) | Silent Zone |
| NQ7 | Km 70.250 at NH-275 Near Madapura Village (Near Ramadevarabetta VS) | Silent Zone |

3.3.7.3 Ambient Noise Levels in Study Area

The equivalent noise levels at various sampling stations are given in **Table 3.15**. Ambient Noise Monitoring photographs are provided in **Figure 3.21**.

Table3-15:-Recorded Noise Levels at Various Locations

| Station Code | Location | Leq (dB(A)) Day | Leq(dB(A)) Night | Permissible limits as per CPCB standards | | Mean Noise Level(dB (A)) |
|--------------|---|-----------------|------------------|--|---------------|--------------------------|
| | | | | Day (dB(A)) | Night (dB(A)) | |
| NQ1 | Ch. Km 0.000 at NH-648 (NH207) Near Manne Village | 58.30 | 51.80 | 55 | 45 | 55.05 |
| NQ2 | Ch. Km 7.100 at SH-3 near Nijgal Kempohalli Village | 64.88 | 43.34 | 55 | 45 | 54.11 |
| NQ3 | Ch. Km 9.200 at NH-48 (NH-4) near to Junction of Dabaspete | 64.53 | 59.40 | 65 | 55 | 61.96 |
| NQ4 | Ch. Km 30.700 at NH-75(NH-48) near to the Junction of Gudemaranahalli | 53.39 | 46.64 | 55 | 45 | 50.02 |
| NQ5 | Ch. Km 44.800 at SH-85 near Magadi Taluk | 65.79 | 43.92 | 65 | 55 | 54.86 |
| NQ6 | Ch. Km 50.400 Near Kariyana Palya Village (Eco-sensitive area) | 66.63 | 49.25 | 50 | 40 | 57.94 |
| NQ7 | Ch. Km 70.250 at NH-275 Near Madapura Village (Near Ramadevarabetta VS) | 66.23 | 58.11 | 50 | 40 | 62.17 |

Source: Ambient Noise Level Monitoring Report by Consultant



Ch. Km0+000 at NH-648 (NH-207) Near Manne Village



Ch. Km 7+100 at SH-3 near Nijgal Kempohalli Village



Ch. Km 9.200 at NH-48 (NH-4) near to Junction of Dabaspete



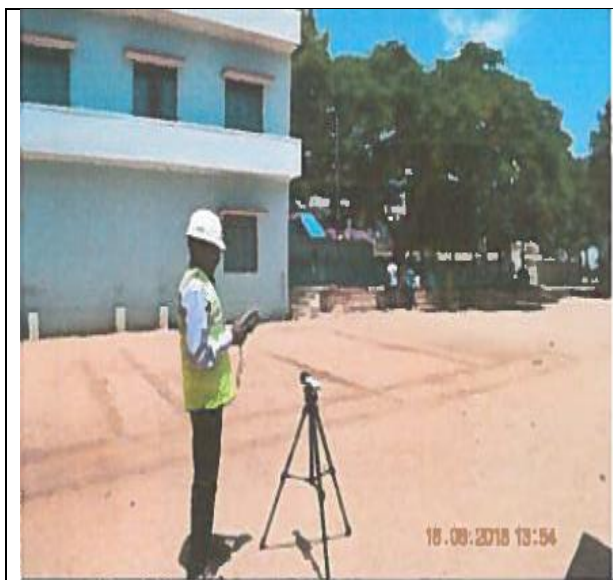
Ch. Km 30.700 at NH-75 (NH-48) near to the Junction of Gudemaranahalli



Ch. Km 44.800 at SH-85 near Magadi Taluk



Ch. Km 50.400 Near Kariyana Palya Village (Eco-sensitive area)

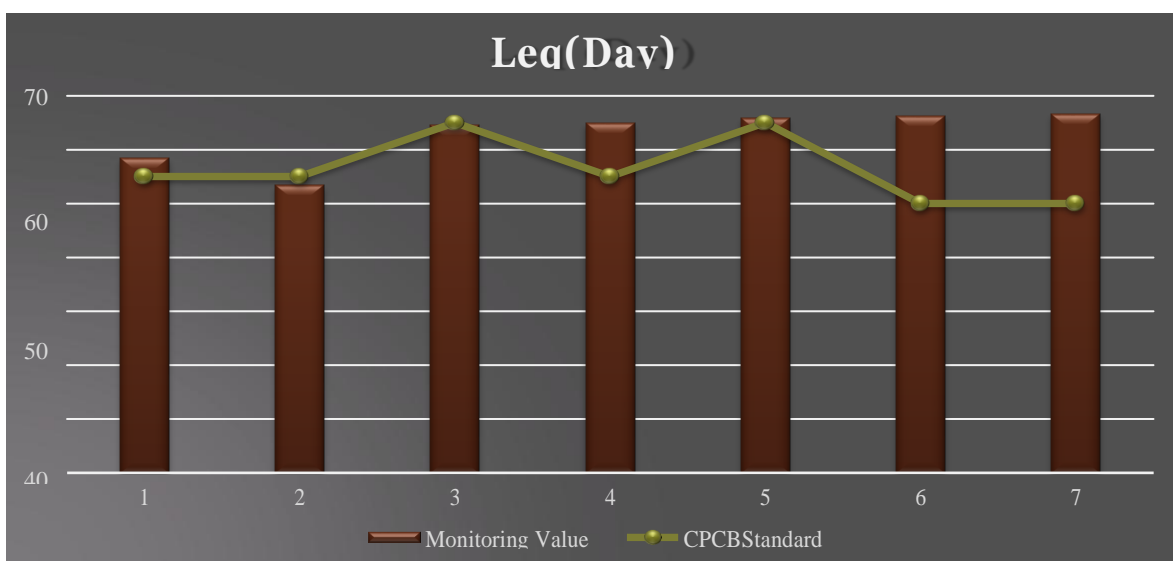


Ch. Km 70.250 at NH-275 Near Madapura Village (Near Ramadevarabetta VS)

Figure3-21: Photographs showing Noise Monitoring Locations at Project Site

Results Analysis

As observed from above monitoring results, the daytime noise levels are in the range of 53.39 dB(A) to 66.63 dBA and the night time noise levels are in the range of 43.34 dB(A) to 59.40 dB(A). The daytime and night time noise levels are exceeding the prescribed limits of CPCB at all silent locations. This is due to the nearby habitation and vehicles plying near to the proposed road. The day and night-time noise levels are found to be higher than the CPCB standards at the maximum locations.



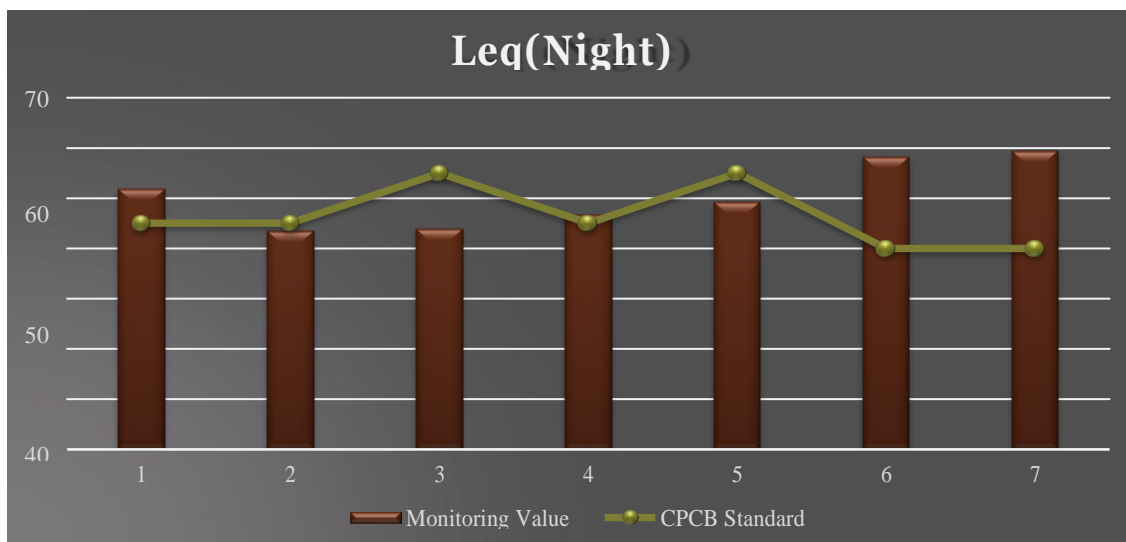


Figure3-22: Recorded Noise Levels in study area

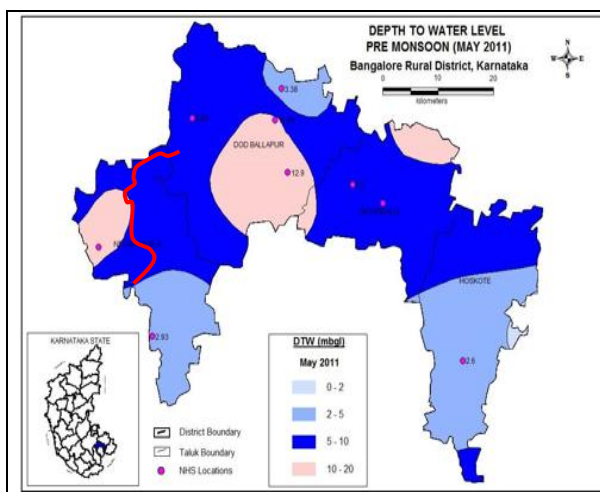
3.3.8 Water Environment

The development of any region is contingent on the availability of sufficient water resources, as developmental activities require water for irrigation, domestic and other purposes.

3.3.8.1 Ground water Hydrology

Bangalore Rural District

The ground water occurs in the open spaces of weathered fractured gneisses and granites. In these rocks the water bearing and yielding properties are primarily due to weathering and fracturing. In the weathered zone, ground water occurs under water table conditions and in the fractured and jointed formations it occurs under semi-confined conditions. In Laterite ground water occurs under phreatic condition. Alluvium along the river courses, though limited in thickness and aerial extent possess substantial ground water potential. **Figure 3.23 and 3.24** shows the pre and post monsoon ground water depths in Bangalore rural district.



Source: Ground water information booklet, Central Ground Water Board, Bangalore Rural district, 2008

Figure 3-23: Pre-Monsoon Ground Water Depth of Bangalore Rural District

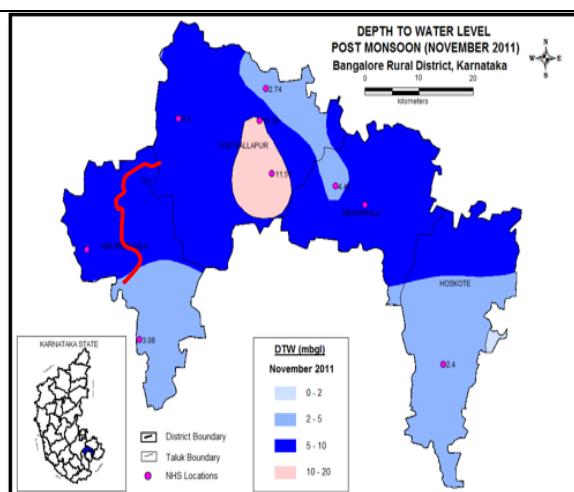
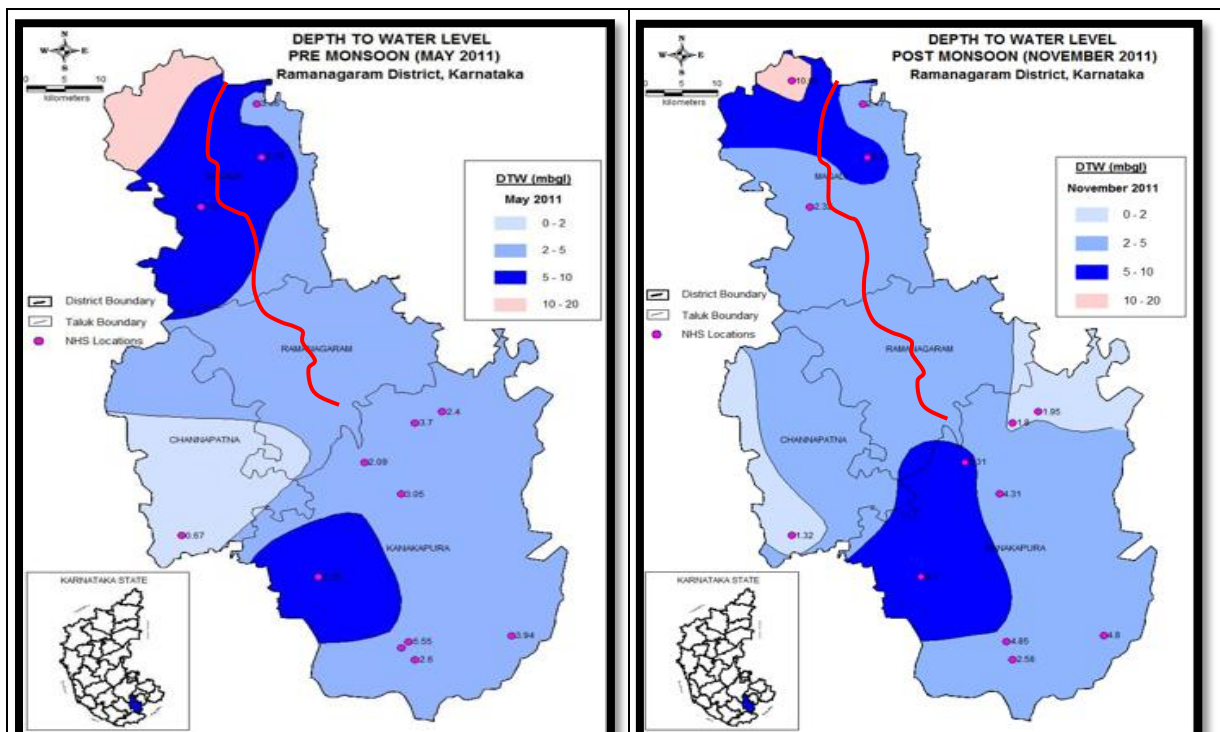


Figure 3-24: Post-Monsoon Ground Water Depth of Bangalore Rural District

Ramanagara District

The entire area of Ramanagara district is part of the Cauvery basin. The major tributaries of the Cauvery river draining the district are Arkavathi and Shimsha rivers. The main drainage of the district is from north to south. The Arkavathi, the Kanva and Shimsha are the important rivers of the district. Arkavathi is a tributary of the river Cauvery and its source is a well in the south western portion of Nandi hills. The Kanva river emerges from the hills to north of Malur in Chanapatna taluk and enters a broad and fertile valley that stretches upto the borders of the district.

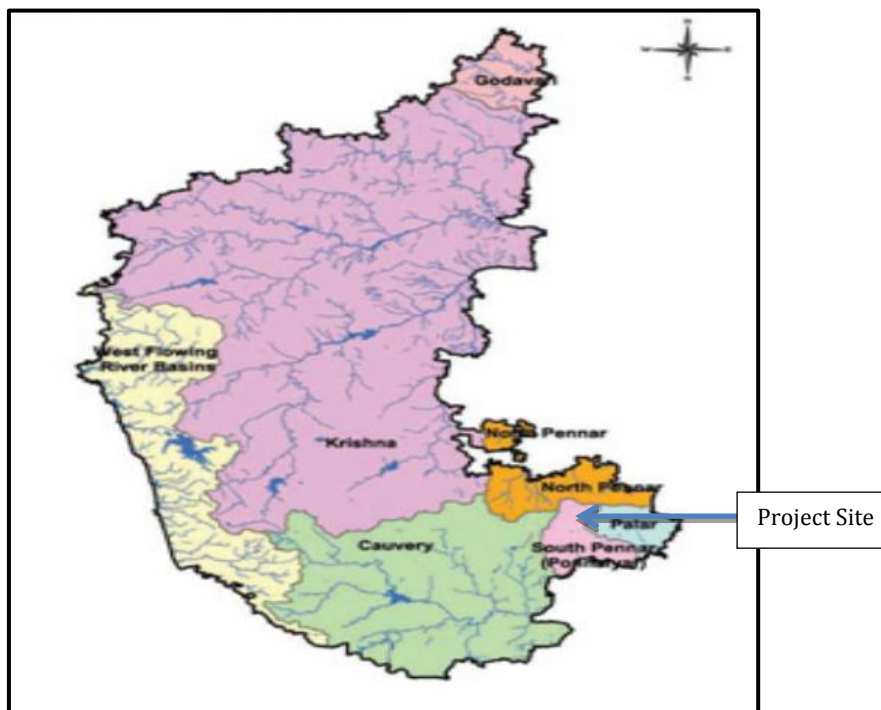


Source: Ground water information booklet, Central Ground Water Board, Ramanagara district, 2013

Figure3-25:Pre-Monsoon Ground water Depth of Ramanagara District

Figure3-26:Post-Monsoon Ground water Depth of Ramanagara District

River Drainage map of Karnataka is given in **Figure3.27**.

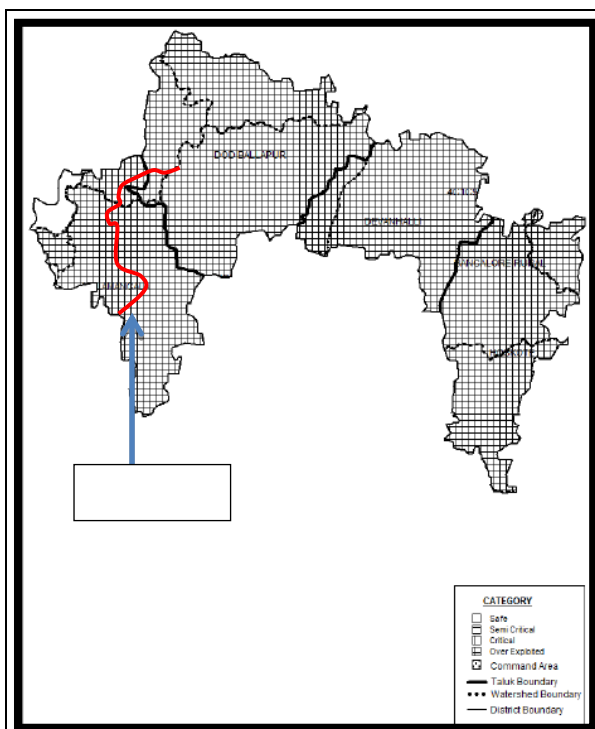


Source:KRSAC

Figure3-27: River Map of Karnataka State

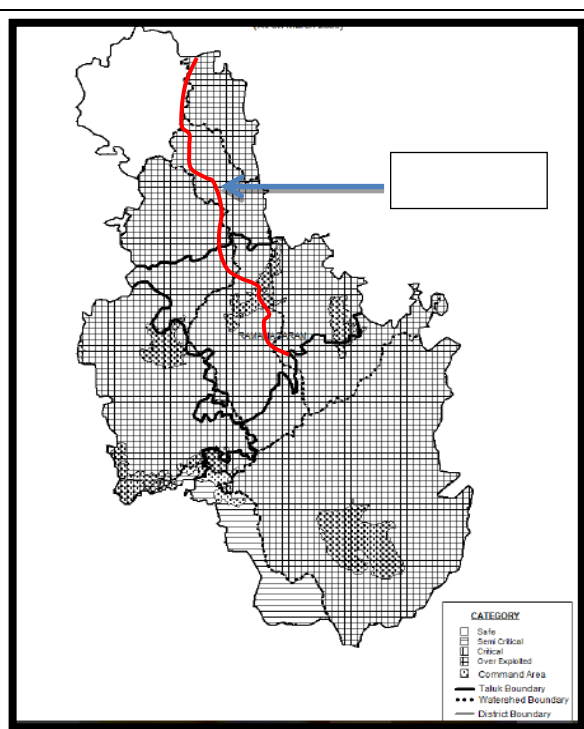
3.3.8.2 Ground Water Resources along the Project Road

Ground water table in the project area varies between 2 mgbl/to 5mgbl. Main source of water in the near by villages is ground water. It was observed during reconnaissance survey and primary field visits that the people of project area mainly use ground water for various purposes.



Source: Ground water information booklet, Central Ground Water Board, Bangalore Rural district, 2013

Figure 3-28: Groundwater Quality Map of Bangalore Rural District



Source: Ground water information booklet, Central Ground Water Board, Ramanagara district, 2013

Figure 3-29: Groundwater Quality Map of Ramanagara District

3.3.8.3 Surface Water Quality

To assess the quality of water in the project area, samples were collected from both surface water bodies. The details of sampling locations for surface water sources are presented in Map Surface Water Quality Location. The Surface Water Sampling Locations are given in **Table 3.16**, respectively and are shown in **Map-3.4** as surface water quality monitoring stations (attached as **Annexure-10**). The analytical results of surface water are given **Table 3.17**.

Field Photographs taken during the sample collection time are shown in **Figure3.30**.

Table3-16: Surface Water Sampling Locations

| Station Code | Location | Source | Co-ordinates of monitoring Location |
|--------------|---------------------------------------|--------|-------------------------------------|
| SWQ1 | Ch. Km 3+000 near Manne Village | Pond | 13°14'53.8"N 77°17'34.2"E |
| SWQ2 | Ch. Km 18+500 near Baswapatna Village | Pond | 13°09'37.2"N 77°14'31.5"E |
| SWQ3 | Ch. 65+500 near Akravati River | River | 12°47'12.32"N 77°18'23.42"E |
| SWQ4 | Ch. 78+500 near Akravati River | River | 12°41'50.17"N 77°18'0.20"E |

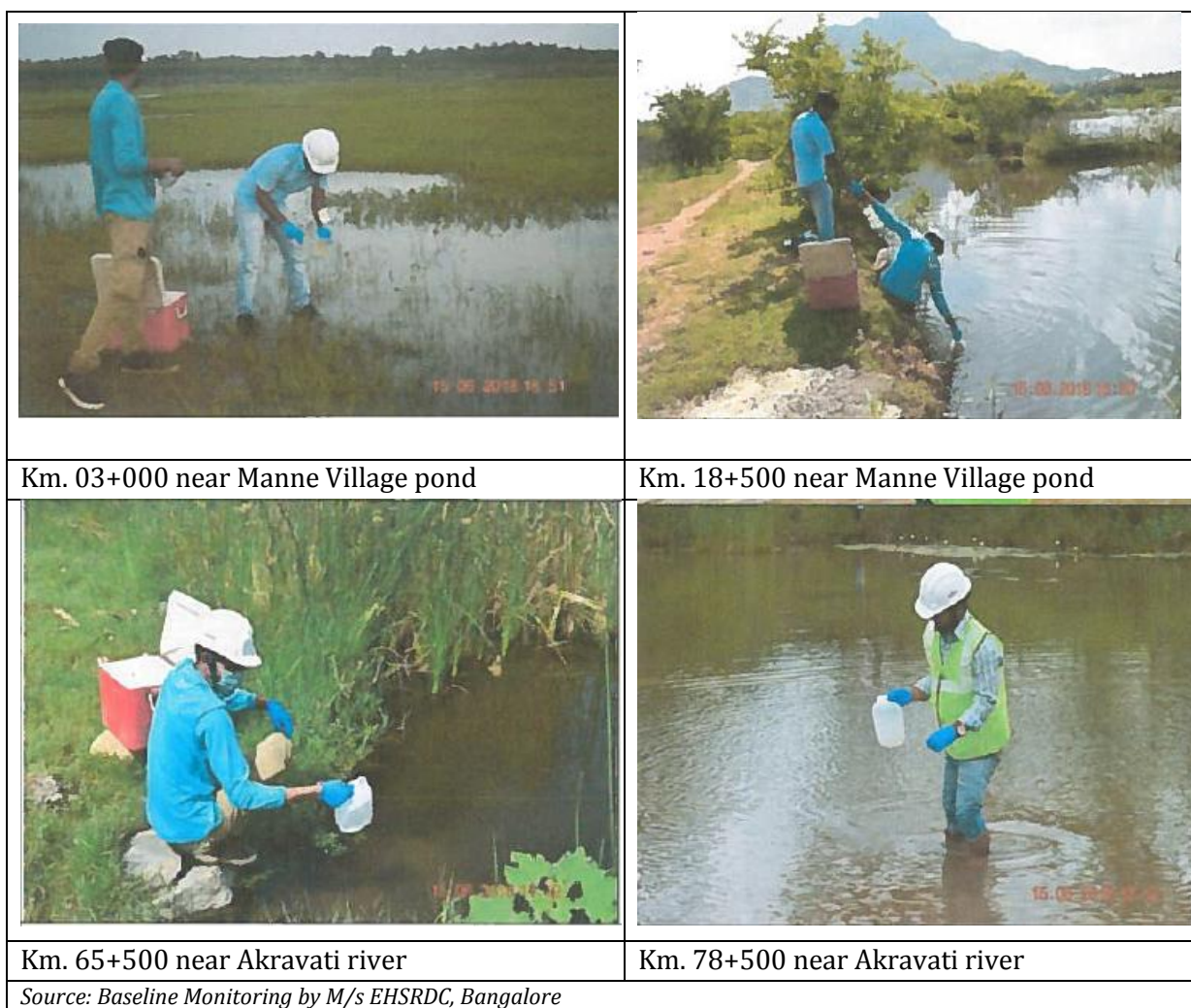


Figure 3-30: Photographs Showing Water Quality Sampling at Project Site

Table3-17: Results of Surface Water Quality Analysis

| Sl.No. | Parameters | Unit | Water Quality Criteria As per CPCB Guidelines | | | | | SWQ1 | SWQ2 | SWQ3 | SWQ4 | Test Methods |
|--------|-----------------------------|-------|---|---|-----------|------|------|-----------|-----------|-----------|-----------|--------------------|
| | | | A | B | C | D | E | | | | | |
| 1. | pH | - | 6.5-8.5 | | | | | 7.88 | 7.87 | 8.25 | 8.01 | APHA4500H+B |
| 2. | Turbidity | NTU | - | | 3.69 | - | - | 21.60 | 2.65 | 0.76 | 1.70 | APHA2130B |
| 3. | Temperature | OC | - | | 25 | - | - | 25.0 | 25.0 | 25.0 | 25.0 | APHA2550B |
| 4. | Conductivity | µS/cm | - | | 340 | 1000 | 2250 | 130.6 | 105.4 | 960 | 852 | APHA2510B |
| 5. | Colour | Hazen | 10 | | <1 | - | - | <1 | <1 | <1 | <1 | IS3025(Part4):1983 |
| 6. | Odour | -- | - | | Agreeable | - | - | Agreeable | Agreeable | Agreeable | Agreeable | IS3025(Part5):1983 |
| 7. | Total Dissolved Solids | mg/L | 500 | | 1500 | - | 2100 | 116.0 | 85.0 | 750 | 559 | APHA2540C |
| 8. | Suspended Solids | mg/L | - | | - | - | - | 16.0 | 14.0 | 8.0 | 6.0 | APHA2540D |
| 9. | BOD(3Days@27°C) | mg/L | 2 | | 3 | - | - | 8.0 | 8.2 | 6.0 | 6.2 | APHA5210B |
| 10. | Chemical Oxygen Demand | mg/L | - | | - | - | - | 44.0 | 48 | 44.0 | 32.0 | APHA5220B |
| 11. | Dissolved Oxygen | mg/L | 6 | | 4 | 4 | - | 5.1 | 4.8 | 5.2 | 5.2 | APHA4500-O |
| 12. | Total Kjeldahl Nitrogen | mg/L | - | | - | - | - | 1.49 | 1.30 | 4.48 | 1.49 | APHA4500-NorgB |
| 13. | Ammonical Nitrogen | mg/L | - | | - | - | - | 0.74 | 0.56 | 3.92 | 0.93 | APHA4500-NH3BC |
| 14. | Total Hardness | mg/L | - | | - | - | - | 42.0 | 27.0 | 240.0 | 200.0 | APHA2340C |
| 15. | Total Alkalinity | mg/L | - | | - | - | - | 58.0 | 36.5 | 232 | 196 | APHA2320B |
| 16. | Sodium | mg/L | - | | - | - | - | 8.0 | 7.4 | 140 | 90 | APHA3500-NaB |
| 17. | Potassium | mg/L | - | | - | - | - | 0.40 | 1.6 | 3.2 | 2.0 | APHA3500-K |
| 18. | Magnesium | mg/L | - | | - | - | - | 3.40 | 2.06 | 24.3 | 28.18 | APHA3500MgB |
| 19. | Calcium as Ca | mg/L | - | | - | - | - | 11.20 | 7.4 | 56.0 | 33.6 | APHA3500-Ca |
| 20. | Ammonia | mg/L | - | - | - | 1.2 | - | 0.14 | 0.40 | 0.88 | 0.04 | APHA4500-NH3F |
| 21. | Chloride as Cl | mg/L | 250 | - | 600 | - | 600 | 3.47 | 8.68 | 198.52 | 133.00 | APHA4500-CIB |
| 22. | Sulphate as SO ₄ | mg/L | 400 | - | 400 | - | 1000 | 10.18 | 6.82 | 23.72 | 17.39 | APHA4500-SO42-E |

| Sl.No. | Parameters | Unit | Water Quality Criteria As per CPCB Guidelines | | | | | SWQ1 | SWQ2 | SWQ3 | SWQ4 | Test Methods |
|--------|---------------------------|----------------|---|-----|------|---|---|---------|---------|-------|-------|---------------------------|
| | | | A | B | C | D | E | | | | | |
| 23. | Phosphate | mg/L | - | - | - | - | - | BDL | 0.11 | 2.12 | 0.21 | APHA4500-PD |
| 24. | Nitrateas NO ₃ | mg/L | 20 | - | 50 | - | - | 10.47 | 5.79 | 8.84 | 2.99 | APHA4500-NO3E |
| 25. | Fluorideas F | mg/L | 1.5 | 1.5 | 1.5 | - | - | BDL | 0.12 | 0.75 | 1.04 | APHA4500FD |
| 26. | Anionic Detergents | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | APHA5540C |
| 27. | Total Iron as Fe | mg/L | 0.3 | - | 50 | - | - | 3.044 | 1.385 | 0.123 | 0.498 | APHA3500-FeB |
| 28. | Copper as Cu | mg/L | 1.5 | - | 1.5 | - | - | 0.005 | 0.004 | 0.003 | 0.003 | IS3025(Part2):2004RA2014 |
| 29. | Zinc as Zn | mg/L | 15 | - | 15 | - | - | 0.013 | 0.031 | 0.008 | 0.010 | IS3025(Part2):2004RA2014 |
| 30. | Arsenic as As | mg/L | 0.05 | 0.2 | 0.2 | - | - | BDL | BDL | BDL | BDL | IS3025(Part2):2004RA2014 |
| 31. | Selenium as Se | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | IS3025(Part2):2004RA2014 |
| 32. | Mercury as Hg | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | IS3025(Part48):1994RA2014 |
| 33. | Lead as Pb | mg/L | 0.1 | - | 0.1 | - | - | 0.003 | 0.003 | BDL | BDL | IS3025(Part2):2004RA2014 |
| 34. | Manganese as Mn | mg/L | - | - | - | - | - | 0.077 | 0.116 | 0.236 | 0.075 | IS3025(Part2):2004RA2014 |
| 35. | Total Chromium | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | IS3025(Part2):2004RA2014 |
| 36. | Phenolic Compounds | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | APHA5530C |
| 37. | Cadmium as Cd | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | IS3025(Part2):2004RA2014 |
| 38. | Oil & Grease | mg/L | - | - | - | - | - | BDL | BDL | BDL | BDL | APHA5520B |
| 39. | Total Coliform | MPNIndex/100ml | 50 | 500 | 5000 | - | - | 170x103 | 220x104 | 430 | 350 | APHA9221A,B,C,D,E&F:2012 |
| 40. | Faecal Coliform | MPNIndex/100ml | - | - | - | - | - | 31x103 | 38x104 | 94 | 79 | APHA9221A,B,C,D,E&F:2012 |

Source: Surface Water Quality analysis report, 2018 by Consultant

Surface Water-Results Analysis:

As stated in above section the surface water samples from four locations were collected and analysed. It was found that the pH concentration of surface water varies from 7.87 to 8.25, total dissolved solids (TDS) from 85.0-750, sulphate varies from 6.82 - 23.72 mg/l, fluoride concentration from 0.12 - 1.04 mg/l, total hardness concentration from 27.0 - 240.0 mg/l, dissolved oxygen (DO) concentration was found between 4.8 - 5.2 mg/l. Biochemical oxygen demand (BOD) concentration of surface water was found between 6.0 - 8.2 mg/l while chemical oxygen demand (COD) of the same varies from 32.0 - 48 mg/l.

The Faecal and Total coliforms were present in surface water of the project area. The concentration of all other parameters is found to be well within the CPCB Standards at all monitoring locations of surface water.

The surface water quality of the project area is within the limit except for all four locations BOD and COD levels were high then the CPCB limits of surface water.

Therefore, the water quality criteria of study area falls in the range of Class B-E water prescribed by CPCB (as per the overall result) and hence recommended for Irrigation, Industrial cooling, Controlled waste Disposal.

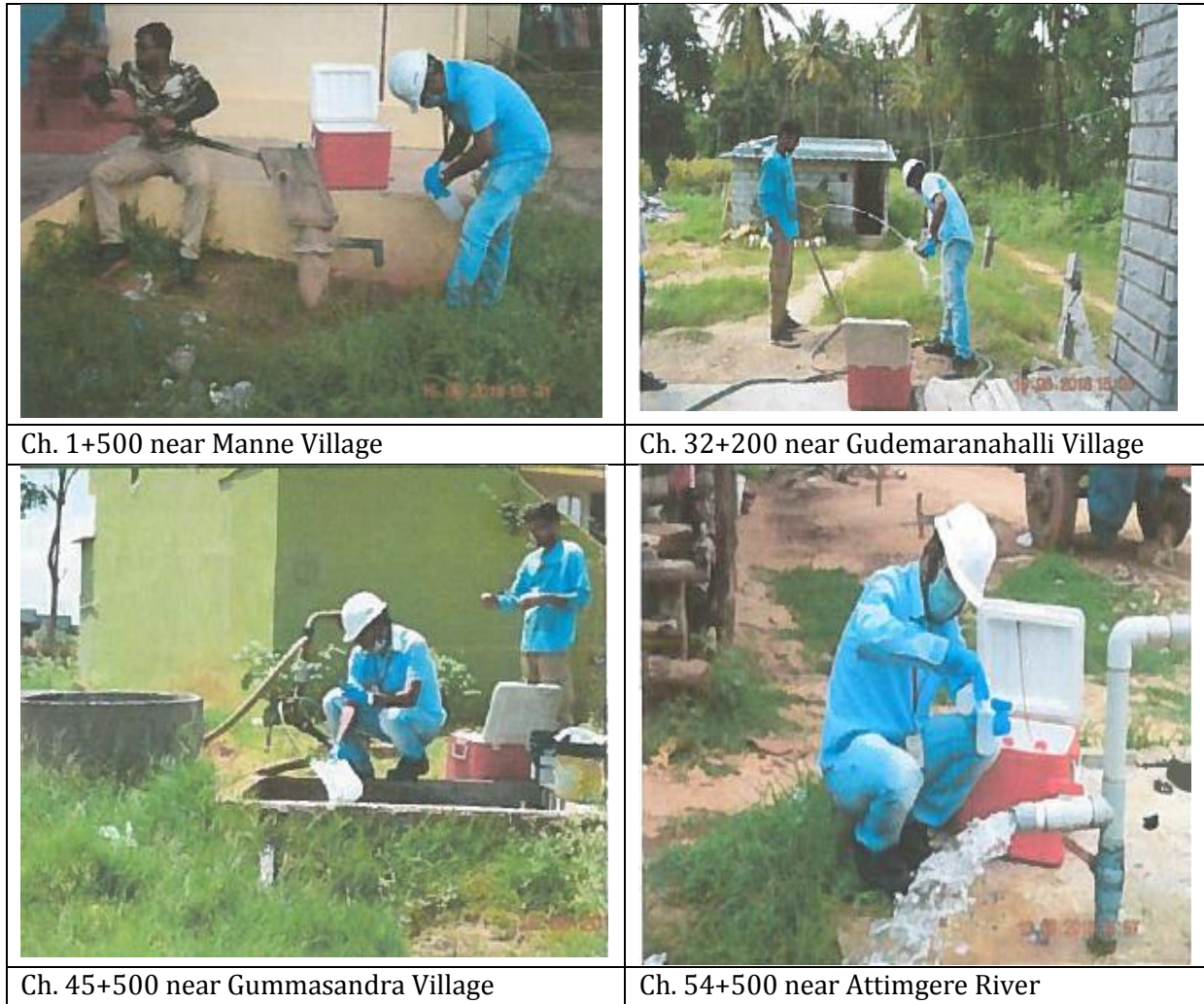
3.3.8.4 Ground Water

A number of ground water sources like hand pumps and tube wells exist along the project road. Four (4)nos. of sampling locations were identified and monitored to assess the ground water quality along the project road as given **Table 3.18** and location were shown in **Map-3.5** as ground water quality monitoring stations (attached as **Annexure - 10**). Monitoring results of ground water quality is presented in **Table3.19**.

Field Photographs taken during the sample collection time are shown in **Figure 3.31**.

Table3-18: GroundWater Sampling Locations

| Station Code | Location | Source | Co-ordinates of monitoring location |
|--------------|--|--------------------|-------------------------------------|
| GWQ1 | Ch.1+500 near Manne Village | Handpump | 13°15'28.11"N 77°17'69.67"E |
| GWQ2 | Ch.32+200 near Gudemaranahalli Village | Groundwater Supply | 13°03'16.5"N 77°15'53.90"E |
| GWQ3 | Ch.45+500 near Gummasandra Village | Well | 12°56'48.72"N 77°14'15.00"E |
| GWQ4 | Ch.54+500 near Attimgere River | Groundwater Supply | 12°52'28.2"N 77°17'00.12"E |



Source: Base line Monitoring by M/s Consultant

Figure 3-31: Photographs Showing Water Quality Sampling at Project Site

Table3-19: Results of GroundWater Quality Analysis, 2018

| S.No. | Parameter | Units | Test Method | GWQ-1 | GWQ-2 | GWQ-3 | GWQ-4 | Limits as per IS 10500 : 2012 | |
|-------|---------------------------|-------|------------------------|-----------|-----------|-----------|-----------|--------------------------------|---|
| | | | | | | | | Requirement (Desirable Limits) | Permissible Limits in the Absence of Alternate Source |
| 1 | pH at 25 oC | -- | IS 3025 (Part 11) 1983 | 7.43 | 8.15 | 8.11 | 8.04 | 6.5-8.5 | No relaxation |
| 2 | Temperature at Site | oC | IS 3025 (Part 9) 1984 | 25 | 25 | 25 | 25 | -- | -- |
| 3 | Turbidity | NTU | IS 3025 (Part 10) 1984 | 0.4 | 0.38 | 0.1 | 0.35 | 1 | 5 |
| 4 | Conductivity at 25oC | µs/cm | IS 3025 (Part 14) 1984 | 977 | 1732 | 650 | 782 | -- | -- |
| 5 | Color | Hazen | IS 3025 (Part 4) 1983 | <01 | <01 | <01 | <01 | 5 | 15 |
| 6 | Odor | -- | IS 3025 (Part 5) 1983 | Agreeable | Agreeable | Agreeable | Agreeable | Agreeable | Agreeable |
| 7 | Total Dissolved Solids | mg/L | IS 3025 (Part 16) 1984 | 674 | 1310 | 453 | 575 | 500 | 2000 |
| 8 | Total Suspended Solids | mg/L | IS 3025 (Part 17) 1984 | BDL | BDL | BDL | BDL | -- | -- |
| 9 | Chemical Oxygen Demand | mg/L | IS 3025 (Part 58) 2006 | BDL | BDL | BDL | BDL | -- | -- |
| 10 | Biochemical Oxygen Demand | mg/L | IS 3025 (Part 44) 1993 | BDL | BDL | BDL | BDL | -- | -- |
| 11 | Dissolved Oxygen | mg/L | IS 3025 (Part 38) 1989 | 5.3 | 5.1 | 4.8 | 5.2 | -- | -- |
| 12 | Total Kjehldal Nitrogen | mg/L | IS 3025 (Part 34) 1988 | 1.3 | 1.68 | 1.3 | 1.3 | -- | -- |
| 13 | Nitrogen | mg/L | IS 3025 (Part 34) 1988 | 0.74 | 0.74 | 0.74 | 0.74 | -- | -- |
| 14 | Total Hardness as CaCO3 | mg/L | IS 3025 (Part 21) 2009 | 228 | 540 | 160 | 212 | 200 | 600 |
| 15 | Alkalinity as CaCO3 | mg/L | IS 3025 (Part 23) 1986 | 276 | 328 | 256 | 272 | 200 | 600 |
| 16 | Potassium as K | mg/L | IS 3025 (Part 45) 1993 | 8 | 2 | 0.8 | 1.2 | -- | -- |
| 17 | Sodium as Na | mg/L | IS 3025 (Part 45) 1993 | 56 | 132 | 56 | 56 | -- | -- |
| 18 | Calcium as Ca | mg/L | IS 3025 (Part 40) 1991 | 57.6 | 2 | 44.8 | 60.8 | 75 | 200 |
| 19 | Magnesium as Mg | mg/L | IS 3025 (Part 46) 1994 | 20.41 | 147.2 | 11.66 | 14.58 | 30 | 100 |
| 20 | Ammonia as N | mg/L | IS 3025 (Part 34) 1988 | 0.03 | 41.79 | 0.05 | 0.06 | 0.5 | No relaxation |

| S.No. | Parameter | Units | Test Method | GWQ-1 | GWQ-2 | GWQ-3 | GWQ-4 | Limits as per IS 10500 : 2012 | |
|-------|------------------------------|-------|------------------------------------|-------|--------|--------|--------|--------------------------------|---|
| | | | | | | | | Requirement (Desirable Limits) | Permissible Limits in the Absence of Alternate Source |
| 21 | Chloride as Cl | mg/L | IS 3025 (Part 32) 1984 | 77.42 | 244.17 | 29.77 | 41.68 | 250 | 1000 |
| 22 | Sulphate as SO ₄ | mg/L | IS 3025 (Part 24) 1986 | 52.19 | 96.09 | 32.42 | 59.61 | 200 | 400 |
| 23 | Phosphate as PO ₄ | mg/L | IS 3025 (Part 31) 1988 | 0.71 | 0.07 | 0.06 | BDL | -- | -- |
| 24 | Nitrate as NO ₃ | mg/L | IS 3025 (Part 34) 1988 | 9.07 | 66.04 | 3.45 | 5.75 | 45 | No relaxation |
| 25 | Fluoride as F | mg/L | APHA 23rd Edn:2017 - 4500F B, D | 0.71 | 0.87 | 1.01 | 0.87 | 1 | 1.5 |
| 27 | Iron as Fe | mg/L | IS 3025 (Part 53) 2003 | 0.693 | 0.106 | 0.066 | 0.093 | 0.3 | No relaxation |
| 28 | Copper as Cu | mg/L | IS 3025 (Part 42) 1992 | 0.014 | 0.005 | 0.005 | 0.005 | 0.05 | 1.5 |
| 29 | Zinc as Zn | mg/L | IS 3025 (Part 49) 1994 | 3.133 | 0.087 | 0.117 | 0.093 | 5 | 15 |
| 30 | Arsenic as As | mg/L | IS 3025 (Part-37) 1988 | BDL | BDL | BDL | BDL | 0.01 | 0.05 |
| 31 | Selenium as Se | mg/L | IS 3025 (Part 2) 2004 | BDL | BDL | BDL | BDL | 0.01 | No relaxation |
| 32 | Mercury as Hg | mg/L | IS 3025(Part-48) 1994 | BDL | BDL | BDL | BDL | 0.001 | No relaxation |
| 33 | Lead as Pb | mg/L | IS 3025 (Part 47) 1994 | BDL | BDL | BDL | BDL | 0.01 | No relaxation |
| 34 | Manganese as Mn | mg/L | APHA 23rd Edn:2017, 3111-B | 20.41 | 0.01 | BDL | 0.332 | 0.1 | 0.3 |
| 35 | Chromium as Cr | mg/L | IS 3025 (Part 52) 2003 | BDL | BDL | BDL | BDL | 0.05 | No relaxation |
| 37 | Cadmium as Cd | mg/L | IS 3025 (Part 41) 1992 | BDL | BDL | <0.001 | <0.001 | 0.003 | No relaxation |

Ground Water-Results Analysis:

As stated in above section the Ground water samples from four locations were collected and analysed. The analysis shows that round water samples had pH ranging from 7.43 to 8.15. Colour was within permissible limits. Most of the heavy metals were found to be below detectable limits, concentration of Lead at all locations was found to be below detectable limits.

The pH concentration of Ground water was found varying from 7.43 to 8.15, total dissolved solids (TDS) varies from 453–1310, calcium concentration from 2.0 - 60.8, magnesium concentration varies from 11.66 - 147.2, Sulphate concentration varies from 32.42 - 96.09, fluoride concentration varies from 0.71 - 1.01. Total hardness concentration was found from 160 -540. Hardness is generally caused by the Ca and Mg ions present in water.

The dissolved oxygen (DO) concentration of Ground water varies from 4.8–5.3, the Biochemical oxygen demand (BOD) concentration of Ground water below detectable limit (BDL) and chemical oxygen demand (COD) concentration of Ground water is also below detectable limit (BDL). The concentration of all other parameters is found to be well within the IS:10500 limits at all monitoring locations of Ground water except Magnesium concentration of GWQ1.

In general ground water quality of project area is good except for few parameters, also quality of ground water for location GW1 to GW4 are fit for drinking.

Monitoring reports of air, noise, soil and surface & ground water are attached as **Annexure-11**.

3.4 BIOLOGICAL ENVIRONMENT

Biological resources are among the most important resources impacted by the road projects. A detailed baseline study of the ecological resources is essential to estimate the magnitude of potential impacts and to avoid or mitigate any loss caused by the proposed project. In this section baseline, details of the flora and fauna of the project area are presented.

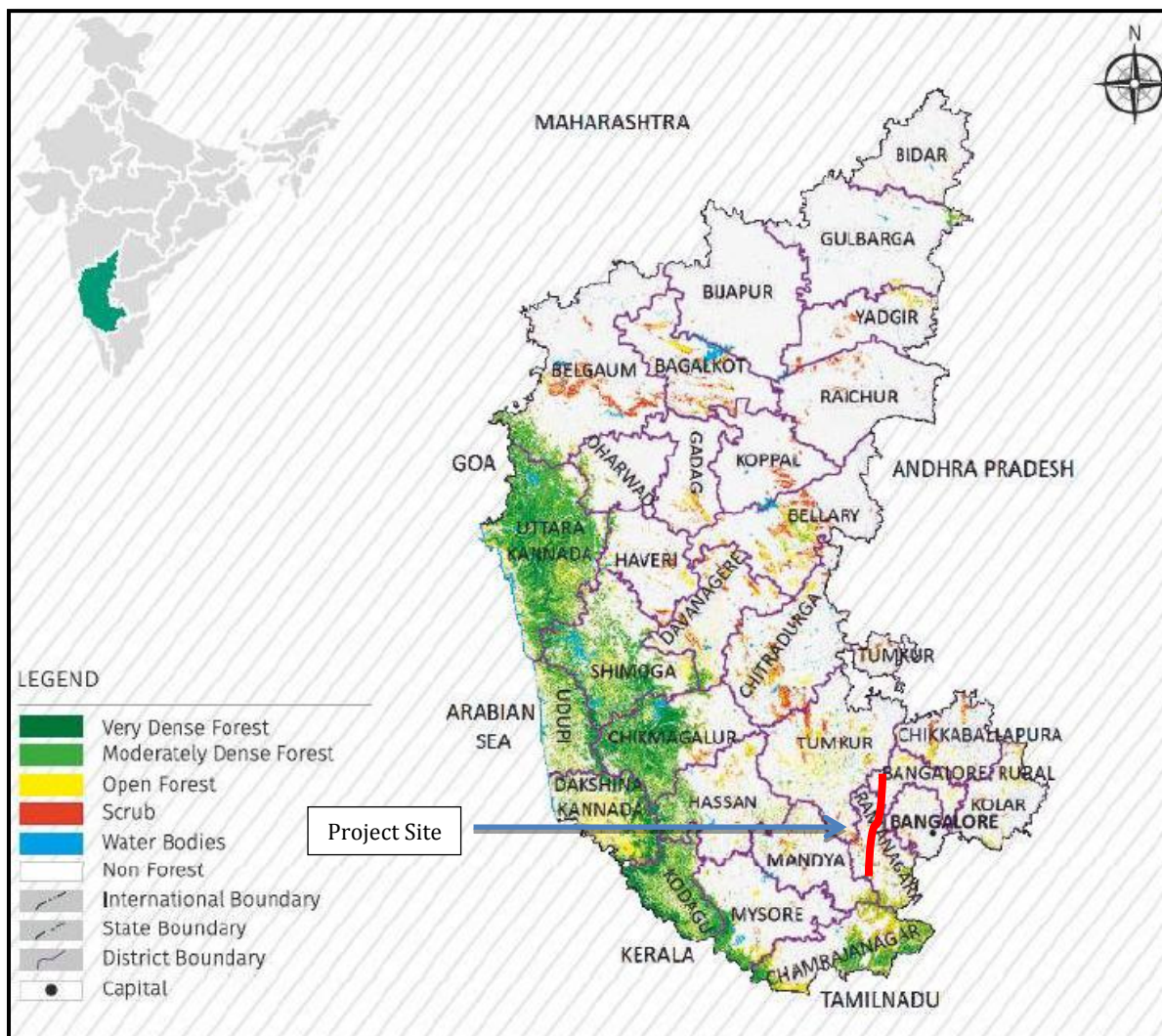
3.4.1 Forest Eco system

As per India State of Forest Report, 2017, the recorded forest area in Karnataka is 37,550 km², which is 19.58% of the geographical area of the state.

The forest cover in the concerned project districts in year 2017 as per Ministry of Environment and Forests, Government of India is given in **Table 3.20** and the forest cover map of Karnataka are shown in **Figure 3.32**.

Table3-20: Forest Cover in Project District (area in sq.km.)

| District | Geographical Area | Very dense forest | Mod. Dense forest | Open Forest | Total | % of G.A. |
|-----------------|-------------------|-------------------|-------------------|-------------|-------|-----------|
| Bangalore Rural | 2,298 | 0 | 16 | 99 | 115 | 5.00 |
| Ramanagara | 3,516 | 0 | 190 | 421 | 611 | 17.38 |



Source: India State of Forest Report, 2017

Figure3-32: Forest cover map of Karnataka showing Project Road

3.4.2 Type of Forest in the study area

The forests of Bangalore rural and Ramanagara division primarily consist of deciduous species topping thorny undergrowth. The trees rarely attain any great size. Nearly 70% of the forest belongs to tropical thorn forest and the rest to different types of tropical dry scrub to deciduous forests.

3.4.3 Involvement of forest land in project roads

The proposed project does not involve any diversion of forest land.

3.4.4 Protected Areas

There is no protected area (National Park, Wildlife Sanctuary, reserved forest, biosphere reserve, and wetland) within the ROW of project road. However, Ramadevarabetta Vulture Sanctuary is approximately 1.2 km away from the project road, whereas ESZ of Ramadevarabetta Vulture Sanctuary is 200 m away. There are no endangered species (IUCN Red list of threatened species) found in the project area.

3.4.5 Road side Trees:

A tree inventory of the existing tree species on the project alignment has been prepared. Acacia, Neem, tamarind and thurai etc. are the common species growing in the area of concern. A tree inventory of the existing tree species on the Project alignment has been prepared. A summary of the tree inventory is given in below **Table 3.21**.

Table 3-21: Summary of Tree Enumeration within Corridor of Impact with Girth Size

| Start (km) | End (km) | Number of Trees | | 0-30 | Girth Size (cm) | | | Total |
|------------|----------|-----------------|------------|------|-----------------|-------|----------|-------|
| | | Left Side | Right Side | | 30-60 | 60-90 | Above 90 | |
| 0.000 | 1.000 | 93 | 97 | 175 | 15 | 0 | 0 | 190 |
| 1.000 | 2.000 | 131 | 119 | 208 | 42 | 0 | 0 | 250 |
| 2.000 | 3.000 | 124 | 140 | 160 | 104 | 0 | 0 | 264 |
| 3.000 | 4.000 | 5 | 11 | 6 | 10 | 0 | 0 | 16 |
| 4.000 | 5.000 | 49 | 18 | 39 | 28 | 0 | 0 | 67 |
| 5.000 | 6.000 | 42 | 55 | 30 | 67 | 0 | 0 | 97 |
| 6.000 | 7.000 | 103 | 91 | 136 | 57 | 1 | 0 | 194 |
| 7.000 | 8.000 | 187 | 85 | 184 | 88 | 0 | 0 | 272 |
| 8.000 | 9.000 | 162 | 165 | 209 | 118 | 0 | 0 | 327 |
| 9.000 | 10.000 | 107 | 188 | 188 | 107 | 0 | 0 | 295 |
| 10.000 | 11.000 | 57 | 55 | 79 | 32 | 1 | 0 | 112 |
| 11.000 | 12.000 | 102 | 132 | 136 | 95 | 3 | 0 | 234 |
| 12.000 | 13.000 | 28 | 11 | 27 | 12 | 0 | 0 | 39 |
| 13.000 | 14.000 | 126 | 143 | 227 | 41 | 1 | 0 | 269 |
| 14.000 | 15.000 | 61 | 124 | 149 | 36 | 0 | 0 | 185 |
| 15.000 | 16.000 | 51 | 85 | 93 | 43 | 0 | 0 | 136 |
| 16.000 | 17.000 | 59 | 69 | 64 | 64 | 0 | 0 | 128 |
| 17.000 | 18.000 | 129 | 149 | 167 | 110 | 1 | 0 | 278 |
| 18.000 | 19.000 | 157 | 140 | 242 | 55 | 0 | 0 | 297 |
| 19.000 | 20.000 | 20 | 15 | 21 | 14 | 0 | 0 | 35 |
| 20.000 | 21.000 | 52 | 47 | 65 | 30 | 4 | 0 | 99 |
| 21.000 | 22.000 | 70 | 74 | 105 | 39 | 0 | 0 | 144 |
| 22.000 | 23.000 | 74 | 60 | 115 | 18 | 1 | 0 | 134 |
| 23.000 | 24.000 | 97 | 78 | 132 | 43 | 0 | 0 | 175 |
| 24.000 | 25.000 | 70 | 75 | 127 | 18 | 0 | 0 | 145 |
| 25.000 | 26.000 | 20 | 17 | 26 | 11 | 0 | 0 | 37 |
| 26.000 | 27.000 | 133 | 83 | 104 | 112 | 0 | 0 | 216 |
| 27.000 | 28.000 | 33 | 37 | 41 | 28 | 1 | 0 | 70 |
| 28.000 | 29.000 | 209 | 238 | 222 | 218 | 7 | 0 | 447 |
| 29.000 | 30.000 | 256 | 280 | 386 | 150 | 0 | 0 | 536 |
| 30.000 | 31.000 | 418 | 404 | 684 | 133 | 5 | 0 | 822 |
| 31.000 | 32.000 | 223 | 232 | 363 | 80 | 12 | 0 | 455 |
| 32.000 | 33.000 | 80 | 58 | 89 | 49 | 0 | 0 | 138 |
| 33.000 | 34.000 | 148 | 180 | 291 | 34 | 3 | 0 | 328 |
| 34.000 | 35.000 | 102 | 126 | 175 | 53 | 0 | 0 | 228 |

| Start (km) | End (km) | Number of Trees | | 0-30 | Girth Size (cm) | | | Total |
|------------|----------|-----------------|------------|------|-----------------|-------|----------|-------|
| | | Left Side | Right Side | | 30-60 | 60-90 | Above 90 | |
| 35.000 | 36.000 | 175 | 170 | 277 | 68 | 0 | 0 | 345 |
| 36.000 | 37.000 | 131 | 136 | 187 | 79 | 1 | 0 | 267 |
| 37.000 | 38.000 | 149 | 133 | 200 | 80 | 2 | 0 | 282 |
| 38.000 | 39.000 | 46 | 150 | 155 | 41 | 0 | 0 | 196 |
| 39.000 | 40.000 | 48 | 56 | 85 | 19 | 0 | 0 | 104 |
| 40.000 | 41.000 | 113 | 70 | 149 | 32 | 2 | 0 | 183 |
| 41.000 | 42.000 | 114 | 54 | 162 | 6 | 0 | 0 | 168 |
| 42.000 | 43.000 | 65 | 74 | 120 | 19 | 0 | 0 | 139 |
| 43.000 | 44.000 | 26 | 14 | 37 | 3 | 0 | 0 | 40 |
| 44.000 | 45.000 | 13 | 21 | 30 | 4 | 0 | 0 | 34 |
| 45.000 | 46.000 | 42 | 20 | 49 | 13 | 0 | 0 | 62 |
| 46.000 | 47.000 | 102 | 107 | 178 | 31 | 0 | 0 | 209 |
| 47.000 | 48.000 | 174 | 197 | 316 | 55 | 0 | 0 | 371 |
| 48.000 | 49.000 | 93 | 122 | 170 | 45 | 0 | 0 | 215 |
| 49.000 | 50.000 | 262 | 269 | 372 | 154 | 5 | 0 | 531 |
| 50.000 | 51.000 | 150 | 169 | 177 | 142 | 0 | 0 | 319 |
| 51.000 | 52.000 | 167 | 113 | 195 | 85 | 0 | 0 | 280 |
| 52.000 | 53.000 | 95 | 114 | 175 | 34 | 0 | 0 | 209 |
| 53.000 | 54.000 | 210 | 207 | 343 | 72 | 2 | 0 | 417 |
| 54.000 | 55.000 | 156 | 137 | 217 | 76 | 0 | 0 | 293 |
| 55.000 | 56.000 | 126 | 133 | 204 | 55 | 0 | 0 | 259 |
| 56.000 | 57.000 | 192 | 135 | 293 | 31 | 3 | 0 | 327 |
| 57.000 | 58.000 | 229 | 173 | 356 | 46 | 0 | 0 | 402 |
| 58.000 | 59.000 | 113 | 105 | 210 | 8 | 0 | 0 | 218 |
| 59.000 | 60.000 | 122 | 124 | 242 | 4 | 0 | 0 | 246 |
| 60.000 | 61.000 | 181 | 225 | 294 | 112 | 0 | 0 | 406 |
| 61.000 | 62.000 | 100 | 74 | 149 | 25 | 0 | 0 | 174 |
| 62.000 | 63.000 | 173 | 228 | 321 | 80 | 0 | 0 | 401 |
| 63.000 | 64.000 | 114 | 110 | 208 | 15 | 1 | 0 | 224 |
| 64.000 | 65.000 | 139 | 181 | 277 | 42 | 1 | 0 | 320 |
| 65.000 | 66.000 | 77 | 111 | 125 | 55 | 8 | 0 | 188 |
| 66.000 | 67.000 | 86 | 92 | 157 | 21 | 0 | 0 | 178 |
| 67.000 | 68.000 | 133 | 121 | 197 | 57 | 0 | 0 | 254 |
| 68.000 | 69.000 | 165 | 116 | 231 | 50 | 0 | 0 | 281 |
| 69.000 | 70.000 | 675 | 225 | 711 | 189 | 0 | 0 | 900 |
| 70.000 | 71.000 | 484 | 753 | 846 | 389 | 2 | 0 | 1237 |
| 71.000 | 72.000 | 122 | 129 | 185 | 66 | 0 | 0 | 251 |
| 72.000 | 73.000 | 243 | 204 | 350 | 96 | 1 | 0 | 447 |
| 73.000 | 74.000 | 306 | 251 | 402 | 155 | 0 | 0 | 557 |
| 74.000 | 75.000 | 160 | 172 | 297 | 35 | 0 | 0 | 332 |
| 75.000 | 76.000 | 157 | 204 | 318 | 43 | 0 | 0 | 361 |
| 76.000 | 77.000 | 147 | 178 | 320 | 5 | 0 | 0 | 325 |

| Start (km) | End (km) | Number of Trees | | 0-30 | Girth Size (cm) | | | Total |
|--------------|----------|-----------------|--------------|--------------|-----------------|-----------|----------|--------------|
| | | Left Side | Right Side | | 30-60 | 60-90 | Above 90 | |
| 77.000 | 78.000 | 206 | 182 | 297 | 91 | 0 | 0 | 388 |
| 78.000 | 79.000 | 213 | 158 | 231 | 138 | 2 | 0 | 371 |
| 79.000 | 80.000 | 123 | 160 | 176 | 107 | 0 | 0 | 283 |
| 80.000 | 81.000 | 148 | 121 | 170 | 99 | 0 | 0 | 269 |
| 81.000 | 82.200 | 119 | 166 | 180 | 105 | 0 | 0 | 285 |
| Total | | 11162 | 11045 | 16806 | 5331 | 70 | 0 | 22207 |

The trees with girth size 30-60cm are 5,331 in number and trees with girth size 60-90 are 70 in number. Altogether, there are 5,401 numbers of trees that falls within the Corridor of Impact. However, trees with less than 30cm girth size have been categorized as poles. The total number of poles is 16,806. Therefore, the total number of trees and poles is 22,207. However, maximum efforts will be given to save the trees especially those which are falling outside the construction zone.

3.4.5.1 Flora

List of Common Floral species found in the project area of Bangalore Rural District are given in **Table 3.22**. List of Common Floral species found in the project area of Ramanagra District is given in **Table 3.23**.

Table 3-22: List of Common Floral species in the project area (Bangalore Rural District)

| S. No. | LocalNames | Botanical Names | Family |
|--------|-----------------|------------------------------|----------------|
| 1 | Kallanamele | <i>Aagri cuneata</i> | Convolvulaceae |
| 2 | Gurugunji | <i>Abruspreparatorius</i> | Fabaceae |
| 3 | ShirmudhreGida | <i>Abutilonindicum</i> | Malvaceae |
| 4 | | <i>Acacia auriculiformis</i> | Mimosaceae |
| 5 | Cachu(Khadira) | <i>Acaciacatechu</i> | Mimosaceae |
| 6 | | <i>Acacia chundra</i> | Mimosaceae |
| 7 | pachali,Belaga | <i>Acaciaconcinna</i> | Mimosaceae |
| 8 | Banni | <i>Acaciaferruginea</i> | Mimosaceae |
| 9 | Kaduseege | <i>Acacia intsia</i> | Mimosaceae |
| 10 | Bilijai,Najbela | <i>Acacia leucophloea</i> | Mimosaceae |
| 11 | Gobli,Karijali | <i>Acacianilotica</i> | Mimosaceae |
| 12 | | <i>Acaciapolycantha</i> | Mimosaceae |
| 13 | | <i>Achras zapota</i> | Sapotaceae |
| 14 | Uthrane | <i>Achyranthesaspera</i> | Amarantaceae |
| 15 | | <i>Adathodavasica</i> | Acanthaceae |
| 16 | Aadusoge | <i>Adenantha pavonina</i> | Caesalpinaceae |
| 17 | Aadusoge | <i>Adinacordifolia</i> | Rubiaceae |
| 18 | Bilpathre | <i>Aeglemarmelos</i> | Rutaceae |
| 19 | | <i>Aeschynomeneindica</i> | Fabaceae |
| 20 | | <i>Agave sisalana</i> | Asparagaceae |
| 21 | Hiremara | <i>Ailanthus excelsa</i> | Simaroubaceae |
| 22 | Ankola | <i>Alangiumlamarckii</i> | Alangiaceae |
| 23 | Sujjalu/Tuggali | <i>Albizziaamara</i> | Mimosaceae |
| 24 | Bage | <i>Albizzialebbek</i> | Mimosaceae |

| | | | |
|----|-------------------|-------------------------------|------------------|
| 25 | Bilwara | <i>Albizziaodoratissima</i> | Mimosaceae |
| 26 | Bellati | <i>Albizziaprocera</i> | Mimosaceae |
| 27 | | <i>Alloteropsiscimicina</i> | Poaceae |
| 28 | Geru | <i>Anacardiumoccidentale</i> | Anacardiaceae |
| 29 | Seethaphala | <i>Anonasquamosa</i> | Annonaceae |
| 30 | Dindiga,Dindlu | <i>Anogeissuslatifolia</i> | Rubiaceae |
| 31 | Arasina | <i>Curcuma longa</i> | Zingiberaceae |
| 32 | Iswareeberuballi | <i>Aristolochiaindica</i> | Aristolochiaceae |
| 33 | Halasu | <i>Artocarpusintegrifolia</i> | Moraceae |
| 34 | Bevu | <i>Azadirachtaindica</i> | Meliaceae |
| 35 | Uppagachi | <i>Azimatetracantha</i> | Salvadoraceae |
| 36 | Bidhiru | <i>Bambusaarundinacea</i> | Poaceae |
| 37 | Kaadumandhara | <i>Bauhiniapurpurea</i> | Caesalpinaceae |
| 38 | Kenchuvala,Achiga | <i>Bauhiniaracemosa</i> | Caesalpinaceae |
| 39 | Arise | <i>Bauhiniavahlii</i> | Caesalpinaceae |
| 40 | Buruga | <i>Bombaxmalabaricum</i> | Bombacaceae |
| 41 | Bilidhupa,Maddi | <i>Boswelliaserrata</i> | Burseraceae |
| 42 | Mulluhonne | <i>Brideliaretusa</i> | Euphorbiaceae |
| 43 | Maradi | <i>Buchananiaangustifolia</i> | Anacardiaceae |

Source: Forest Working Plan of Bangalor Rural Division

List of Common Floral species found in the project area of Ramanagra District:

Table 3-23: List of Common Floral species in the project area (Ramanagara District)

| Sl. No. | Local Name | Botanical Name | Family |
|---------|---------------|------------------------------|------------------|
| 1 | Shathavari | <i>Asparagus recemosus</i> | Asparagaceae |
| 2 | Makali | <i>Decalepishamiltonii</i> | Apocynaceae |
| 3 | Madhunashini | <i>Gymnema sylvestre</i> | Apocynaceae |
| 4 | Bilikare | <i>Limonia acidissima</i> | Rutaceae |
| 5 | Aswagandha | <i>Withania somnifera</i> | Solanaceae |
| 6 | srigandha | <i>Santalum album</i> | Santalaceae |
| 7 | Bilwa | <i>Aegle marmelos</i> | Rutaceae |
| 8 | Guraganji | <i>Abrus precatorius</i> | Fabaceae |
| 9 | Eshwariberu | <i>Aristolochia indica</i> | Aristolochiaceae |
| 10 | Muthuga | <i>Butea monosperma</i> | Fabaceae |
| 11 | Kakke | <i>Cassia fistula</i> | Caesalpinaceae |
| 12 | Nelly | <i>Emblia officinalis</i> | Euphorbiaceae |
| 13 | Vishnukranthi | <i>Evolvulus alsinoides</i> | Convolvulaceae |
| 14 | Gowrigadde | <i>Gloriosa superba</i> | Colchicaceae |
| 15 | Sogadebeeru | <i>Hemidismus indicus</i> | Apocynaceae |
| 16 | Bela | <i>Feronia elephantum</i> | Rutaceae |
| 17 | Kirunelli | <i>Phyllanthus amarus</i> | Euphorbiaceae |
| 18 | Chitramoola | <i>Plumbago zeylanica</i> | Plumbaginaceae |
| 19 | Eegi | <i>Premnato mentosa</i> | Lamiaceae |
| 20 | Honne | <i>Pterocarpus marsupium</i> | Fabaceae |
| 21 | Kadugeru | <i>Semicarpus anacardium</i> | Anacardiaceae |
| 22 | Chilla | <i>Strychnos potatorum</i> | Loganiaceae |
| 23 | Amruthaballi | <i>Tinospora cordifolia</i> | Menispermaceae |
| 24 | Maddi | <i>Morindatinctoria</i> | Rubiaceae |
| 25 | Adusoge | <i>Adhathodavasica</i> | Acanthaceae |
| 26 | Bevu | <i>Azadirachtaindica</i> | Meliaceae |

| Sl. No. | Local Name | Botanical Name | Family |
|---------|---------------|----------------------------------|-----------------|
| 27 | Balavadike | <i>Boerhavia diffusa</i> | Nyctaginaceae |
| 28 | Murkal | <i>Buchananianalanzan</i> | Anacardiaceae |
| 29 | Agniballi | <i>Cardiospermum halicacabum</i> | Sapindaceae |
| 30 | Avarike | <i>Cassiaauriculata</i> | Caesalpinaceae |
| 31 | Padavali | <i>Cissampelosp pereira</i> | Minispermaceae |
| 32 | Garudapathala | <i>Clerodendronserratum</i> | Verbenaceae |
| 33 | ArishinaBurga | <i>Cochlospermumgossypium</i> | Bixaceae |
| 34 | Shivani | <i>Gmelinaarborea</i> | Lamiaceae |
| 35 | Neelisoppu | <i>Indigoferatinctoria</i> | Fabaceae |
| 36 | Tigerselaw | <i>Martyniadiandra</i> | Martyniceae |
| 37 | Tulasi | <i>Ocimumsanctum</i> | Lamiaceae |
| 38 | Hulisoppu | <i>Oxalis Sp.</i> | Oxalidaceae |
| 39 | Kukkiballi | <i>Passiflora foetida</i> | Passifloraceae |
| 40 | Shivanakadle | <i>Pavoniazeylanica</i> | Malvaceae |
| 41 | Honge | <i>Millettia pinnata</i> | Fabaceae |
| 42 | Kare | <i>Randia Sp.</i> | Rubiaceae |
| 43 | Vishakaddi | <i>Sidaacuta</i> | Malvaceae |
| 44 | Kisangi | <i>Sidacordifolia</i> | Malvaceae |
| 44 | Kadbadne | <i>Solanum sp.</i> | Solanaceae |
| 46 | Nerale | <i>Syzigium cumini</i> | Myrtaceae |
| 47 | Imli | <i>Tamarindesindica</i> | Fabaceae |
| 48 | Thorematti | <i>Tarminaliaarjuna</i> | Combretaceae |
| 49 | Thare | <i>Terminalia bellirica</i> | Combretaceae |
| 50 | Karaveera | <i>Thevetianudiflora</i> | Apocynaceae |
| 51 | Kaadumenasu | <i>Todaliasp.</i> | Rutaceae |
| 52 | Neglu | <i>Tribulus terrestris</i> | Zygophyllacerae |
| 53 | Kaadujeerige | <i>VernoniaSp.</i> | Asteraceae |

Source: Forest Working Plan of Ramanagara Division

3.4.5.2 Fauna

The Divisions has significant areas which are ecologically fragile and bio-diversity rich. The Biodiversity of the forests in Division is abundant in variety. Due to the rocky terrain and availability of corridors in private lands many wild animals such as Elephants, Leopard, sloth bear, Jackal, Spotted Deer, Wild Boar, Hare etc. are present in the Divisions There are no endangered species (IUCN Red list of threatened species)found in the project area.

Table 3-24: List of Common Wild Faunal species of the proposed project area

| Bangalore Rural | | |
|-----------------|--------------------------------|---------------------------|
| Local Name | Zoological Name | Schedule as per WPA, 1972 |
| Bonnet Macaque | <i>Macacaradiata mongooses</i> | II |
| Common Mongoose | <i>Herpestese dwardsi</i> | II |
| Tiger | <i>Panthera tigris</i> | I |
| Leopard | <i>Panther apardus</i> | I |
| Jungle cat | <i>Felis chaus</i> | II |
| Wild dog | <i>Cuonal pinus</i> | II |
| Elephant | <i>Elephas maximus</i> | I |
| Gaur | <i>Bos gaurus</i> | I |
| Sambar | <i>Cervus unicolor</i> | III |
| Spotted deer | <i>Axis axis</i> | III |

| | | |
|--------------------|----------------------------|-----|
| Barking deer | <i>Muntiacus muntjak</i> | III |
| Mouse deer | <i>Tragulus meminna</i> | - |
| Indian wild boar | <i>Sus scrofa</i> | III |
| Pangolin | <i>Manis crassicaudata</i> | I |
| Common langur | <i>Presbytis entellus</i> | - |
| Small Indian civet | <i>Viverricula indica</i> | II |
| Sloth bear | <i>Melursus ursinus</i> | I |
| Indian porcupine | <i>Hystrix indica</i> | IV |
| Indian hare | <i>Lepus nigricollis</i> | IV |
| Jackal | <i>Canis aureus</i> | II |
| Flying fox | <i>Pteropus giganteus</i> | IV |
| Ramanagara | | |
| Local Name | Zoological Name | |
| Elephant | <i>Elephas maximus</i> | I |
| Slothbear | <i>Melirsusursinus</i> | I |
| Leopard | <i>Panther apardus</i> | I |
| Indian Wild Boar | <i>Susscrofa</i> | III |
| Indian Porcupine | <i>Hystrix indica</i> | IV |
| Common Mongoose | <i>Herpestese dwardsi</i> | II |
| Sambar | <i>Cervus unicolor</i> | III |
| Spotted deer | <i>Axis axis</i> | III |
| Jungle cat | <i>Felis chaus</i> | II |
| Pangolin | <i>Manis crassicaudata</i> | I |
| Common Langur | <i>Presbytis entellus</i> | - |

Source: Forest Working Plan of Bangalore Rural and Ramanagara Division

3.5 SOCIO-ECONOMIC ENVIRONMENT

3.5.1 Area and Location

Karnataka is a state in the southwest region of India. The capital and largest city is Bangalore (Bengaluru). Karnataka is bordered by the Arabian Sea to the west, Goa to the northwest, Maharashtra to the north, Telangana to the northeast, Andhra Pradesh to the east, Tamil Nadu to the southeast, and Kerala to the south. The state covers an area of 191,976 sq.km or 5.83 percent of the total geographical area of India. It is the seventh largest Indian state by area. According to the 2011 census of India, the total population of Karnataka was 61,095,297 of which 30,966,657 (50.7%) were male and 30,128,640 (49.3%) were female, or 1000 males for every 973 females. The literacy rate was 75.36% with 82.47% of males and 68.08% of females being literate. 84.00% of the population were Hindu, 12.92% were Muslim, 1.87% were Christian, 0.72% were Jains, 0.16% were Buddhist, 0.05% were Sikh, 0.02% were belonging to other religions, and 0.27% of the population did not state their religion.

3.5.2 District Profile of Bangalore Rural

Bangalore Rural district is located in the southeast part of Karnataka state between the north latitude 12° 15' and 13° 31' and East longitude 77° 04' and 77° 59', covering parts of the topographic sheets 57G and H. The district is bounded by Kolar and Tumkur district in the north, Mandya district on the west, Chamarajanagar district on the south and towards southeast by Tamil Nadu state. Bangalore district is well served by road, railway and airways. The

National Highways passing through the district is connecting the state capital with other major cities like Hyderabad, Pune and Chennai. The interior villages are well connecting by metalled roads. Bangalore district is also well serve by Railways. The railway line connects Bangalore to New Delhi, Hyderabad, Bombay and Chennai.

3.5.2.1 Religion

The villages in the state are comprised of Hindus as the majority community. The presence of Muslims and Christians as the two non-Hindu and minority communities is limited. This is due to their economic position in the social structure of the village community, where they are generally non-landowning households and lead their lives by performing certain other occupations, but also needed for the village's Jajmani system in the traditional society. These included collection and sale of leather from dead domesticated farm animals, sale of copper, aluminium and steel vessels and their repair, tailoring, preparation of cotton beds, smithy and a few others. The Christians are limited to a few pockets of the state where the Church began its activities in the 19th century and led to the conversion of people particularly from the Dalit and tribal communities. Thus, both the non-Hindus found more in the urban than rural areas.

This situation is echo in our sample villages also. Of the total 115 households contacted for collecting information on the survey's subject matter, a majority (96.5 per cent) hailed from the Hindu religion. Barring these 111 households, the remaining all four belonged to Muslim community (3.5 %).

3.5.2.2 Language

Kannada is the official language of Karnataka and spoken as a native language by about 64.75% of the people. Other linguistic minorities in the state as of 2011 are Urdu (9.72%), Telugu (8.34%), Tamil (5.46%), Marathi (3.95%), Tulu (3.38%), Hindi (1.87%), Konkani (1.78%) and Malayalam (1.69%).

3.5.2.3 Demography

Bangalore Rural District is located in the southeast corner of Karnataka spanning a geographical area of 2,298 sq.km and it forms about 3.02 percent of the total area of the state. The total population of the district is 9,90,923, Literates 77.9%, Population density 431 per/sq km. and Sex ratio is 946 as per the 2011 census. The district lies between the latitude parallel to 12 15' North and the longitude and meridians 77 05' East and 78 West.

The salient Features of Bangalore Rural District are given in **Table 3.25**.

Table 3-25: Salient Features Bangalore Rural District

| S. No. | Particular | Units | Figure |
|--------------|---|-------------------|---------------|
| 1 | Area | In'000Sq. km. | 5814 |
| 2 | Administrative Units | | |
| 3 | Revenue Villages | Number | 1051 |
| 4 | Revenue Talukas | Number | 4 |
| 5 | Gram Panchayats | Number | 228 |
| 6 | Municipalities (including corporations & NPs) | Number | 5 |
| 7 | Population | | |
| Total | | In Persons | 990923 |

| S. No. | Particular | Units | Figure |
|----------------|------------------------------------|-------------------|---------------|
| 9 | Male | InPersons | 509172 |
| 10 | Female | InPersons | 481751 |
| 11 | Male to Total Population | % | 51.38 |
| 12 | Female to Total Population | % | 48.62 |
| 13 | Sex | Ratio | 946 |
| 14 | Rural | InPersons | 722179 |
| 15 | Urban | InPersons | 268744 |
| 16 | Rural Population (%) | % | 72.88 |
| 17 | Urbanization | % | 27.12 |
| 18 | Density of Population(per Sq.Km.) | InPersons | 431 |
| 19 | Child Population (0-6 Years) | | |
| Total | | In Persons | 107062 |
| 21 | Males | InPersons | 54908 |
| 22 | Females | InPersons | 52154 |
| 23 | Rural | % | 72.29 |
| 24 | Urban | % | 27.71 |
| 25 | Sex Ratio (Females per 1000 Males) | Ratio | 950 |
| 26 | Literates | | |
| Total | | In Persons | 688749 |
| 28 | Males | InPersons | 385311 |
| 29 | Females | InPersons | 303438 |
| 30 | LiteracyRate | | |
| Total | | % | 77.9 |
| 32 | Males | % | 84.8 |
| 33 | Females | % | 70.6 |
| 34 | ScheduledCastesPopulation | | |
| Total | | In Persons | 213700 |
| 36 | Males | InPersons | 107424 |
| 37 | Females | InPersons | 106276 |
| 38 | SexRatio(Femalesper1000Males) | InPersons | 989 |
| 39 | ScheduledTribesPopulation | | |
| Total | | Number | 52903 |
| 41 | Males | Number | 27147 |
| 42 | Females | Number | 25756 |
| 43 | SexRatio(Femalesper1000Males) | Number | 949 |
| 44 | WorkingPopulation | | |
| Total | | Number | 459891 |
| Males | | Number | 315499 |
| Females | | Number | 144392 |

3.5.2.4 Employment

All the three categories - landed with small land size holdings, landed with marginal land size holdings and the landless - all depend on wage employment as a source of income to their households. Respondents from 17.3 households (20 households out of 115 households) work as daily wage earners. They are exclusively dependent upon wage labour for livelihood. It does not rule out possibility of wage employment among the 61.7 per cent of the agriculture-dependent households

3.5.2.5 Connectivity

This district is well connected with National Highways and Indian Railways.

- There are 5 railway stations with a total railway route length of 204.39 km
- Bengaluru – Guntakal Railway line connecting to Mumbai, Ahmedabad, Jaipur, Delhi, Hyderabad passes through Doddaballapur
- Bengaluru – Chennai railway line passes through Hoskote Taluk
- Bengaluru – Hubli – Pune railway Line passes through Nelamangala Taluk
- Yelahanka – Bengerpet – KGF railway line passes through Devanahalli
- NH – 7 UP to TN via Karnataka passes through Dobbaspet
- NH – 48 Bengaluru, Hassan, Mangalore passes through Devanahalli
- NH – 4 Thane to Chennai via Karnataka passes through Hoskote
- NH – 7 Bengaluru – Tumakuru passes through Dobbaspet
- Kempegowda International airport is situating in the district.

3.5.2.6 Economy

The main occupation of the people in the district is cultivation and most of them are agricultural labourers. The literacy rate is 61.9% in rural parts of which male literacy rate is 72.4% and 51.1% is female literacy rate. In addition, in urban parts of the district the literacy rate is 76.2 % of which male literacy rate is 81.9% and female literacy rate is 70.10%.

The contribution of Horticulture to the Economy of the district is quite substantial. The district has considerable tracts under Horticultural crops like mango and Grapes. Betel vine Gardens also seen in many places. Animal Husbandry is being practice since Generations as an adjunct to Agriculture. A high degree of Urbanisation of Bangalore city has enhanced the economic importance of dairy, poultry keeping And Horticulture, which provide livelihood to a very large section. Considerable numbers are also engaged in raising sheep for wool as well. Vijayapura have been the most notable centres of Sericulture and Doddaballapura and Devanahalli are remember for prosperous silk weaving Industry.

The District lies in the southern maiden region of the State and is largely.

3.5.2.7 Industry

Plenty of quarries and crushing plants spread over the entire district. Granite quarrying and crushing are going on for the past three decades and density of crushing plants in the district is high. The district has 24 textiles 31 chemical 86 engineering factories are the important industries in the district and their total employees are 37190.

- 71 large and medium scale industries with aggregated investment INR 4335.21 crore
- 9307 small – scale industries with aggregated investment INR 1414.43 crore
- 12% of MSMEs in aerospace sector

Potential Sectors are garments, automobile parts, electronic goods, granites, Ophthalmic lenses, machine tools, Aerospace, logistic facilities for development of e-commerce

3.5.2.8 Tourist Places

Tourist Places within the district are:

- Shivagange Betta near Dobbaspet
- Vijayavittal Temple at Arasinakunte
- Fort and International Airport in Devanahalli taluk,
- Ghati Subramanya Swamy Temple in Doddaballapura Taluk

Doddaballapura Taluk is famous for Handlooms and having Industrial area & Apparel Park.

3.5.3 District Profile of Ramanagara

Ramanagara is a part of the Southern Karnataka Plateau and is located in the South – eastern corner of Karnataka State. Ramanagara City is the administrative headquarters of this district. The district is part of Bangalore Division. It has the greatest extent of 105.25 km. from north to south and 62.08 km. from east to west, covering a total geographical area of 3516 sq.km. The most conspicuous areas of very low and very high area of the district is located at 365 and 1225 metres of contour lines above the mean sea level respectively. The district lies between the north latitude of 12 degrees 14 minutes to 13 degrees and 11 minutes and east longitudes between 77 degrees 3 minutes to 77 degrees 8 minutes. The district bound on the north by Bangalore Rural and Tumkur districts, on the northeast by Bangalore Urban district and on the west by Mandya district. On the South and southeast, Chamarajanagar district and districts of Tamil Nadu State cover the district. Its average elevation is 800 meters above the mean sea level.

3.5.3.1 Religion

The villages in the state are comprised of Hindus as the majority community. The presence of Muslims and Christians as the two non-Hindu and minority communities is limited. As per official census 2011 and population data 2018 of Ramanagara district, Hindu are majority in Ramanagara state. Total population of Ramanagara district is 1,082,636 as per census 2011. Hinduism constitutes 88.60% of Ramanagara population. Muslims are minority in Ramanagara state forming 10.56% of total population.

3.5.3.2 Language

Kannada is the official language of Karnataka and spoken as a native language by about 64.75% of the people. Other linguistic minorities in the state as of 2011 are Urdu (9.72%), Telugu (8.34%), Tamil (5.46%), Marathi (3.95%), Tulu (3.38%), Hindi (1.87%), Konkani (1.78%) and Malayalam (1.69%)

3.5.3.3 Demography

According to the 2011 census, Ramanagara district has a population of 1,082,636. The district has a population density of 303 inhabitants per square kilometre. Its population growth rate over the decade 2001-2011 was 50.6 %. Ramanagara has a sex ratio of 976 females for every 1000 males.

The salient Features of Bangalore Rural District are given in **Table 3.26**.

Table3-26: Salient features of Ramanagara District

| Sl. No. | Particular | Units | Figure |
|---------|---------------------|-------------|--------|
| 1 | Area | In'000Sq.Km | 3576 |
| 2 | AdministrativeUnits | | |
| 3 | RevenueVillages | Number | 823 |

| Sl. No. | Particular | Units | Figure |
|----------------|--------------------------------------|-------------------|----------------|
| 4 | Revenue Talukas | Number | 4 |
| 5 | Gram Panchayats | Number | 130 |
| 6 | Municipalities (incl. Corpns. & NPs) | Number | 2 |
| 7 | Population | | |
| Total | | In Persons | 1082636 |
| 9 | Male | In Persons | 548060 |
| 10 | Female | In Persons | 534576 |
| 11 | Male to Total Population | % | 50.62 |
| 12 | Female to Total Population | % | 49.38 |
| 13 | Sex | Ratio | 976 |
| 14 | Rural | In Persons | 814877 |
| 15 | Urban | In Persons | 267759 |
| 16 | Rural Population (%) | % | 75.27 |
| 17 | Urbanization | % | 24.73 |
| 18 | Density of Population (per Sq. Km.) | In Persons | 303 |
| 19 | Child Population (0-6 Years) | | |
| Total | | In Persons | 107841 |
| 21 | Males | In Persons | 54963 |
| 22 | Females | In Persons | 52878 |
| 23 | Rural | % | 71.70 |
| 24 | Urban | % | 28.30 |
| 25 | Sex Ratio (Females per 1000 Males) | Ratio | 962 |
| 26 | Literates | | |
| Total | | In Persons | 674758 |
| 28 | Males | In Persons | 378461 |
| 29 | Females | In Persons | 296297 |
| 30 | Literacy Rate | | |
| Total | | % | 69.22 |
| 32 | Males | % | 76.76 |
| 33 | Females | % | 61.50 |
| 34 | Scheduled Castes Population | | |
| Total | | In Persons | 203819 |
| 36 | Males | In Persons | 102612 |
| 37 | Females | In Persons | 101207 |
| 38 | Sex Ratio (Females per 1000 Males) | In Persons | 986 |
| 39 | Scheduled Tribes Population | | |
| Total | | Number | 22946 |
| 41 | Males | Number | 11619 |
| 42 | Females | Number | 11327 |
| 43 | Sex Ratio (Females per 1000 Males) | Number | 975 |
| 44 | Working Population | | |
| Total | | Number | 531459 |
| Males | | Number | 344349 |
| Females | | Number | 187110 |

3.5.3.4 Employment

Agriculture is one of the most primary & oldest occupations of Ramanagara district. Agriculture is the main source of livelihood in Ramanagara district & it is a main source of income. Major crops produced in the district are Ragi, Paddy, Maize, Tur, Groundnut, Sunflower and Sugarcane. Horticulture is also famous in Ramanagara district. Mango, Banana, Pineapple, Papaya, Sapodilla (chiku), Jack fruit, Grapes, Tomato, Onion, Chilli, Roses, Gladiolus are the major horticulture crops in Ramanagara district.

3.5.3.5 Connectivity

This district is well connected with National Highways and Indian Railways.

- NH-48 (Bengaluru - Mangalore) and NH - 209 (connecting Bengaluru to Dindigal - TamilNadu) passes through the district
- District has railway connectivity to Bengaluru, Mysore and other location with 6 Railway Stations and 44km of railway line.
- Double line conversion of Bengaluru - Mysore is under progress

The district has Nearest Airport in Bengaluru at a distance of 41.45 km in East direction.

3.5.3.6 Economy

The main economy of the district is:

- Ramanagara is famous for its silk market, one of the biggest in Asia, giving it the other name of Silk City; it is also known as Cosmopolitan Cocoon Market because of the people from different states participates in cocoon transaction here. On an average, 35 Metric tons of cocoons transacted daily in this market.
- In Ramanagara, there are 600 cottage basins (improved), 85 multi end reeling units and 04 Automatic Reeling Unit of 400 Ends capacities. There are also about 95 Twisting units functioning at this place.
- Ramanagara district includes the Bidadi Industrial Area, the first Industrial Area in the state, which houses the manufacturing units of Toyota and Coca-Cola, and a 1400 MW combined cycle gasbased power plant.

3.5.3.7 Industry

Ramanagara has a very famous silk market, which is also one of the biggest in India, for this reason, the district known as 70 Silk town. The Bidadi industrial area has established in Ramanagara district and has the manufacturing units of Toyota and Coca-Cola, and a 1400 MW combined cycle gasbased power plant.

- 64 Large and Medium Scale Industries
- 1633 small scale industries with aggregated investment INR 169.4 crores
- 2 industrial areas (total 5 phases) and 4 Industrial estates

3.5.4 Socio-Cultural profile of the Project Road

Of the total surveyed households, a total of 1170 persons are affected due to acquisition of houses. **Table-3.27** on the analysis of Socio-Cultural profile of the surveyed households shows that along the project corridor, there were households belonging to only two religions viz Hindus (98.31%) and Muslims (1.69%). Social group-wise most of the affected people represents the Backward caste (45.76%) and of the remaining 42.37% are

General castes. The incidence of Scheduled Castes is around 11.86% along the project road. Observed across the family pattern majority (71.19%) of the affected households are nuclear families and of the remaining 27.12 percent of the affected households live as joint families.

Most of the households are staying along the roadside from a long time where in nearly 72.88% of them are living since more than 10 years. About 15.25% of them are found to have settled in the last 2-6 years. Details are presented in table below. Analysis on literacy level of head of the affected households shows that around 38.98 percent of them are literates. During the survey, some of the owners/occupants of the structures are not available and the respondent is not in a position to give the details of the concerned head of the Household.

Table3-27: Socio-Cultural Characteristics of Structure Affected Population

| Item | Description | No | % of total |
|------------------------------|--------------------|------------|---------------|
| Population | Male | 158 | 50.16 |
| | Female | 157 | 49.84 |
| | Total | 315 | 100.00 |
| Religious Group | Hindu | 58 | 98.31 |
| | Muslim | 1 | 1.69 |
| | Christian | 0 | 0.00 |
| | Others | 0 | 0.00 |
| | Total | 59 | 100.00 |
| Social Group | General | 25 | 42.37 |
| | BC | 27 | 45.76 |
| | SC | 7 | 11.86 |
| | ST | 0 | 0.00 |
| | Total | 59 | 100.00 |
| Family Type | Joint | 16 | 27.12 |
| | Nuclear | 42 | 71.19 |
| | Individual | 1 | 1.69 |
| | Total | 59 | 100.00 |
| Years of stay | Up to 1 year | 2 | 3.39 |
| | 2 to 4 years | 6 | 10.17 |
| | 5 to 6 years | 3 | 5.08 |
| | 7 to 9 years | 5 | 8.47 |
| | 10 and above years | 43 | 72.88 |
| | Total | 59 | 100.00 |
| Education level of HH | Illiterate | 23 | 38.98 |
| | 1-5 class | 2 | 3.39 |
| | 6-7 Class | 4 | 6.78 |
| | 8-9 Class | 7 | 11.86 |
| | SSC | 2 | 3.39 |
| | Inter | 17 | 28.81 |
| | Degree | 3 | 5.08 |
| | PG | 1 | 1.69 |
| | Technical | 0 | 0.00 |

| | | | |
|--|--------------|-----------|---------------|
| | Professional | 0 | 0.00 |
| | Total | 59 | 100.00 |

3.5.5 Economic Profile along the Project Road

Occupation wise, most of them are engaged into agriculture activity (61.02%) followed by Non-Agri. Labour (0.00%), commercial activity of Trade/Business and petty shop keeping is around 11.86% and 11.86% respectively and other occupations such as Govt. Service, pvt.Service, pensioners etc.

The income levels of the surveyed households shows that, around 86.44 percent fall under lower and middle income families who are earning less than Rs. 300000 per annum. Of the remaining, around 5.08 percent are earning between Rs. 300000 to Rs. 500000 and 8.47 percent are earning above Rs. 500000 per annum. Details are given in **Table 3.28**.

Table3-28: Economic Profile of Structure Affected Population

| Item | Description | Number of HH | % of total |
|----------------------------|--------------------------------|--------------|------------|
| Occupation of HH | Agriculture | 36 | 61.02 |
| | Trade/Business | 7 | 11.86 |
| | Petty shop keeping | 7 | 11.86 |
| | Agri labour | 8 | 13.56 |
| | Non-Agri labour | 0 | 0.00 |
| | HH Industries/Artisan activity | 0 | 0.00 |
| | Govt service | 0 | 0.00 |
| | Pvt.service | 1 | 1.69 |
| | Professional | 0 | 0.00 |
| | Self employed | 0 | 0.00 |
| | Others | 0 | 0.00 |
| | | Total | 59 |
| Annual income (Rs.) | Up to 50000 | 2 | 3.39 |
| | >50000 to 100000 | 24 | 40.68 |
| | >100000 to 300000 | 25 | 42.37 |
| | >300000 to 500000 | 3 | 5.08 |
| | >500000 | 5 | 8.47 |
| | | Total | 59 |

The expenditure pattern for the affected households shows that a majority of them are having an average monthly expenditure between Rs. 4000 to Rs. 10000 per month. Details are given in **Table 3.29**. Majority of the affected persons i.e. 84.75% reportedly hold the ration cards given for Below Poverty Level (BPL) families

Table 3-29: Monthly Expenditure and Others for Structure Affected House holds

| Monthly Expenditure (Rs.) | Description | No. of HHs | % of HH |
|---------------------------|----------------|------------|---------|
| | <4000 | 4 | 6.78 |
| | 4000 to 10000 | 39 | 66.10 |
| | 10000 to 15000 | 8 | 13.56 |

| | | | |
|--------------------|--------------|-----------|---------------|
| | >15000 | 8 | 13.56 |
| | Total | 59 | 100.00 |
| Ration Card | White (BPL) | 50 | 84.75 |
| | Pink (APL) | 9 | 15.25 |
| | Total | 59 | 100.00 |

3.5.6 Impact on Common Property Resources

A total of 41 common properties are affected across the project road. Of which 14 (34.15%) are religious structures in the form of small temples. About 15 (36.59%) of other religious structure in the form of mosques/tombs are affected in this project road. In addition, around 6 (14.63%) of Government buildings are affected. Apart from this, around 6 (14.63%) of other structures such as compound walls, arch, statue, shopping complex, bus stops, markets etc. owned by the government/community are affected. No other structures owned by the community/government are affected along the project road. Details of the usage of these common properties such as religious places and other structures are given in **Table 3.30**.

Table3-30: Common Properties along the corridor

| Sl. No. | Usage | No | % to total |
|--------------|---|-----------|---------------|
| 1 | Religious Places (Temples) | 14 | 34.15 |
| 2 | Mosques/Tombs | 15 | 36.59 |
| 2 | Government Buildings | 6 | 14.63 |
| 3 | Others (Market, Arch, Statue, Shopping Complex, Bus Stops, Compound Walls Etc.) | 6 | 14.63 |
| Total | | 41 | 100.00 |

3.5.7 Other Assets and Minor Structures Affected

In addition to the above listed properties other minor assets, which includes well, bore well, watertanks, taps, Hand pumps and Overhead Tanks etc. around a total of 172 minor assets are affected in this road. Details are given in the **Table 3.31**.

Table3-31: Details of Other Minor Assets Affected

| Sl. No. | Usage | No | % to total |
|--------------|---|------------|---------------|
| 1 | Well | 32 | 18.60 |
| 2 | Bore Wells | 14 | 8.14 |
| 3 | Water Tanks | 60 | 34.88 |
| 4 | Pump House | 34 | 19.77 |
| 5 | Hand Pumps | 2 | 1.16 |
| 5 | Others (Over Head tanks, Sump, Pits, Taps etc.) | 30 | 17.44 |
| Total | | 172 | 100.00 |

3.5.8 Type and Area of the Affected Structures

Of the total 310 structures affected, 101 (32.58%) and 102 (32.90%) structures are pucca and semi-pucca respectively. Remaining 96 (30.97%) and 11 (3.55%) are kutcha and movable structures respectively. The total area affected excluding compound walls length is about 18294.45 square meters. Details are presented in **Table 3.32**.

Table3-32: Type and Area of Structures Affected along Project

| Sl. No | Type | Total Structures Affected | | Total Area affected (Sq.mts) | |
|--------------|------------|---------------------------|--------------|------------------------------|---------------|
| | | No | % | No | |
| 1 | Pucca | 101 | 32.58 | 5219.02 | 28.53 |
| 2 | Semi pucca | 102 | 32.90 | 7194.61 | 39.33 |
| 3 | Kutcha | 96 | 30.97 | 5752.12 | 31.44 |
| 4 | Movable | 11 | 3.55 | 128.70 | 0.70 |
| Total | | 310 | 96.45 | 18294.45 | 100.00 |

3.5.9 Land Acquisition

The total land need to be acquired for the proposed project is 685.367hectarefor development of proposed project road. The agricultural land price has been calculated as an average of the Circle/Guidance Value in the respective villages. While calculating the cost irrespective of type and usage, the cost of all structures/buildings and other assets as per Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR) to avoid any further issues in future.

The valuation of losses has been considered on the basis of prevailing Circle/Guidance rate derived from Department of Stamps and Registration of Government of Karnataka. While calculating the Land cost for each village, average of all types of lands in that particular village was considered. Further, as the Land rates are not available for some of the villages, land rate in nearby village was considered for the same. However, the compensation for the other assets (Bore well/Well/Hand Pumps etc.) likely to be affected was obtained from the local public.

CHAPTER : 4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 ENVIRONMENTAL IMPACTS AND ISSUES

This chapter assesses the impact of the proposed project on the existing baseline environment. The sections deal with the prediction of impacts due to the project on the natural environment and socio & cultural environment. **Table 4.1** presents the general environmental impacts expected due to the proposed construction of the Greenfield road project. Impacts have been assessed based on the information collected from the screening & scoping of environmental attributes.

Besides, below-mentioned impact on natural environment there will be socio-economic impacts due to disruptions on the social and economic interactions of communities. This involves effect on both the adjacent communities (mostly direct) as well as the nearby communities (mostly indirect). The various impacts have been detailed as:

- General impacts that apply to the entire project corridor,
- Specific impacts on likely properties and PAPs, within the Corridor of Impact (CoI) of the project corridors. **Table 4.2** presents the general impacts on social and cultural environment.

Table 4-1: General Impacts on Natural Environment

| Project Activity | Planning and Design Phase | Pre-construction Phase | | Construction Phase | | | | |
|------------------|------------------------------|--------------------------------|---|---|---|--|--|--------------------------------------|
| | | Removal of Sensitive Receptors | Removal of trees and vegetation | Earth work including quarrying | Laying of pavement | Vehicle & Machine operation & maintenance | Asphalt & crusher plants | Sanitation & Waste (labour camps) |
| Air | | Dust generation | Reduced buffering of air and noise pollution, Hotter, drier micro-climate | Dust generation | Asphalt odour | Dust and Pollution | Soot, odour, dust and pollution | Odour/smoke |
| Land | Loss of productivity of Land | Generation of debris | Erosion and loss of top soil | Erosion, loss of top soil and natural fertility | Pressure on Base Area | Contamination by fuel and lubricants Compaction | Contamination Compaction of soil | Contamination from wastes |
| Water | Loss of water sources | Siltation due to loose earth | Siltation due to loose earth | Alteration of drainage Break in continuity of ditches Siltation, Stagnant water pool in quarries. | Affecting available ground water source and Reduction of ground water recharge area | Degradation of available water sources nearby the construction zone and Contamination by fuel and lubricants | Contamination by asphalt leakage or fuel | Contamination from wastes Overuse |
| Noise | | Noise Pollution | Noise Generation Due to machinery work | Noise Generation Due to machinery work | Low Level noise due to working of running equipment | Noise Generation Due to machinery work | Noise Generation due to machinery work | |
| Flora | | Loss of Biomass | Loss of Natural affection | Removal of Vegetation Lowered productivity Loss of ground for vegetation | | Removal of vegetation | Lower productivity Use as fuel wood | Felling trees for fuel |
| Fauna | | | Disturbance Habitat /Wild life loss | Disturbance | | Disturbance | Disturbance | Poaching |

Table 4-2: General Impacts on Social and Cultural Environment

| Project Activity | Planning and Design Phase | Pre-Construction Phase | | | Construction Phase | | | | |
|-----------------------------------|----------------------------------|--------------------------------|--|---|---|--------------------------|--|---|---------------------------------------|
| | | Land acquisition | Removal of Structures | Removal of trees & vegetation | Earth works including quarrying | Laying of pavement | Vehicle & machine operation & maintenance | Asphalt and crusher plants | Labour Camps |
| Agricultural land | - | Change in land type and prices | Loss of land economic value | Loss of standing crops | Loss of productive land | Loose top soil fertility | - | Dust on agricultural land reduce the productivity | - |
| Buildings and built-up structures | - | Change in land type and prices | Loss of structures, Debris generation, Noise and Air pollution | - | Noise, vibration may cause damage to structures | - | Noise, vibration may cause damage to structures | Dust accumulation on building and structure | - |
| People and Community | Anxiety and fear among community | - | Displacement of people Psychological impact on people loss of livelihood | Loss of shade & community trees, Loss of fuel wood and fodder, Loss of income | Noise and Air pollution | Odour and dust | Noise and Air pollution, Collision with pedestrians livestock and vehicles | Air and noise pollution and discomfort | Community clashes with migrant labour |
| Cultural Assets | - | - | Displacement loss of structure within ROW | Loss of sacred trees. | Noise, vibration may cause damage to structure | - | Damage from vibration & air pollution | Dust accumulation | - |
| Utilities and Amenities | - | - | Interruption in supply | - | - | - | Damage to utility and amenities | Dust accumulation on water bodies | Pressure on existing nearby amenities |
| Labour's Health & Safety | - | - | - | - | Increase of stagnant water and disease | Asphalt odour and dust | Collisions with vehicles, pedestrians & livestock | Impact on health due to dust generation | Increase in communicable diseases |

4.1.1 Land Acquisition

The major impacts during pre-construction and designing phase are related with the land acquisition. The Greenfield alignment needs land area throughout the corridor. The RoW considered for the Greenfield alignment is generally 70m except toll plaza, interchanges. The major land use along the project road is agriculture, so the major share of land acquisition shall be from agriculture land. No forestland needs to be acquired. **Table 4.3** presents the chainage wise details of land acquisition required for the project road. Total 685.367 hectere of land is required, out of which 619.294 hectere in private and 66.073 hectere in the Govt. land.

Table 4-3: Details of Land Acquisition

| Sl. No. | Name of the Taluk | Chainage (Kms.) | | Length (Kms.) | No. of Villages | Land to be Acquired (Ha.) | | | Agriculture | Non-Agriculture |
|--------------|-------------------|-----------------|--------|---------------|-----------------|---------------------------|---------------|----------------|----------------|-----------------|
| | | From | To | | | Private | Government | Total | | |
| 1 | Nelamangala | 0.000 | 19.675 | 19.675 | 16 | 168.432 | 9.311 | 177.743 | 154.636 | 23.107 |
| 2 | Magadi | 19.675 | 56.034 | 36.359 | 29 | 261.267 | 35.003 | 296.270 | 257.755 | 38.515 |
| 3 | Ramanagara | 56.034 | 82.200 | 26.166 | 16 | 189.595 | 21.759 | 211.354 | 183.878 | 27.476 |
| Total | | | | 82.200 | 61 | 619.294 | 66.073 | 685.367 | 596.269 | 89.098 |

4.1.2 Removal of Pavement

Since, it is a Greenfield project, no pavements are required to be removed except at few locations where the proposed alignment traverses the existing crossroads, hence no major impact envisages.

4.1.3 Removal of Road side Structures

Roadside dwelling and business unit would also be impacted, and their impact may not be transformed rather need mitigation measures. Engineering Design team in consultation with environmental and social team has finalized the alignment to minimize/ restrict the impact on built-up areas. Even after such engineering efforts, some of these residential and/or commercial units are required to be dismantled (partially or fully). About 310 structures and 172 minor assests are required to be removed. The impact is not envisaged high because these structures are small in size.

4.1.4 Removal of Trees and Vegetation

Approximately 685.294 ha. of area will be acquired, where vegetation will have to be removed for the construction of the new project road. Trees up to tow line are to be felled. About 5,401 non-forest trees and 16,806 numbers of poles (girth size having less than 30 m are categorized as poles) are falling under Corridor of Impact. However, maximum efforts will be given to save the trees especially those which are falling outside the construction zone.

4.1.5 Extraction of material for Construction Activity

Presents the details of construction material required for construction of new project road. The quarries for these aggregates and borrow earth are locally available hence no significant direct impacts envisaged, however strict guidelines have been prepared to minimize the adverse impact; some of these guidelines are as follows.

- Top soil will be excavated and preserved and re-applied for vegetation growth.
- The contractor shall prepare re-development plan for the quarry site and get it approved by the EMU, before the commencement of any quarry activity.
- Contractor will be responsible for adhering to the condition laid by the Director of Geology and Mining at the time of issue of quarrying permit or quarrying lease.
- The contractor shall restore all haul roads to their original state.
- Contractor will be responsible for enforcing all safety measures/guidelines detailed time to time by EMU.

4.1.6 Machinery and plant for construction activity

Vehicles & machinery like Dumpers, Excavators, Road Rollers and Pavers etc. will be required for project intervention and will have an impact on their influence area. These machineries will have its bearing on surrounding environment especially on-air quality subject to emission level of machinery and Noise Environment, however strict guidelines have been prepared to minimize the adverse impact, some of these guidelines are as follows:

- Construction equipment and Machineries deployed for construction will be regularly maintained and not older than 3 years.
- Vehicles/ equipment will be regularly subjected for emission tests and will have valid "Pollution under Control" certificate.
- All vehicles deployed for material haulage will be spill proof.
- Water tankers with suitable sprinkling system will be deployed along the haulage roads and in the work site.

4.1.7 Man power for Construction Activity

Contractor will be encouraged for hiring/ engaging more and more local labours. However, there would be 1500 temporary employees and 500 permanent employees during construction phase of the project. Also, there would be 200 temporary employees and 50 permanent employees during operation phase of the project. Other than this, indirect employees will also be engaged in the form of transportation, maintenance of plantation etc.

4.2 AIR ENVIRONMENT

Air quality will impact during construction activity and due to growth in traffic volume of the project corridor in operation phase. During Construction phase, the main source of air pollution is fugitive dust emission from the mobile sources and fixed sources. Mobile sources are mostly the vehicles transporting the construction materials. The fixed sources of air pollution will be Hot Mix Plants (HMPs), diesel generator sets, construction machines, and excavation/grading activities which produce fugitive dust emissions.

4.2.1 Air Quality Emissions

4.2.1.1 Pre-construction Phase

Impact: The pre-construction stage activities includes site clearance, shifting of utilities, removal of trees presents in the corridor of impact, transportation of man and material, construction of accommodations, construction of stockyards, installation of construction plants and construction of office buildings. Dust generation during such activities would be the predominant polluting activity during pre-construction stage and particularly so if pre-construction tasks are performed during dry weather. The impacts due to the pre-construction activity are temporary and location specific and the width of the impacts is limited. Impacts at the pre-construction stage are temporary as these are localized and fugitive in nature.

Mitigation: The impact will be mostly within the RoW. Dust generation on the haul road due to pre-construction activities will be efficiently countered by sprinkling of water. The enforcement of the measures of face mask for labours will be kept.

4.2.1.2 Construction Phase

Impact: During the construction phase, dust emissions in unpopulated areas will be emitted and deposited on the leaves of trees and other vegetation which may affect the growth of the trees and other vegetation. Certain amount of dust and gaseous emissions will be generated during the construction phase from excavation machine and road construction machines. Pollutants of primary concern include particulate matters i.e. PM₁₀ and PM_{2.5}. However, suspended dust particles matter may be coarse and will be settled within a short distance of construction area. Therefore, impact will be temporary and restricted within the closed vicinity of the construction activities only.

Gaseous emissions include carbon monoxide (CO), unburned hydrocarbons, sulphur dioxide (SO₂), and nitrogen oxides (NO_x) etc. from the DG set/ vehicles involved in transportation of materials during road construction.

Generation of dust and particulates is from:

- Site clearance and use of heavy vehicles and machinery etc.
- Transport of raw materials, borrow and quarry material to construction sites;
- Earthworks;
- Handling and storage of aggregates at the asphalt plants;
- Concrete batching plants and;
- Asphalt mixing plants due to mixing of aggregates with bitumen.

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 stage along the project road.

Generation of Exhaust Gases

Generation of exhaust gases is likely due to movement of heavy machinery for clearance of the PRow for construction. Toxic gases are released through the heating process during bitumen production. Although the impact will be much localized, it can spread downwind

direction depending upon the wind speeds. The health effects of inhaling particulate matter have been widely studied in humans and animals and include asthma; lung cancer, cardio-vascular issues, and premature death and are given in **Table 4.4**.

Table 4-4: Emission and their Impacts (Prediction of Impact on Ambient Air Quality)

| Emission | Impact | |
|-----------------|--|---|
| | Human | Vegetation |
| Hydrocarbons | Prolonged exposure to hydrocarbons contributes to asthma, liver disease, lung disease, and cancer. Inhaling formaldehyde can cause irritation. It is a major contributor to eye and respiratory irritation, which is caused by photochemical smog. | Ethylene causes injury to the leaves of sensitive plants. Effects are epinasty, chlorosis, curling, and abscission and growth retardation |
| CO | Reduces the ability of hemoglobin to carry oxygen to the body tissues. | - |
| NO ₂ | Nitrogen dioxide damages the cell membranes in the lung tissues and constriction of the lung passages. Edema or a filling of the intercellular spaces with fluid. Eye and nasal irritation and pulmonary discomfort are also common. | Nitrogen dioxide causes growth retardation |
| CO ₂ | Asphyxiation, caused by the release of carbon dioxide in a confined or unventilated area. Kidney damage or coma. | Elevated atmospheric carbon dioxide and reduces plant growth |
| Ozone. | Ozone causes an irritant action in the respiratory tract, cough chest pain, eye irritation, headaches and asthma attacks. Chronic effects include losses in immune system functions, accelerated aging and increased susceptibility to other infections. | Ozone concentrations cause flecks on the upper surfaces, premature aging and suppressed growth, leaf bleaching, necrosis |
| SO ₂ | The health problems related to the mucous membrane and respiratory tract are due to sulfate aerosols. Chronic effects of SO ₂ include increased probabilities of bronchitis, "colds" of long duration and suppression of immune system. | SO _x produce injury on leaves and plants which is characterized by the killing of marginal or intervention areas of the leaf. |
| Fugitive Dust | Irritation to the eyes, nose and throat. Respiratory distress, including coughing, difficulty in breathing and chest tightness. Increased severity of bronchitis, asthma and emphysema. | Reduced photosynthesis due to reduced light penetration through the leaves. This can cause reduced growth rates and plant vigor. Increased incidence of plant pests and diseases. |

Mitigation: During the construction stage, there are two major sources: the first one is construction activities at working zones, which cause primarily dust emission and second are

from operation of the construction plant, equipment and machinery, which causes gaseous pollutants. The specific measures include:

- Locating Plant at a significant distance from nearest human settlement in the predominant downwind direction.
- Vehicles delivering fine materials like soil and fine aggregates shall be covered to reduce spills on existing roads.
- Water will be sprayed on earthworks, temporary haulage and diversions on a regular basis.
- Batch type hot mix plants fitted with the bag filter / cyclone and scrubber will be installed for the reduction of the air pollution.
- Pollution control systems like water sprinkling and dust extractors and cover on conveyors will be installed for the crushers.
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the emission levels conform to the SPCB/CPCB norms.

Air pollution monitoring plan has been delineated for construction phase separately for checking the effectiveness of the mitigation measures adopted during the construction phase of the contract.

4.2.1.3 Operational phase

Impact: During the operational stage air pollutant will be from vehicular movements on road which is not much significant. No fugitive dust 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 proposed road will reduce traffic congestion within the cities.

Mitigation: Avenue and median plantation activity shall be carried out as per IRC SP-21:2009 and Green Highway Policy-2015.

4.2.2 Air Quality Modelling

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

Job Parameters

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

Aerodynamic Roughness Coefficient: determine the amount of local air turbulence that affects plume spreading. For the present modelling rural roughness options have been considered.

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

Run conditions

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

Wind Direction: The direction the wind is blowing from, measured clockwise in degrees from the west.

As the model study is on “Worst Case scenario”, therefore CALINE 4 will consider this input.

Link Geometry

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

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

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

Link Activity

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

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

Receptor Positions

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

Approach and Methodology

The CALINE model was run for CO, NO₂ and particulate matters. The air quality was predicted for year 2018, 2020, 2030, 2040, and 2050. It is evident from the modeling result of air pollutants concentration of CO, NO₂, PM₁₀, PM_{2.5} given in **Table 4.5, 4.6, 4.7** and **4.8** respectively.

Table 4-5: Predicted CO Quality

| Parameters | Year | Baseline Concentration in µg/m ³ | Incremental Concentration in µg/m ³ | Resultant Concentration in µg/m ³ | CPCB Standard |
|------------|------|---|--|--|-------------------------------|
| CO | 2018 | 0.19 | 88 | 88.19 | 2000 microgram/m ³ |
| | 2021 | | 152 | 152.19 | |
| | 2030 | | 486 | 486.19 | |
| | 2040 | | 1148 | 1148.19 | |
| | 2050 | | 2647 | 2647.19 | |

Table 4-6: Predicted NO₂ Quality

| Parameters | Year | Baseline Concentration in µg/m ³ | Incremental Concentration in µg/m ³ | Resultant Concentration in µg/m ³ | CPCB Standard |
|-----------------|------|---|--|--|----------------------------|
| NO ₂ | 2018 | 20.30 | 14.4 | 34.7 | 80microgram/m ³ |
| | 2020 | | 29.2 | 49.5 | |

| | | | | | |
|--|------|--|------|-------|--|
| | 2030 | | 84.4 | 104.7 | |
| | 2040 | | 178 | 198.3 | |
| | 2050 | | 371 | 391.3 | |

Table 4-7: Predicted PM₁₀ Quality

| Parameters | Year | Baseline Concentration in $\mu\text{g}/\text{m}^3$ | Incremental Concentration in $\mu\text{g}/\text{m}^3$ | Resultant Concentration in $\mu\text{g}/\text{m}^3$ | CPCB Standard |
|------------------|------|--|---|---|----------------------------------|
| PM ₁₀ | 2018 | 56.7 | 1.2 | 57.9 | 100 microgram/ m ³ |
| | 2020 | | 2.4 | 59.1 | |
| | 2030 | | 8 | 64.7 | |
| | 2040 | | 15.2 | 71.9 | |
| | 2050 | | 36 | 92.7 | |

Table 4-8: Predicted PM_{2.5} Quality

| Parameters | Year | Baseline Concentration | Incremental Concentration | Resultant Concentration | CPCB Standard |
|-------------------|------|------------------------|---------------------------|-------------------------|-----------------------------|
| PM _{2.5} | 2018 | 15.4 | 0.72 | 16.12 | 60 microgram/m ³ |
| | 2020 | | 1.44 | 16.84 | |
| | 2030 | | 4.8 | 20.2 | |
| | 2040 | | 9.12 | 24.52 | |
| | 2050 | | 21.6 | 37 | |

The predicted values of air quality parameters indicate that particulate matter and gaseous pollutants are within the CPCB standard till year 2050.

Mitigation: The air pollutant will be from vehicular movement on road and dust emission by tyres. As such the national and international bodies are quite active in controlling the air pollution through emission limit, auto technology and fuel quality which will counter the increase in air pollution due to increase in traffic during operation phase. Additional measures/proposed are given below:

- Pollution resistant species, which can grow in high pollutant concentrations or even absorb pollutants, can be planted along the roadside.
- Monitoring of air pollution levels at sensitive locations shall be carried out all through the operation stage to check that the pollution levels are within standards prescribed by CPCB. A monitoring plan to this effect has been prepared and is presented in the EMP.
- Other measures such as the reduction of vehicular emissions, ensuring vehicular maintenance and up-keep, 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.

4.2.3 Air Quality Monitoring

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the air pollution with increase in traffic 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 Program (Chapter 6). In addition, standard/acceptable values are given in Baseline Environment. Any value/result will not be within acceptable limits of CPCB, will be reported to engineer, for remedial measures.

Regular water sprinkling will be done to suppress dust during construction phase. Air pollution norms will be enforced. Labourers will be provided masks. Fine materials to be completely covered, during transport & stocking. Plant to be installed in downwind direction from nearby settlement.

4.3 LAND ENVIRONMENT

4.3.1 Topography

Impact: Since it is a green field project and considerable portion of the alignment passes through undulating area, it is proposed to raise the height of the embankment throughout the length of the road. The overall topography of the area is not going to alter much due to these minor changes, rather there will be some positive impacts as follows:

- Raising of embankment leads to no submergence areas, for round the year connectivity
- More drainage structures will ease/improve the hydrology of the area, relieve the flooding situation.
- Vertical geometrics improvement leads to better sight distance, safer transportation.
- Junction design/ improvement will provide better and efficient traffic movement.
- The embankment will be raised throughout the length of the greenfield alignment to suitable height from the existing level.

Mitigation: The raising of the embankment would be done to relieve the waterlogging in the area. There is no appreciable change in topography. The raising due to submergence and profile improvement is positive impacts on the local environment. The raised sections are located away from habitations. Adequate measures have been taken so that the raising if any in settlement areas should be minimum possible and in no case exceed 0.5 m.

4.3.2 Geology

Impact: Likely impact on the geological resources will occur from the extraction of materials (borrow of earth, granular sub base and aggregates for base courses and bridges). The boulders will be procured from the authorized suppliers and prevalent rules will be followed for borrowing of soil, sand and aggregates. Hence, the impact on general geology of the region is insignificant. At the construction sites, no blasting is proposed; therefore, there will be no added impact on the geology of the area.

Mitigation: As part of the project preparation, the sources of quarries for the fine and coarse aggregates have been identified for use in road works and structural works. No new quarry has been proposed for the project requirements. Only existing, live, licensed quarries will be used as sources of coarse and fine aggregates. It will be ensured that the aggregates procured during construction stage will be from the authorized or licensed suppliers only.

Selected soil borrow areas have been identified during the design stage of the project. Most of these borrow areas are local borrow areas, and agricultural fields not in productive use, and

where farmers want to lower the level of the land (reduction of energy requirement for the watering and reduce loss of water, nutrients, and fertilizer through the seepage).

4.3.3 Land

Impact: One of the major 'local' impacts due to highway project is upon the local land resources required for construction of the project road. It is a greenfield alignment, where acquisition of agricultural land has been unavoidable to accommodate the proposed cross-sections. The project will impact 685.367ha. of land out of which 87 percent is agriculture land.

Mitigation: As far as possible the land acquisition has been kept to the minimum. The compensation for land will be provided to the affected persons as per RFCTLARR Act, 2013. The total compensation allocated for land looser is 2034.54 Cr.

4.3.4 Generation of Debris

Impacts: The major source of debris generation is dismantling of existing cross drainage structures and RoW residential and commercial structures.

Mitigation Due to the removal of structures (residential and commercial), pavement scarification (at existing crossroads) and cross drainage structures lot of debris will generate, which need to be disposed properly to avoid contamination of land and water.

4.3.5 Soil Erosion

Impacts: Erosion of top-soil can be considered a moderate, direct and long-term negative impact resulting from the construction and maintenance of roads. The potential for soil erosion is high and pervasive during the construction stage. Starting with clearing and grubbing of trees, vegetation is stripped away, exposing raw soil. The construction of new fill slopes for grading and bridge-end fills also exposes large areas to erosion, if protection methods are not implemented. Finally, during the operation or maintenance phase of highway development, erosion can continue to occur in areas not vegetated. Fills are exposed to long-term exposure to water and wind. Although soil erosion occurs sporadically on highway corridors, the most affected sites are generally bridge end fills and over-steep Banks.

Mitigation: More trees plantation to enhance environment and soil conservation. Top soil should be removed and stored separately during excavation. Top soil may be used to re-vegetate the disturbed slope as early as possible. During operation phase, to prevent soil erosion along the embankment, regular monitoring inspections will be undertaken to ensure the drainage; bridge approaches and re-vegetated areas are maintained and strengthened to prevent re-occurrence of soil erosion.

4.3.6 Contamination of Soil

Construction Stage: In this project, contamination of the soil may take place, from the following activities at the construction zones, construction labour camps, construction plant sites and other auxiliary facilities required for the construction. Details of the activities from which the contamination can occur are presented below;

- Scarified bitumen wastes, over production of bituminous product,
- Debris generation due to dismantling of structures,

- Maintenance of the machinery and operation of the diesel generator sets on site,
- Oil spill from the operation of the diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets,
- Operation of the emulsion sprayer and laying of hot mix,
- Operation of the residential facilities for the labour and officers,
- Storage and stock yards of bitumen and emulsion,
- Excess production of hot mix and rejected materials,

Mitigation: Contamination of soil can spoil the soil and can also contaminate the surface as well as ground water sources. Details of potential impacts due to the contamination of soil and their mitigation are presented in **Table 4.9**.

Table 4-9: Potential impacts due to the contamination of soil and their mitigation

| Potential Impact | Mitigation |
|--|---|
| Scarified bitumen wastes, Excess production of hot mix and rejected materials. | Scarified waste and excess/rejected hot mix, with the consent of village authority, will be used in village roads construction. |
| Debris generated from dismantling of structures. | A comprehensive list of instructions/procedures has been suggested in Guidelines for Debris. Disposal Sites and Management, for contractor to adhere to for safe and environmental friendly disposal of debris. |
| Maintenance of the machinery and operation of the diesel generator sets on site. | The base of all machinery, generators will be paved and all the waste/spill will be drained to oil interceptor before discharging. Conceptual Plan of oil interceptor is shown in Figure 4.1 . |
| Oil Spill from the operation of the diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets | |
| Operation of the emulsion sprayer and laying of hot mix | Proper demarcation of the surface to be sprayed /paved will be done to minimize the excessive spread of emulsion/hot mix |
| Operation of the residential facilities for the labour and officers | The residential facilities will be provided with proper sanitation, and planned setup of construction camp. |
| Storage and stock yards of bitumen and emulsion | The base of bitumen/emulsion stock yard will be paved and all the waste/spill will be drained to oil interceptor before discharging. |

Oil interceptor: Oil and grease from polluting run-off is another major concern. During construction, discharge of Oil and Grease is most likely from workshops, oil and waste oil storage areas, diesel oil pumps, vehicle parking areas from the construction camps. Vehicle/machinery and equipment maintenance and refueling will be carried out so that spillage of fuels and lubricants do not contaminate the soil. The source is well defined and restricted. An “oil interceptor” will be provided for wash down and refueling areas. Fuel storage will be in proper bunded areas. All spills and collected petroleum products will be disposed off in accordance with MoEF&CC and SPCB guidelines. Fuel storage and fueling areas will be located at least 300m from all cross drainage structures and significant

water bodies. **Figure 4.1** provides the conceptual plan of the arrangement for the oil interceptor for the removal of oil and grease.

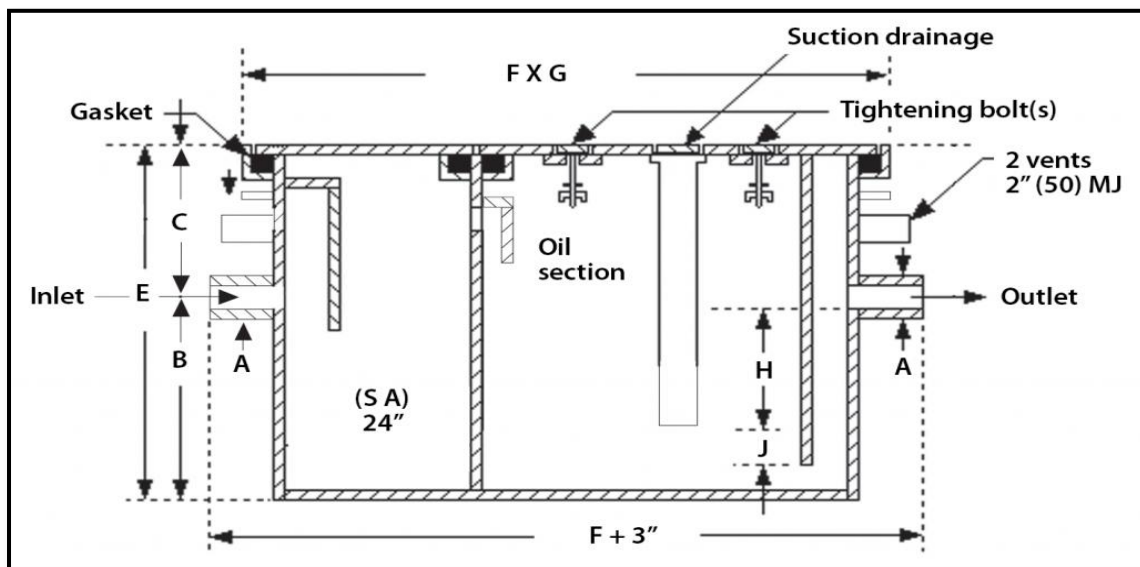


Figure 4-1: Conceptual plan of Oil Interceptor

Operation Stage: During the operation stage, soil may get contaminated with similar reasons, as mentioned above, during routine and periodical maintenance of the project road. The implications of accidental discharge are potentially disastrous. But, it must be emphasized that the probability of such an accident is quite low, as one of the objectives of the design is the enhancement of road safety.

4.3.7 Soil Quality Monitoring-Mitigation

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the concentration of pollutants in the soil due to construction activity shall be monitored, as contamination of soil is directly linked with contamination of water. The monitoring plan shall be functional in construction as well as in operation stages. The frequency, duration and responsibility will be as per the Chapter 6 as Environmental Monitoring Program. The locations of soil monitoring stations are given in Chapter-3 as The Baseline Environment. Any value/result not within acceptable limits will be reported to engineer, for remedial measures.

4.3.8 Construction and Demolition Waste-Mitigation

The key objectives of the guidelines are intended to:

- Promote an integrated approach, whereby environmental management of construction and demolition waste is given due consideration throughout the duration of the project ;
- Approach has been towards reduction of environmental impacts
- Provide both general and specific guidance in relation to the preparation of satisfactory
- construction and demolition waste management plans for projects which exceed a specified threshold size

- Construction and Demolition waste will be managed as per Construction and Demolition Waste Management Rules, 2016.

Major dust generating sources in C&D at sites are:

- Loading and unloading activities: waste and C&D products
 - Incoming/outgoing vehicles
 - Due to machinery used in C&D operations
- Other pollution abatement measures and safety issues

i. **Residual waste deposition:** Solid Waste generation/management in C&D waste operations-residues (C&D waste processing facility) will be sent to landfill in consultation with concerned authorities.

ii. **Diesel uses in equipment/genset/vehicle movement generate emissions:** Necessary pollution control measures will be adopted to reduce emissions.

4.4 NOISE ENVIRONMENT

4.4.1 Impacts

Environmental noise particularly highway traffic noise, is a complex phenomenon because its intensity and characteristics vary with time depending upon the frequency as well as type of vehicles on the road. The impacts of noise due to the project will be of temporary significance locally in the construction phase and slight increase may occur during the operation stages.

4.4.1.1 Noise Modeling

As discussed in Baseline Environment (Chapter-3), the baseline day & night time noise levels monitored at various locations along the proposed project roads are already higher than permissible limits specified by the MoEF&CC for residential and rural areas. Therefore, noise quality modeling by Dhvani pro was carried out in order to predict the future noise level of the project area. It is evident from predicted values that, resultant noise levels for operation phase of the project will increase slightly at receptor locations near proposed road. The noise levels in year 2020, 2030, 2040 and 2050 are given in **Table 4.10**.

Table 4-10: Predicted Noise Quality (dB(A)) of the project area

| Location | Year | Base line Concentration | Incremental Concentration | Resultant Concentration | CPCB Standard |
|----------|------|-------------------------|---------------------------|-------------------------|---|
| NQ1 | 2020 | 55.05 | 54.1 | 57.6 | Daytime 55 dBA and Nighttime 45 dBA for Residential area. |
| | 2030 | | 58.9 | 60.4 | |
| | 2040 | | 61.7 | 62.5 | |
| | 2050 | | 64.4 | 64.8 | |
| NQ2 | 2020 | 54.11 | 47 | 54.9 | |
| | 2030 | | 53.7 | 56.9 | |
| | 2040 | | 55.4 | 57.8 | |
| | 2050 | | 59.1 | 60.3 | |
| NQ3 | 2020 | 61.96 | 51.9 | 62.4 | |
| | 2030 | | 56.7 | 63.1 | |
| | 2040 | | 59.5 | 63.9 | |

| | | | | |
|-----|------|-------|------|------|
| | 2050 | | 62.1 | 65.1 |
| NQ4 | 2020 | 50.02 | 51.2 | 53.7 |
| | 2030 | | 50.1 | 53.2 |
| | 2040 | | 52.9 | 54.7 |
| | 2050 | | 55.5 | 56.6 |
| NQ5 | 2020 | 54.86 | 44.8 | 55.3 |
| | 2030 | | 46.9 | 55.3 |
| | 2040 | | 48.7 | 55.8 |
| | 2050 | | 50.8 | 56.3 |
| NQ6 | 2020 | 57.94 | 51.5 | 58.8 |
| | 2030 | | 52.8 | 59.1 |
| | 2040 | | 59.1 | 61.6 |
| | 2050 | | 61.8 | 63.3 |
| NQ7 | 2020 | 62.17 | 48.7 | 62.4 |
| | 2030 | | 53.6 | 62.7 |
| | 2040 | | 56.4 | 63.2 |
| | 2050 | | 59 | 63.9 |

Since the baseline day & night time noise levels monitored at various locations along the project roads are higher than permissible limits specified by the MoEF&CC for residential and rural areas, noise is a major area of concern.

4.4.2 Mitigation Measures

The source of noise and its Impact and mitigation measures are presented in **Table 4.11** and **Table 4.12**, respectively.

Table 4-11: Source of noise pollution

| Sr. No. | Phase | Source of Noise pollution | Impact categorization |
|---------|--------------------|---|---|
| 1 | Pre-construction | <ul style="list-style-type: none"> Man, material & machinery movements Establishment of labour camps onsite offices, stock yards and Construction plants | <ul style="list-style-type: none"> All activities will last for a short duration and also shall be localized in nature |
| 2 | Construction Phase | <ul style="list-style-type: none"> Plant Site - stone crushing, asphalt production plant and batching plants, diesel generators etc. Work zones - Community residing near to the work zones | <ul style="list-style-type: none"> Plant Site: Impact will be significant within 500m. Work zones: Such impacts again will be of temporary nature, as the construction site will go on changing with the progress of the works. |
| 3 | Operation Phase | <ul style="list-style-type: none"> Due to increase in traffic | <ul style="list-style-type: none"> Will be compensated with the uninterrupted movement of heavy and light vehicles till the facility reaches the level of service |

Table 4-12: Impact due to Noise and mitigation measures

| Sr.No. | Item | Impact | Impact (Reason) | Mitigation |
|--------|---------------------|---------------|---|---|
| 1. | Sensitive receptors | Direct impact | The baseline noise is already exceeding the CPCB limits also there will be considerable | Noise barrier to be provided at locations of road passing through built-up area or residential area or any sensitive locations. Also, traffic |

| | | | | |
|-----|--|-------------------------------|--|---|
| | | | increase in noise levels in the vicinity of road. | calming devices to be used. No Horn Zone sign Post to be displayed. |
| 2a. | Noise Pollution (Pre-Construction Stage) | Direct impact, short duration | Man, material & machinery movements. Establishment of labour camps onsite offices, stock yards and construction plants | Area specific and for short duration Machinery to be checked & 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 | Camps to be setup away from the settlements, in the down wind direction. Noise pollution regulation to be monitored and enforced. |
| 2c. | Noise Pollution (Operation Stage) | Marginal Impact | due to increase in traffic (due to improved facility) | Noise barrier to be provided at locations of road passing through built-up area or residential area. Also traffic calming devices to be used. No Horn Zone sign Post to be displayed. |
| 3. | Noise Pollution Monitoring | | Effectiveness / shortfall (if any) Any unforeseen impact | Measures will be revised & improved to mitigate/ enhance environment due to any unforeseen impact. |

The other noise mitigation measures proposed during construction and operation Phase are as follow:

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90dB(A). If required, high noise producing generators such as concrete mixers, generators, graders, etc. must be provided with noise shields.
- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum.
- Workers in the vicinity of high noise levels will be provided earplugs, helmets and will be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8 hour shift.
- During construction vibratory compactors will be used sparingly within the urban areas. In case of complaints from roadside residents, the engineer will ask the site engineer to take suitable steps of restricting the work hours even further or use an alternative roller.
- Proposed tree and shrub plantations planned for avenue plantation especially close to settlements, may form an effective sound buffer during the operation stage.
- People will be convinced / educated to prevent sensitive land uses from developing up adjacent to the project corridors.
- Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the concentration of pollutants in the soil due to construction activity shall be monitored, as contamination of soil is directly linked with contamination of water. 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 Program (Chapter-6). Any value/result not within acceptable limits will be reported to engineer, for remedial measures.

The noise barrier will be provided below mentioned sensitive locations at the project route.

Table 4-13: Proposed Noise barrier locations – STRR Phase 1

| S. No | Location (km) | | Length (m) | Habitation | Temple | School |
|-------|---------------|--------|------------|-----------------|---------------------------|---------------------------|
| | From | To | | | | |
| 1 | 1.400 | 1.450 | 50 | | | Govt Primary School Manne |
| 3 | 1.700 | 1.730 | 30 | | Maaramma Devi Temple | |
| 4 | 9.900 | 10.000 | 100 | Agalakuppa | | |
| 5 | 15.750 | 15.950 | 200 | Hosapalya | | |
| 10 | 19.800 | 19.900 | 100 | | SreeVeeranjaneyaDevalaya | |
| 9 | 20.000 | 20.100 | 100 | Basavapatna | | |
| 13 | 32.150 | 32.250 | 100 | | Lakshmi Devi Temple | |
| 11 | 32.250 | 32.400 | 150 | Gudemaranahalli | | |
| 12 | 32.600 | 32.650 | 50 | | | Govt. Primary School |
| 14 | 39.200 | 39.300 | 100 | Belagumba | | |
| 15 | 39.300 | 39.400 | 100 | | Pattaladamma Temple | |
| 16 | 39.400 | 39.500 | 100 | | | Govt. High Primary School |
| 17 | 40.350 | 40.450 | 100 | Anandanagara | | |
| 19 | 48.550 | 48.650 | 100 | Basavenahalli | | |
| 22 | 54.150 | 54.200 | 50 | Attingere | | |
| 23 | 54.200 | 54.250 | 50 | | AttingereBasavanna Temple | |
| 25 | 69.100 | 69.150 | 50 | Madapura | | |
| 26 | 69.500 | 69.600 | 100 | | Muneshwara Temple | |
| 27 | 69.100 | 69.150 | 50 | | | Govt. School |
| 31 | 74.100 | 74.200 | 100 | RampuraDoddi | | |
| 32 | 79.250 | 79.450 | 200 | Hunasanahalli | | |
| 33 | 80.950 | 81.150 | 200 | Kunagal | | |
| 34 | 81.600 | 81.800 | 200 | Koonagal | | |

4.5 WATER ENVIRONMENT

4.5.1 Impacts

Due to the proposed project, there will be some direct and indirect long-term impacts on the water resources. **Table 4.14** presents the major adverse impacts on the water resources and the indicators chosen to assess the impacts for the study.

Table 4-14: Impacts on Water Resources due to Construction Activities

| Impacts Due To Construction | Indicators |
|---|--|
| Loss of water bodies | Area of water bodies affected |
| Loss of other water supply sources | Number of wells affected |
| Alteration of drainage, run off, flooding | No. of cross drainage channels |
| Depletion of ground water recharge | Area rendered impervious |
| Use of water supply for construction | Quantum of water used |
| 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 |

Surface Water Bodies: The proposed alignment is crossing Arkavathi River at design km 78.100. Other than this, it also passes through ponds/water bodies at km 8.800, km 12.800, km 27.300 and km 73.500 for that suitable structures have been proposed to maintain the natural drainage pattern of these water bodies.

Alteration of Cross Drainage: During the construction period, some amount of drainage alteration is anticipated, due to construction of temporary traffic diversions and new bridges and culverts. With these bridging of existing causeways, there will be an improvement in the drainage characteristics of the surrounding area and the alteration will be temporary in nature. All the diversions will be provided with adequate waterway for drainage.

4.5.1.1 Run-off and Drainage:

Sediment accumulation in water bodies decreases the storage capacity for road run-off. Tower construction activities can lead to increased run-off both, during the construction and operational stage. This can be considered a high adverse impact.

| Sr.No. | Phase | Reason |
|--------|--------------------|---|
| 1 | Construction phase | The removal of vegetation and compaction of soil can lead to increased run-off during the monsoon |
| 2 | Operational phase | The area of open ground lost and added impervious black top surface increases the amount and rate of run-off. |

Overall, there will be an increase in the impervious surface due to road construction. Since soil erosion is associated with concentrated flow of water, it is imperative to prevent any increased diversion of run-off into drainage channels.

4.5.1.2 Increased Sedimentation:

Degradation of water quality due to sediment transport may occur from activities like removal of trees, removal of grass cover, excavation, stock piling of materials as part of the pre-construction and construction activities. The soil type present along the project corridor consists of the sandy loam to loamy sand.

The impacts due to increased sediment laden run-off will make the water more turbid. This is a significant negative impact on the water bodies supporting aquatic life. Heavier sediment may smother the algae growing in the lower strata and could completely alter

the nature of the watercourse. Excessive sediment loads may also mean disruption to areas of fish breeding.

4.5.1.3 Contamination of Water during Construction Stage

The degradation of the surface and to a much less extent ground water quality can occur from pavement construction works, bridge construction works, construction plants, machinery and accommodations of workers. The sources of water pollution from the construction activities are as follows;

- Water flow from scarified bitumen materials
- From the foundation works of the bridges and culverts such as piling and excavation for open/ well foundations
- Oil spills from the maintenance of the machinery and operation of the diesel generator sets on site.
- Oil Spill from the operation of the diesel pumps and diesel storage, transportation and transfer, parking places, and diesel generators.
- Operation of the emulsion sprayer and laying of hot mix.
- Operation of the residential facilities for the labour and officers.
- Storage and stockyards of bitumen and emulsion.

Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers camps and from spillages from vehicle parking and/or fuel and lubricant storage areas.

4.5.1.4 Contamination of Water during Operation Stage:

During the operation stage, water may get contaminated with similar reasons, as mentioned above, during routine and periodical maintenance of the project road. The implications of accidental discharge are potentially disastrous. But, it must be emphasized that the probability of such an accident is quite low, as one of the objectives of the design is the enhancement of road safety.

4.5.2 Mitigation Measures

As Arkavati River and few minor streams are crossing the alignment, the bridge will be constructed at these locations. These surface water bodies may be affected during construction phase. The construction material will be stored far from water bodies. Also, proper bunds will be provided to protect sedimentation in river.

4.5.2.1 Alteration of cross drainage

- All cross-drainage structures have been designed to handle a 50-year peak flood level. A detailed hydrological study will be carried out to calculate the design discharge.
- Pipe drainages will be provided for diversion roads constructed for the construction of new bridges and culverts.
- Storm water from all longitudinal and cross drainage works will be connected to the natural drainage courses.
- The contractor will remove obstructions that may cause temporary flooding of local drainage channels, during the construction phase.

- Contractor will be responsible for removal of debris generated due to the dismantling of structure and earth generated due to the excavation of foundation, from the water course before the onset of monsoon.

4.5.2.2 Run-off and drainage

- Continuous Drain (lined/unlined) will be provided throughout the project road for efficient drainage of storm water.
- Lined drain is provided at built-up sections for quick drainage of storm water.
- The increased runoff due to increased impervious (Bituminous Top) surface will be countered with increased pervious surface area through soak pits, at hand pump locations.
- The local bodies need to discourage/stop the filling of private water bodies, ponds etc. to develop commercial places and shops due to the improved roads and improved connectivity.

4.5.2.3 Water Requirement and wastewater

The measures for water conservation are as follow:

- The construction water will be purchased from the approved vendors. Contractor needs to obtain approvals from competent authority for taking adequate quantities of water from surface and ground water sources, if required. This is required to avoid depletion of water resources.
- Contractor is required to minimise wastage of water.
- Water conservation methods to adopt during construction process to make optimum use of water, as limited water sources are available along the proposed alignment.
- The septic tanks will be constructed at site during construction and operation phase of the project.
- The wastewater will be collected from site on regular basis and treated in nearby common effluent treatment plant. If water will be discharged outside, the use based classification for Surface Water as per CPCB Guidelines.

4.5.2.4 Increased sedimentation

- Silt fencing will be provided
- Desilting will be done for the existing ponds/Tanks, if any.
- Desilting of the waste water will be ensured before the discharge of drain water into natural stream

4.5.2.5 Rain water Harvesting

This is green field alignment project. The proposed project will increase of surface run-off due to more paved road surface. It will have adverse impact on ground water recharging if measures are not taken during the design.

Rainwater harvesting pit will be provided on either side of road at 500 m interval subject to the first aquifer below 10m. Therefore, approx. 100 ground water recharge pits have been proposed as rainwater harvesting structures. The prototype drawing of water harvesting structure is given in **Figure-4-2**. The design of RWH pits will be as per IRC:SP:50-2013. In addition, the oil interceptors will considered in design to avoid water contamination.

Other Mitigation Measures

- Detailed hydrological survey will be conducted and adequate drainage facilities provided to discharge the run-off to existing catchments area.
- Longitudinal road-side drains on both sides of the road and out fall should be nearby culverts/ bridges on nalas/ rivers/ drains.
- All the construction preparatory activities for culverts, bridges and other structures will be carried out during dry seasons.
- Water for construction will be arranged by the contractor from the existing sources.
- Minimum use of water from existing sources for construction purpose will be ensured promoted at construction site/camps to minimize likely impacts on other users.

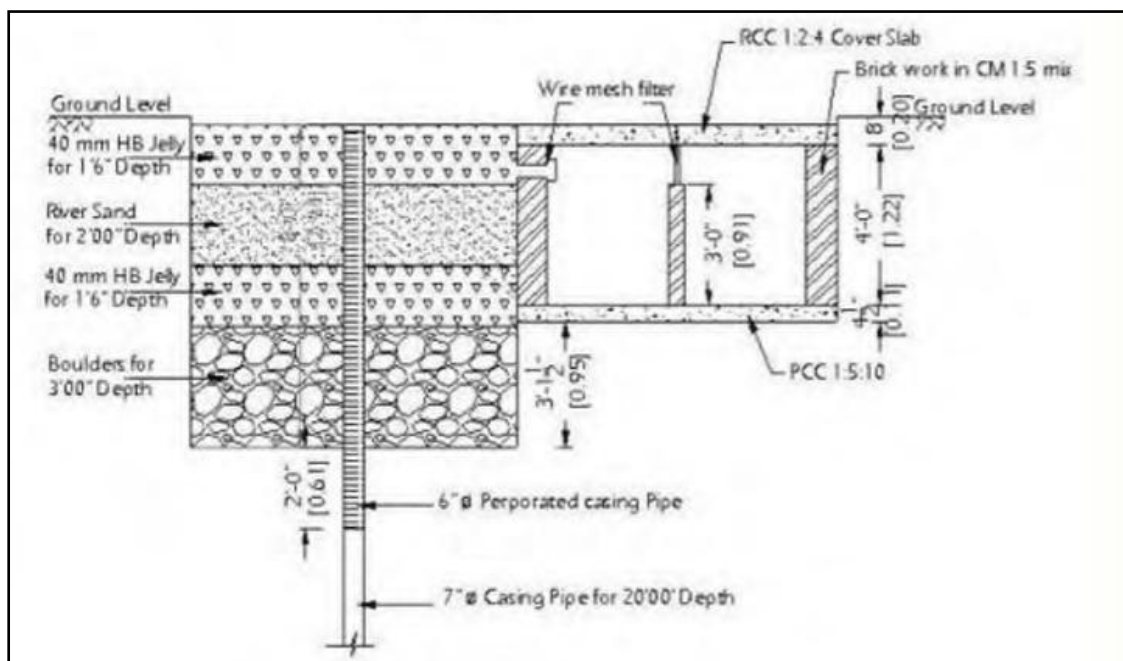


Figure 4-2: Typical Rainwater Harvesting

4.5.2.6 Contamination of Water

- Oil interceptor will be provided at plant site and truck lay byes.
- Construction work close to the streams or water bodies will be avoided during monsoon.
- The discharge standards promulgated under the Environmental Protection Act, 1986 will be strictly adhered to all wastes arising from the project, will be disposed off in a manner that is acceptable to the State Pollution Control Board (SPCB).
- 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 to.
- Construction labourers' camps will be located at least 1000m away from the nearest habitation.
- All approach roads to rivers and other surface water bodies need to be closed permanently to avoid vehicle washing and to avoid major pollution sources. This is applicable to all areas including the secondary construction sites.

- Automotive service centres will be discouraged from establishing along the corridors without installing preventive measures against petroleum and oil contamination.

4.5.2.7 Water Quality Monitoring

Apart from provision of the mitigation measures, their effectiveness and further improvement in designs to reduce the concentration of pollutants in the soil due to construction activity shall be monitored, as contamination of soil is directly linked with contamination of water. 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 Program (Chapter 6). Any value/result not within acceptable limits will be reported to engineer, for remedial measures.

4.6 ECOLOGY

The construction of proposed Greenfield project road can have a substantial impact on the degradation and loss of natural eco systems, especially in less developed areas. Although the actual areas converted to highways may cover only a small proportion of the region, but the fragmentation of habitats caused by highway development is often severe. The scale of both the habitat conversion and habitat fragmentation effects caused by highway development varies with the size of the project. The impacts of projects also vary according to the environmental setting, especially the degree of naturalness in the local and regional ecosystems.

Impacts

The major impact in this project on flora involves the removal of trees to permit construction and to provide clear zone for safety of the road users. **Table 4.15** below presents the major adverse impacts on the flora & fauna and the indicators chosen to assess the impacts for this study.

Table4-15: Impacts on flora & fauna due to construction activities

| Impacts due to Construction | Indicators |
|-----------------------------|---|
| Tree felling | No. of trees to be felled |
| vegetation | Area of vegetation loss |
| Cattle Grazing | Ground Area and location of grazing round |

4.6.1 Forest

No forest area exists within the corridor of impact. Therefore, no diversion of forest land for proposed development is involved. Hence, no direct impacts on forest are anticipated for proposed development. However, 5401 numbers of trees and 16806 numbers of poles will be affected due to proposed development and necessary permission from the forest department will be obtained before felling of these trees.

4.6.1.1 Wildlife

The project is not falling in any protected area and its eco-sensitive zone therefore no wildlife clearance is required. As there is no notified wildlife area and wildlife movement in the project area, however there is elephant movement corridor in other project nearby, therefore it was advised by MOEF&CC to prepare a comprehensive environmental management plan for wildlife management. Hence, CEMP has been prepared along with the

Wild life Management Plan in consultation with forest officials and attached as **Annexure-6** and **Annexure-5**. Also, no endangered species as per IUCN red list is found in the project area.

4.6.1.2 Tree Cutting

The project area is greenfield and there are mix kinds of trees in proposed corridor. The road construction will impose significant and direct impact on these trees, it includes.

The loss of shade

- Loss of ecology in the area.
- Loss of tree products.
- The removal of trees would lead to erosion and contributes to the loss of the micro-ecosystems developed on the roadside.
- Besides this, trees act as noise barrier, dust absorption, air purifier etc.

A detailed tree inventory is being carried out of all the existing trees within the corridor of impact. Due care has been given in alignment design to reduce/minimize the loss of flora. As a result, about 5,401 numbers of trees and 16,806 numbers of poles are likely to get affected due to the proposed project. However, maximum efforts will be given to save the trees especially those which are falling outside the construction zone. The major trees affected Eucalyptus, *Azadirachta indica*, *Acacia catechu* *Ficus Tamarindus indica* etc. No tree will be cut beyond the proposed toe line. Cutting of trees for fuel by workers, especially near their camps is of major concern. Therefore, adequate training of the workers and availability of their fuel requirements are to be ensured by the Contractor.

4.6.1.3 Removal of Vegetation

Clearing and grubbing of the area is the foremost requirement to start the construction activities in accordance with MORTH specifications. The impact due to removal of vegetation includes

- Dust generation during windy atmosphere
- Loss of productive top soil
- Soil erosion during rainy season, may lead to water contamination.

4.6.1.4 Cattle Grazing

No cattle grazing grounds have been found along the corridor of Impact.

4.6.2 Mitigation

The mitigation and enhancement measures taken along the project corridor includes

- a) To compensate the felling of trees.
- b) Avenue Plantation
- c) Landscaping at Junctions and intersection locations etc.

4.6.2.1 Avenue Plantation

Trees shall be planted along the project corridors by the NHAI through Department of Forest. NHAI should sign a MOU with Department of Forest. Such, plantations will be initiated once the construction is complete. The objective behind such plantation is to cover/ re-vegetate the

areas within the RoW that are at presently barren. To maintain the present character of strip plantation, similar indigenous trees should be planted.

Total 33215 trees saplings will be planted in two rows along the corridor by NHAI. Plantation will be carried out as per the IRC: SP: 21:2009

4.6.2.2 Landscaping at Junctions and medians

No trees are planted up to 50m before the intersections so as to achieve clear sight distances for intersections. Shrubs will be planted in the median. It is estimated that 43796 nos. of plants will be carried out in the median. Plantation will be done as per the IRC: SP: 21:2009 and Green Highway Policy-2015.

4.6.2.3 Mitigation Removal of Vegetation

- Measures will be taken in reducing and curtailing the clearing and grubbing of excess land.
- High embankment will be re-vegetated with local shrubs and grasses to prevent soil erosion from the bare earth, prior to the monsoon.

4.7 SOCIO-ECONOMIC IMPACTS

4.7.1 Impacts

Engineering, environmental and socio-economic surveys, conducted during the design phase, for the generation of the baseline information, give indications of several adverse impacts in the vicinity of the alignment, which are related to common human psychology and general in nature.

4.7.1.1 Fear of uncertainties regarding future

These normally become long lived, given the length of time, which elapses between initial surveys and commencement of construction. Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation. These involve:

- uncertainty of the amount of land/property to be acquired,
- time of acquisition and evacuation,
- extent and amount compensation,
- Provision of alternative land or job, etc.

4.7.1.2 Inducement of Land prices

Once the project becomes common knowledge, there may be an incidence of unscrupulous speculators moving in to purchase land at what might seem to be advantageous prices, prior to the commencement of the official procedures. Such impact is more likely to occur in the case of urban fringe areas during the design and pre-construction phase.

4.7.1.3 Inducement of Squatter

Squatters may attempt to occupy land along and adjacent to the proposed alignments, in the hope of receiving compensation or some other inducements to leave when construction commences. Such squatters could cause undue pressure on local resources such as water

and firewood, which could result in conflicts with those who are harvesting the resources presently.

4.7.1.4 Loss of utilities and amenities

Site clearance involves removal of various assets, utilities and amenities that are:

- Natural (trees, bushes and grasslands), and
- Physical structures (public or private assets and utilities).
- Relocation of utilities like electricity, water and telephone lines. For people dependent on the above, this constitutes economic loss for some time before these are restored to their previous status.

4.7.1.5 Public health and safety

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

- Dismantling of properties has psychological impacts on their owners and others associated with them.
- Debris generated on account of the above mentioned activities.

b) Labour Camps during construction period can bring the following problems.

- In the case of non-local labour (if so is arranged by the contractor), 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.
- If alternative fuels are not made available to the workforce, there is a likelihood that trees will be cut down for cooking or heating purposes.
- Insanitary 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 dependants 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,

c) Allied activities during construction period may cause local disruption.

- 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.
- Traffic jams and congestion, loss of access and other road accident risks, as a result of diversion of traffic and construction work on road.

There will be some impact on land during construction, limited mainly to temporary acquisition to cater to road diversion or traffic detours and establishment of labour camps.

d) Accidents and Safety

- Although the design speeds have been kept lower in the major settlement areas, some amount of severance is expected in the rural areas, especially where the residential area is on one side and their agricultural land and other facilities are on the other side of the highway. School children and women carrying pots full of water from the water sources (ponds/wells) also get exposed to this risk.

4.7.1.6 R & R Issues

The major social impacts are due to land acquisition. The land acquisition will lead to displacement of people as a result of affected structure and other properties. There would be impact on 260 households, 310 structures and 172 minor assets due to proposed development. The detail of affected persons and properties is given in Baseline Environment (Chapter-3).

4.7.1.7 Land Use Changes

Land use changes along the road corridors are anticipated. These shall bring about a change in the characteristics of the adjacent lands. There would be succession of land uses and higher return uses would displace the lower returns uses. This phenomenon will occur at major intersections and in settlement areas along the project corridors. The urban fringe areas along the project roads will be subjected to ribbon development.

4.7.2 Mitigation Measures

Table 4-16: General Impacts–Mitigation

| S.No. | Item | Impact | Impact (Reason) | Mitigation/Enhancement |
|-------|--|---------------------|---|--|
| 1. | Fear of uncertainties regarding future | Direct, long Impact | Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation | Public participation sessions were/will be conducted in different stages of project |
| 2. | Inducement of land prices | Direct impact | Danger of unscrupulous speculators moving in to purchase land | Market Value Assessment Committee will decide the actual cost of land |
| 3. | Inducement of squatter influx | Direct impact | Squatters may attempt to occupy adjacent land in the hope of receiving compensation, undue pressure on local resources | The dates of base-line Socio-economic survey have been considered as cut-off date for identification of project affected people PAP. |
| 4. | Loss of utilities and amenities | Direct Impact | Natural (trees, bushes and grasslands), and Physical structures (public or private assets and utilities). | Relocation of utilities will be completed prior to start of project work. These have been further discussed in details in RAP |
| 5a. | Public | High direct | Psychological impacts on | Advance notice as per RAP |

| | | | | |
|-----|------------------------------|-----------------|--|--|
| | Health and Safety | adverse impact | their owners and others associated with them. Debris generated | (4months before commencement ofwork) will be given to the owners of the affected properties. Debris, so generated will be disposed to the satisfaction of Engineer. Monitoring of air, water, noise and land during construction and operation phase. |
| 5b. | Labour Camps | Direct Impact | Can have clashes with the local population, Pressure on basic facilities like medical services, power, water supply, etc. Transmission ofcommunicable diseases including AIDS., sanitary conditions in the labour camps | All contractors will be encouraged to recruit the local people as labourer at least for unskilled and semi-skilled jobs. Hygiene and basic facilities will be ensured at labour camp to prevent the spread of disease. |
| 5c. | Allied activities | Indirect Impact | Social and economic life of the local population due toquarrying and crushing operations, traffic diversions, etc. traffic jams and congestion, loss of access and other road accident risks, temporary land acquisition | Detailed traffic control plans shall be prepared and submitted to the engineer for approval 5 days prior to commencement of work on any section of road |
| 5d. | Accidents and Safety | Direct Impact | School children, ladies carrying pots full of water | The contractor will provide, erect and maintain barricades, including signs marking flags lights and flagmen as required by theEngineer |
| 6. | Resettlement of People | Indirect impact | Pressure on civil amenities, water sources, grazing lands, fuel wood, medical facilities etc. | A comprehensive resettlement action plan has been prepared toimprove the standard of living ofthe affected population. |
| 7. | Land Use Changes | Indirect impact | Succession of land uses and higher return uses would displace the lower return uses at major intersections and in settlement areas. Urban fringe areas will be subjected to ribbon development. | The ribbon development is anticipated during operation phase of the project. |
| 8. | Removal of encroachments and | Indirect impact | loss of shelter disturbance to family and community life | Impact will be avoided by implementation of phase-wise resettlement action |

| | | | | |
|----|----------------|-----------------|---|---|
| | squatters | | | Program Notice will be served 4 months in advance |
| 9. | Host Community | Indirect Impact | Displaced, resettled families will put pressure on the existing scarce infrastructure and amenities available with the host community | Special provision will be made in the cospecial provision will be made in the comprehensive resettlement action plan for the host community |

4.7.2.1 Fear of uncertainties regarding future

It's a green field project with 70m RoW. Land and property owners are subjected to sufferings regarding uncertainties of the extent of loss and the nature of compensation. At places where the community utilities are to be affected a certain amount of anxiety will be among the people in that particular community.

To remove such fear from the people, public participation sessions were/will be conducted in different stages of project, viz. pre-design, design, pre-construction and construction.

In the pre-design stage, a comprehensive socio-economic survey was conducted to prepare base line status of the households squatting or encroached upon the RoW. During the survey each households were contacted/interviewed and they were explained about the purpose of the survey, need of the project and benefits associated with the project etc.

The second stage of public participation was in the form of village meetings, focus group discussion, individual interviews, voluntary and academic institution consultation.

The third stage of participation session will start before pre-construction. The EMU will verify and consult the individual EPs with the help of an NGO for distribution of ID card. At this stage the EPs will be explained about their entitlement and R&R framework. All people likely to be displaced will be informed in advance through NGO by a time bound Programme about resettlement to remove fear of uncertainty.

During the construction stage, the consultation process will continue to avoid any inconvenience to the community at any point of time.

4.7.2.2 Inducement of Land Prices

As the project becomes common knowledge, the land prices along the corridor will increase. For the construction of highway, 685.367 ha. of land will be required; Market Value Assessment Committee (MVAC) will decide the actual cost of such land. The actual cost of land may be different from induced land cost. The MVAC have time bound Program to calculate the actual cost of land. In calculating the actual land, cost individual project affected person (PAP) & NGOs will be involved.

4.7.2.3 Inducement of Squatter Influx

Once the project becomes common knowledge, people may attempt to occupy the land along the corridor in anticipation of compensation. To avoid such, the dates of base-line socio-economic survey have been considered as cutoff date for identification of project-affected people, who are eligible for compensation. The cut off dates will be used to establish whether a person located in the right way qualifies as a PAP for the

disbursement of compensation. All the PAPs recorded during socioeconomic baseline survey are eligible for compensation after verification by EMU.

4.7.2.4 Loss of utilities and amenities

The site clearance for construction of road may result in loss or relocation of certain utilities and amenities, viz electricity, water and telephone line etc. People dependent upon these utilities and amenities may experience inconvenience and economic loss. Though such impacts are unavoidable keeping in mind the scale of work, but every care will be taken in co-ordination with concerned departments, to restore the facility within shortest possible time to avoid any prolonged hardship or inconvenience to the community. Similarly other utilities like water source, cattle trough etc. will be constructed or replaced at appropriate place with the consent of community prior to dismantling the existing one.

4.7.2.5 Public Health and Safety

- a)** During the Pre-construction and Construction Phases dismantling of the structures for CoI clearance and road construction may result in health hazards. To minimise this potential negative impact the following recommendations should be adopted:
- To avoid the psychological impacts due to the demolition of properties on the owners and other tenants. The advance notice as per RAP will be given to the owners of the affected properties. An advance notice will be served at least four months before construction commences. For squatters needing relocation, all R&R activities will be undertaken and entitlements will be completed before construction starts.
 - Debris generated from the demolition of properties will be properly disposed of to avoid the health problems. Earth material, if required will be dumped in borrow areas as approved by the engineer. Borrow areas will be filled to avoid health hazards from stagnant water collecting in these areas. The contractor will make all arrangements for dismantling and cleaning up of debris. Implementation will be as per the approval and direction of the engineer.
- b)** During the construction period the potential negative community impacts arising from imported labour in the labour camps will be avoided as per following: -
- All contractors will be encouraged to recruit the local people as labourer at least for unskilled and semi-skilled jobs. This would automatically reduce the magnitude of impact expected due to outside labour. Wherever the local labourers are not available the contractor should ensure the following provision for imported labour.
 - The additional stress on the facilities like medical services, power, water supply due to a labour camp in a local area will be avoided by the contractor providing these facilities for the labourers as per the direction of the Engineer
 - In areas where wildlife resources are abundant, construction workers shall be instructed how to protect natural resources, fauna, flora and aquatic life. In such areas hunting and unauthorised fishing are prohibited.
 - In the labour camps, 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 will be properly designed built and operated so that no health hazard occurs. Garbage bins will be provided in the camp and

regularly emptied. The collected garbage will be disposed off in a hygienic and approved manner.

c) Allied activities during construction period may cause local disruption:

In the construction phase, there may be inconvenience to the local people as well as the to the nearby highway passengers due to traffic jams and congestion, loss of access and other road accident risk as a result of construction. Detailed traffic control plans shall be prepared and submitted to the engineer for approval 5 days prior to commencement of work on any section of road. In the preparation of the traffic control plan special consideration shall be given to the safety of pedestrians and workers at night.

d) Accidents and Safety

To avoid the accidents during construction phase, contractor shall take all necessary measures to ensure traffic safety. The contractor will provide, erect and maintain barricades, including signs marking flags lights and flagmen as required by the Engineer. In the operation phase, traffic control measures such as speed breakers and sign boards (including speed limits) will be provided and strictly enforced in residential areas, near schools and water bodies like ponds and wells

4.7.2.6 Resettlement of People

People displaced from their home and livelihood on account of the proposed activity will be taken care in the project. A comprehensive resettlement action plan will be prepared to improve the standard of living of the affected population if not at least restore their livelihood and regaining their former standard of living (Refer Resettlement Action Plan Report)

4.7.2.7 Land Use Changes

As regards land use changes, it is observed that the impact would be long term negative impact. Since the project is entirely a new Greenfield developmental project, the possibility of major land acquisition is envisaged. In design stage, utmost care has been taken to keep the land acquisition minimal for road realignment and geometric purpose. The probable impact on road-side business and trees within ROW has been reduced and avoided through design.

Besides mitigation & enhancement, following measures will be taken for safety of the locals:

- Local people will be informed about the schedule of construction activity, so that the local people remain prepared in advance.
- The existing sign boards will not be removed but shifted to appropriate place during construction, so that people don't find problem in identifying the tourist/religious place.
- During construction proper demarcation and sign board, indicators and flag man will be deputed for safe traffic movement.

4.7.2.8 Compensation

The replacement cost of structure is estimated based upon the average of prevailing market value (collected during site visits from local public) of the structure. Most of the

existing structures are either semi-pucca or kutcha. As per survey, a total number of 310 structures including 268 private structures are estimated for the social budget. Structures which are likely to be impacted are Semi-Pucca (102 Nos) followed by Pucca (101 Nos) and Kutcha/Movable (107 Nos). However, while calculating compensation for structures we considered all structures as pucca in nature irrespective of their usage. Apart from private structures; religious and govt. structures are also considered for R&R compensation. The solatium of 100 percent of the rate of affected structures is included for final compensation.

4.8 SOLID WASTE GENERATION

4.8.1 Impacts

The road construction activities will generate a number of waste materials such as:

- a. Vegetation and demolition waste from site clearance;
- b. Excavated materials from earthworks (e.g. cuttings, pile foundations);
- c. General construction waste (e.g. wood, scrap metal, concrete);
- d. Chemical wastes generated by general site practices (e.g. vehicle and plan maintenance/servicing); and
- e. Municipal waste generated by site workers. It is estimated that 250 grams/day /person of municipal waste will be generated.

4.8.2 Mitigation

The above-mentioned waste materials have the potential to cause adverse environmental impacts during generation, storage, transport and disposal. The principal adverse effects relate to dust, water quality, general health and safety and visual impacts. Potential hazards associated with the inappropriate handling of chemical wastes include effects on human health (i.e. dermal and toxic effects with respect to site workers), phyto-toxic effects to vegetation, contamination of the soil, ground waters and surface water following spillage, risk of fire or explosions and discharge of chemical wastes to sewer and potential disruption of the sewage treatment works. If not appropriately managed, municipal wastes generated by site workers have a potential to cause impacts in terms of nuisance, insects and vermin. This may give rise to adverse environmental impacts for both site workers and site neighbours, which could include odour nuisance if putrescible material is not collected on a frequent basis, wind-blown material causing litter problems, if it is not well maintained and cleaned regularly. **Table 4.17** presents the waste management methods.

Table4-17: Waste Management

| Waste Type | Control Measures Proposed | Disposal Method |
|----------------------|---|---|
| General Requirements | <ul style="list-style-type: none"> • Minimization of waste generation for disposal (via reduction/recycling/re-use) • Segregating waste materials according to type to facilitate re-use and recycling • Separation of inert construction and demolition materials for either re-use onsite or use as material fill • During demolition works, segregating materials at source as far as practical • Co-ordinate material deliveries to site | Construction waste will be disposed as per C&D Waste Management Rules, 2016 |

| | | |
|----------------------------------|--|---|
| | <p>inorder to minimize storage times on siteand the likelihood of causing damage</p> <ul style="list-style-type: none"> • Training site staff in waste minimization Practices • Transport of wastes off site as soon aspossible • Maintenance of accurate waste records • Use of re-useable metal hoardings /signboards • No on-site burning will be permitted | |
| Vegetation from preparatory orks | <ul style="list-style-type: none"> • Segregation of materials to facilitatedisposal • In site mulching by contractor to reducebulk and review of opportunities for possible use within landscaping areas | Re-use/landfill |
| Demolition waste | <ul style="list-style-type: none"> • Segregation of materials to facilitate disposal • Appropriate stockpile management | Pre designated disposal site |
| Excavated materials | <ul style="list-style-type: none"> • Segregation of materials to facilitate disposal /reuse • Appropriate stockpile management • Re-use of excavated material on or offsite (where possible) • Special handling and disposalprocedures in the event thatcontaminated materials are excavated | Construction waste will be managed as per C&D Waste Management Rules,2016 |
| Construction waste | <ul style="list-style-type: none"> • Segregation of materials to facilitate recycling/reuse (within designated area and in appropriate containers/stockpiles) • Appropriate stockpile management • Planning and design considerations toreduce over ordering and waste generation • Recycling and re-use of materials where possible (e.g. metal, wood from hoardings, formwork) • For material which cannot be reused/recycled, collection should becarried out by an approved waste contractor for landfill disposal | Construction waste will be managed as per C&D Waste Management Rules,2016 |
| Chemical waste | <ul style="list-style-type: none"> • Storage within locked, covered and bunded area • Storage area should not be located adjacent to sensitive receivers e.g. drains • Minimize waste production and recycleoils/solvents where possible • A spill response procedure should be inplace and absorption material available for minor spillages • Use appropriate and labelled containers Educate site workers on site cleanliness/waste management procedures • Collection by a licensed chemical wastecollector. | Chemical Waste collection by a licensed agency |
| Municipal waste | <ul style="list-style-type: none"> • Waste should be stored within a temporary refuse collection facility, inappropriate | Landfill |

| | | |
|--|--|--|
| | containers prior to collection and disposal. Regular, daily collections are required by an approved waste collector and recycler | |
|--|--|--|

4.9 RISKS AND MITIGATION DURING CONSTRUCTION STAGE

4.9.1 Loss of Access

At all times, the Contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses will not be undertaken without providing adequate provisions. The works will not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.

4.9.2 Traffic Jams, Congestion and Safety

Detailed Traffic Control Plans will be prepared prior to commencement of works on any section of road. 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 and the EMU. Special consideration will be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night.

The Contractor 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.

The Contractor will take all necessary measures for the safety of traffic during construction and provide erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement.

4.9.3 Safety of the Workers

4.9.3.1 Risk from Operations

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

4.9.3.2 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 provisions and to the satisfaction of the Engineer.

4.9.3.3 Risk of Lead Pollution

No man below the age of 18 years and no woman 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.

4.9.3.4 Risk Caused by Force Majeure

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.

4.9.3.5 Risk from Explosives

Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor will not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor will comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable:

- The Contractor 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.
- The Contractor 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.

4.9.3.6 Malarial Risk

The Contractor 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 kilometer 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 water-scarce corridors such as 02, 23 and 28.

4.9.3.7 First Aid

At every workplace, a readily available first aid unit including an adequate supply of sterilized 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.

4.9.3.8 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 publicwater supply then, storage tanks will be provided. All water supply storage will be at a distance of notless than 15m from any latrine, drain or other source of pollution. Where water has to be drawn froman 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.

4.9.3.9 Hygiene

The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the resident engineer.

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 in the 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 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. Construction camps are to be sited awayfrom 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 off 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 sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.

4.10 CONCLUSION

From the above discussions, it is clear that the project will have overall positive impacts due to development of project road sections of NH-948A. The major impacts of project include land acquisition (predominately agricultural and barren). Due consideration have been given to environmental and socio-economic issue during designing phase of the project. Some adverse environmental impacts have been identified which are likely to occur during construction phase which are temporary and short lived and can be mitigated effectively by implementing suggested mitigation measures. The project provides scope for environmental enhancement of the area. Green belt development along the new alignment has been incorporated in the project, which will serve screen for air and noise pollution generated due to vehicular traffic, but at the same time, it will also enhance the overall environmental quality of adjacent areas all along the project corridor. In order to ease the passage of locals from one side of project roads to other, sufficient numbers of underpasses have been proposed for pedestrian movements as well as for local traffic.

It is required to strictly adopt and implement the Environment Management Plan (EMP) The mitigation measures suggested will minimize the identified impacts to acceptable limits.

CHAPTER : 5 ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

This chapter comprises of consideration of feasible alternative routes with respect to terrain, geometric design, connectivity etc. for the development of the proposed highway. A comparative analysis of various alternate routes has been carried out based on the engineering, environmental, social and economic criteria to achieve the project objectives. This chapter describes how the environmental and social parameters were carefully considered in the selection of final alignment with considerable impact on the environment.

5.2 ORIGINAL STRR ALIGNMENT AND PROPOSED MODIFICATIONS

The original corridor proposed with 90m right-of-way consists of divided 4lanes carriageways with depressed median of 20.50m, with service roads (7m) on both sides to facilitate local traffic movement. The provision of high-speed rail corridor of 15m on one side throughout the proposed alignment is also considered. In addition to this, provision of utility corridor of 5m and bus lay-by area also considered on both sides. The corridor of 90m was considered by the state government. The proposed Ring roads is planned to have better connectivity with the 8 satellite towns namely Anekal, Kanakapura, Ramanagara, Magadi, Neelmangala, Doddaballapura, Devanahalli & Hoskote. However, the project deferred due to paucity of funds with the State government.

However, the earlier proposed alignment by the Karnataka state government passes through some of built up stretches, tanks including religious structures, burial grounds etc. Also during the course of time, some new developments also come up. Therefore, it was indispensable to further study the alignment and update, considering the current scenario along the original proposed alignment. Accordingly, modifications are proposed to ensure minimal social impact and to serve the alignment to wider spectrum of inhabitants in that region. The detailed description is given below:

5.2.1 Modifications proposed in Original STRR alignment

1. The original alignment passes through the Dobbaspeth town connecting NH 4 on Bangalore side. This extended further on Doddaballapura side towards NH 207 to ensure avoidance of Dobbaspeth town local traffic.
2. The original alignment (in the cross point of Hassan road) passes through thickly built up area in Gudermahanahalli from km 14.000 to km 22.000 This stretch consists of residential, school and religious structures.
3. The earlier alignment passes through thickly built up area from km 22.000 to km 25.600 in Harthi/Renganahalli.
4. The original alignment passes through Savanadurga Forest area from km 34.700 to km 41.700. This forest also has wildlife.
5. The original alignment pass through Siddadevarabetta Forest area from km 43.000 to km 46.700
6. The original alignment passes through Ramadevarabetta forest area from km 57.700 to km 58.300 near NH 275 crossing in Ramanagara.
7. The proposed Right of Way (RoW) will be kept as 70m.

5.2.2 Value addition proposed

Further the alignment made value additions by connecting some cross roads and considering the current and future proposals in that location as per below details.

1. The starting point of the STRR extended to connect NH 207 (near km 131.200) with a bypass provision in Dobbaspet town on Pune side to ensure uninterrupted traffic flow, contrary to the earlier proposed location pass through the mid of built up area in Dobbaspet. It is relevant to mention that the through traffic contribute from Pune direction, on NH 4 is significant.
2. There is Multi Model Logistic Park (MMLP) and proposed KIADB coming up near Dobbaspet on SH 3 spread at about 250acres of land. The Feasibility study also done for the proposed MMLP project. Therefore, connection to proposed logistic park is eminent and provision made accordingly to these logistic park & KIADB with proposed STRR.
3. NHAI is currently developing bypasses to Kankapura and Ramanagara towns under different programs to ease traffic congestion on NH 209 and NH 275 respectively. Thus, in order to ensure seamless traffic flow through these proposed bypasses, it is necessary to integrate with proposed STRR at these locations.

The modification proposed to the original alignment of the Karnataka state portion tabulated in **Table 5.1**.

Table 5-1: Modified proposed in the Original STRR alignment in Karnataka

| S. No | STRR Original alignment (km) as received | | | Modified STRR Alignment (km) | | | Re-Alignment Side w.r.t Original STRR Alignment | Reason for change |
|-------|--|-------|-------------|------------------------------|-------|-------------|---|--|
| | From | To | Length (km) | From | To | Length (km) | | |
| 1 | 0.00 | 6.50 | 6.50 | 0.00 | 17.50 | 17.50 | Right | To provide Bypass to Dobbasapete town and to connect NH 207 and Proposed MMLP in Dobbasapete |
| 2 | 6.50 | 14.00 | 7.50 | 17.50 | 25.00 | 7.50 | | No change in the original alignment |
| 3 | 14.00 | 22.00 | 8.00 | 25.00 | 33.40 | 8.40 | Left | To avoid Temple and Pond |
| 4 | 22.00 | 25.60 | 3.60 | 33.40 | 37.00 | 3.60 | Left | To avoid Built-up area |
| 5 | 25.60 | 34.70 | 9.10 | 37.00 | 46.00 | 9.00 | | No change in original alignment |
| 6 | 34.70 | 41.70 | 7.00 | 46.00 | 52.70 | 6.70 | Right | To avoid Savanadurga forest. |
| 7 | 41.70 | 43.00 | 1.30 | 52.70 | 54.00 | 1.30 | | No change in original alignment |

| | | | | | | | | |
|----|-------|-------|-------|-------|--------|-------|------|--|
| 8 | 43.00 | 46.70 | 3.70 | 54.00 | 58.00 | 4.00 | Left | To avoid Siddadevarabetta Reserve Forest. |
| 9 | 46.70 | 51.00 | 4.30 | 58.00 | 62.20 | 4.20 | | No change in original alignment |
| 10 | 51.00 | 68.00 | 17.00 | 62.20 | 80.80 | 18.60 | Left | To avoid Siddadevarabetta Vulture Sanctuary (Ramanagara) |
| 11 | 68.00 | 74.00 | 6.00 | 80.80 | 86.75 | 5.95 | | No change in original alignment |
| 12 | 74.00 | 99.00 | 25.00 | 86.75 | 106.00 | 19.25 | Left | To avoid Reserve forest and Hill cutting (Kanakapura) |

5.3 MODIFICATIONS IN ORIGINAL STRR ALIGNMENT

1. Inclusion of Multi Model Logistic Park (MMLP) & proposed KIADB in Dobbaspet: DesignChange km 0.000 to km 17.500 (original km 0.000 to km 6.500)

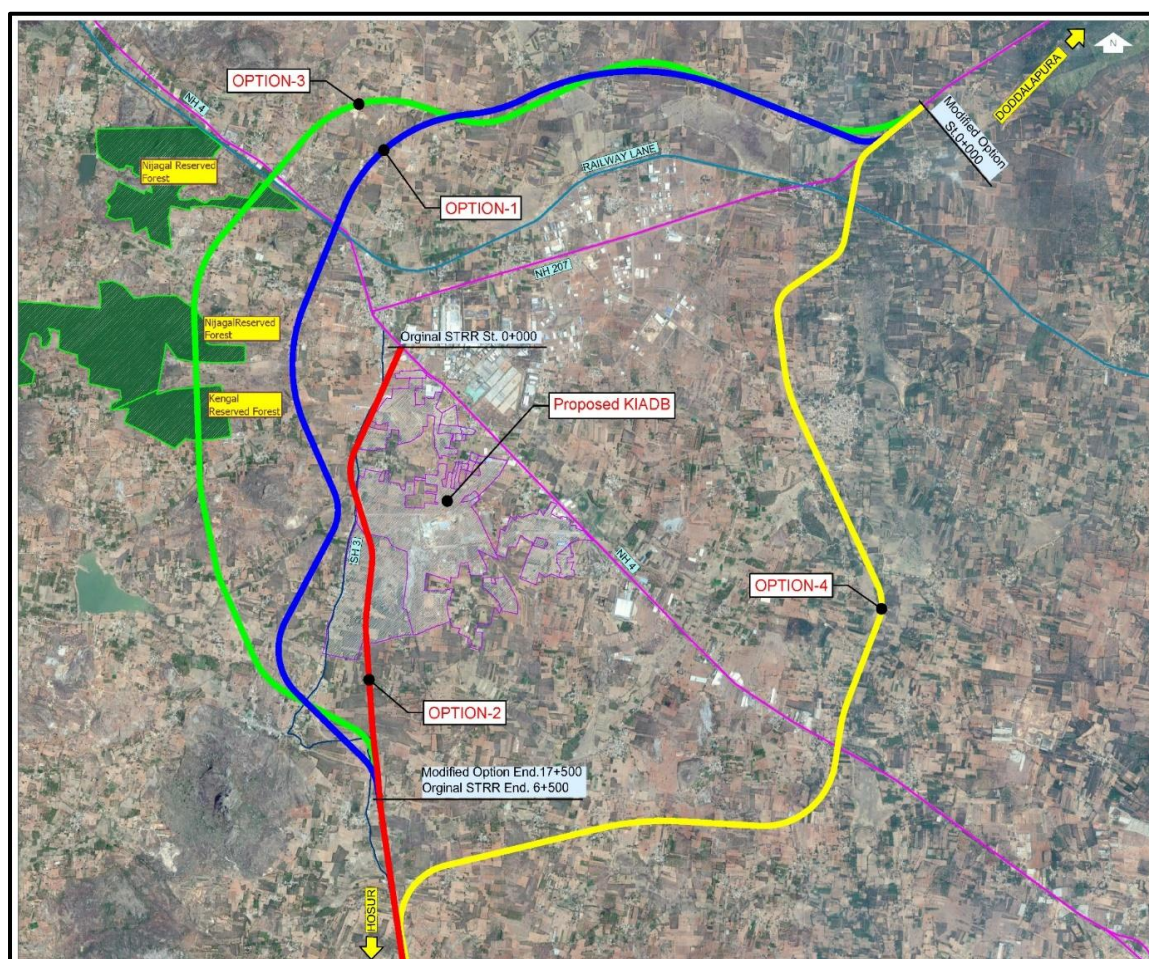


Figure 5-1: Alignment options for design change km 0.000 to km 17.500 (Original km 0.000 to km 6.500)

Comparative statement

The comparative statements of all four options of proposed modifications are given in **Table 5.2.**

Table 5-2: Comparison of Alternatives for design chainage km 0.000 to km 17.500 (Original km 0.000 to km 6.500)

| S. No. | Description | Option-1 | Option 2 (OriginalSTRR) | Option-3 | Option-4 |
|--------|---|---|---|---|---|
| 1 | Length of Alignment (km) | 17.5 | 6.5 | 19.6 | 17.54 |
| 2 | Built-up stretch | Nil | Nil | Nil | Nil |
| 3 | Terrain | Plain | Plain | Plain | Plain |
| 4 | Speed | 100 kmph | 100 kmph | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. |
| 6 | Existing Land use pattern through proposed alignment | Agricultural Land/Barren Land | Industrial Land / Agricultural Land | Agricultural Land / Forest Land | Agricultural Land / Residential |
| 7 | Proposed ROW (m) | 75 | 75 | 75 | 75 |
| 8 | Total Additional land required in hec. | 131.25 | 48.75 | 147 | 131.55 |
| 9 | No of affected Structures (tentative) | 0 | 20 | 5 | 20 |
| 10 | ROB | 1 | 0 | 1 | 1 |
| 11 | Bridge | 0 | 0 | 0 | 0 |
| 12 | Interchange | 1 | 0 | 0 | 0 |
| 13 | Environmental Impact | No significant environmental impact is envisaged | No significant environmental impact is envisaged | The proposed alignment will pass through Nijagal and Kengal Reserve Forest | No significant environmental impact is envisaged |
| 15 | Tentative cost (INR in crores) | 941.05 | 320.89 | 994.576 | 1029.5624 |
| 16 | Merits | 1. No structure/establishment is | | Better road geometry could be achieved | |

| S. No. | Description | Option-1 | Option 2 (OriginalSTRR) | Option-3 | Option-4 |
|--------|-----------------------|---|--|--|---|
| | | affected 2. Connectivity given to proposed MMLP in Dobbasapete 3. Comparatively shorter alignment | | | |
| 17 | Demerits | | 1. Alignment passes through built-up location at Dobbasapete 2. Passes through the proposed MMLP Industrial location in Dobbasapete 3. Not connecting Dobbasapete as a whole | 1. Larger alignment length 2. Passes through Forestland & thus forest clearance need to be obtained before implementation of project 3. Passes through the aggregate quarry area 4. Passes through abutting CISF land | 1. Poor alignment Geometry 2. Passing through Built-up stretch 3. Land cost will be more as the alignment passing through built-up region |
| 18 | Recommendation | Recommended | Not Recommended | Not Recommended | Not Recommended |

2. Design Chainage km 25.000 to km 33.400 (Original km 14.000 to km 22.000)

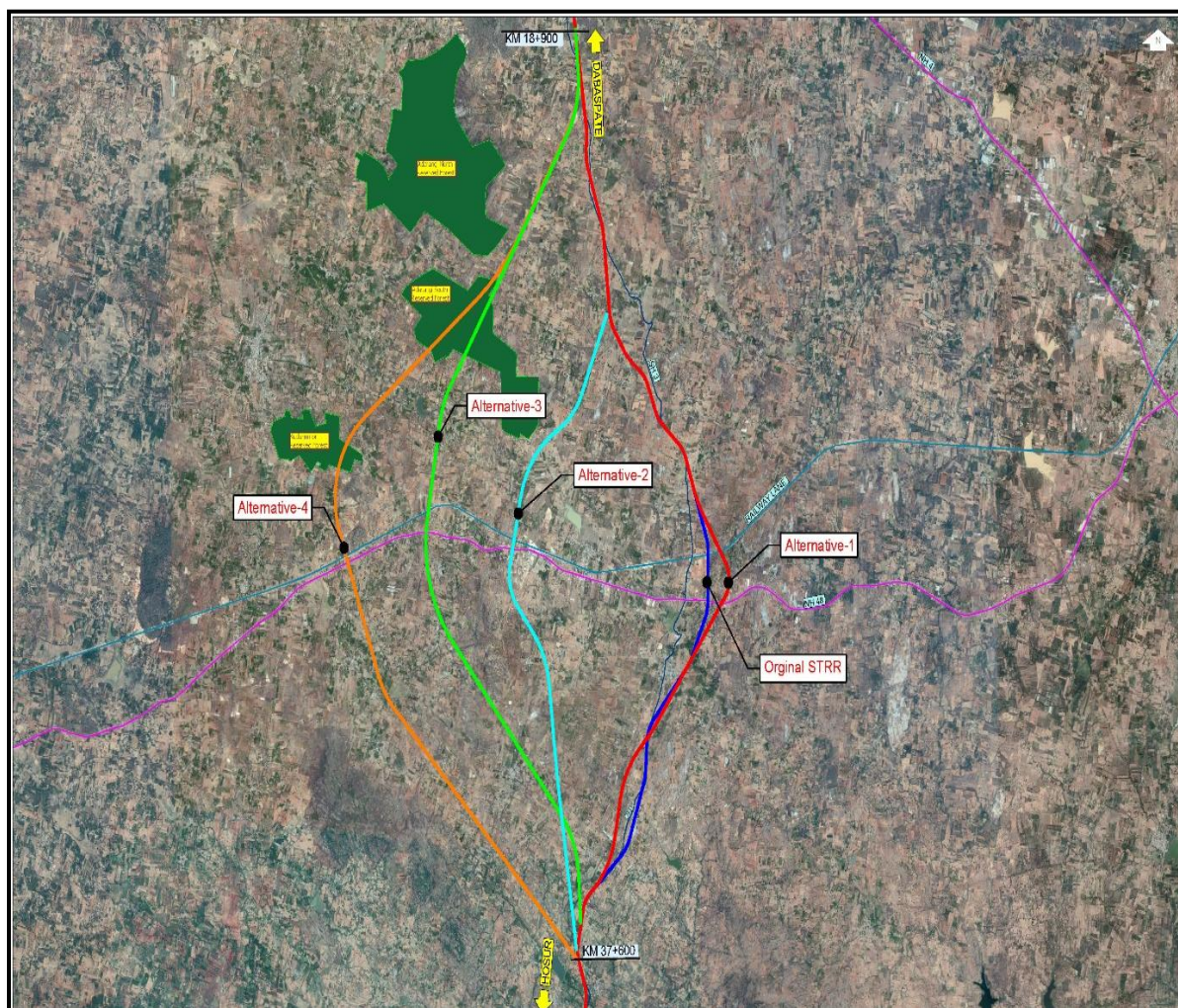


Figure 5-2: Alignment options for design chainage km 25.000 to km 33.400 (Original km 14.000 to km 22.000)

Comparative statement

The comparative statements of all four options of proposed modifications are given in **Table 5.3**.

Table 5-3 : Comparison of Alternatives for design chainage km 25.000 to km 33.400 (Original km 14.000 to km 22.000)

| S. No. | Description | Original STRR | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|--------|---------------------------------|-------------------|-------------------|-------------------------------------|-------------------------------------|---------------------------------------|
| 1 | Length of Alignment (km) | 26 | 27.2 | 26.1 | 27.2 | 29.3 |
| 2 | Built-up stretch | Nil | Nil | Nil | Nil | Nil |
| 3 | Terrain | Plain/rolling | Plain/rolling | Plain/rolling | Plain/rolling | Plain/rolling |
| 4 | Speed | 100 kmph | 100 kmph | 100 kmph | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, | Geometry is good, | Geometry is good, supports 100 kmph | Geometry is good, supports 100 kmph | Ground profile is undulating of about |

| S. No. | Description | Original STRR | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|--------|---|---|---|--|--|--|
| | | supports 100 kmph speed. Good sight distance with curves widely spaced. | supports 100 kmph speed. Good sight distance with curves widely spaced. | speed. Good sight distance with curves widely spaced. | speed. Good sight distance with curves widely spaced. Ground profile is undulating of about 50 to 90 resulting huge cut and fill | 50 to 90 resulting huge cut and fill quantities. Horizontal Geometry is good, supports 100 kmph speed. |
| 6 | Existing Land use pattern through proposed alignment | Mostly Agricultural Land | Mostly Agricultural Land | Barren/Agricultural Land | Barren/Agricultural Land | Barren/Agricultural Land |
| 7 | Proposed ROW (m) | 75 | 75 | 75 | 75 | 75 |
| 8 | Total Additional land required in Hectare | 195 | 204 | 195.75 | 204 | 219.75 |
| 9 | No of affected Structures (tentative) | 50 | 20 | 20 | 5 | 5 |
| 10 | ROB | 1 | 1 | 1 | 1 | 1 |
| 11 | Major Bridge | 0 | 0 | 0 | 0 | 0 |
| 12 | Interchange | 1 | 1 | 1 | 1 | 1 |
| 13 | Environmental Impact | Pass through mid of pond | No significant environmental impact is envisaged | No significant environmental impact is envisaged | No significant environmental impact is envisaged | No significant environmental impact is envisaged |
| 15 | Tentative civil cost (INR in crores) | 1574.06 | 1512.432 | 1510.341 | 1572.432 | 1627.333 |
| 16 | Merits | - | Less construction cost and better alignment geometry | The alignment will be comparatively closer Mangalore side | The alignment will be close to Mangalore side and the VOC in long run will be reduced as most of traffic comes from Mangalore port | The alignment will be close to Mangalore side and the VOC in long run will be reduced as most of traffic comes from Mangalore port |
| 17 | Demerits | Passes through large number of structures including | About 15 to 20 structure only affected. Interchange and ROB | Passes through close to a community graveyard and provision of | Interchange and ROB provisions will be close (300m) and so combined provision of single | Interchange and ROB provisions will be close (100m) and so combined provision of single structure is |

| S. No. | Description | Original STRR | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|--------|-----------------------|--|--|---|---|------------------------------------|
| | | religious structure, resulting higher land & social cost Passes through the mid of a pond. Interchange and ROB provisions will be close to 1000m and so combined provision of single structure is required. Higher construction cost | provisions will be separate as the distance is about 1.1km | interchange will be affect and Passes through big plots comprising soap factory, restaurant etc.structures also the alignment is closed to Milk plant, electrical substation, railway station and major water body. Interchange and ROB provisions will be close (250m) and so combined provision of single structure is required. Height of ROB will be in second level due to existing ROB approach. Higher construction cost | structure is required. Higher construction cost | required. Higher construction cost |
| 18 | Recommendation | Not Recommended | Recommended | Not Recommended | Not Recommended | Not Recommended |

3. Avoiding thick built up area in Rangenahalli:Design Chainage km 33.400 to km 37.000 (original km 22.000 to km 25.600)

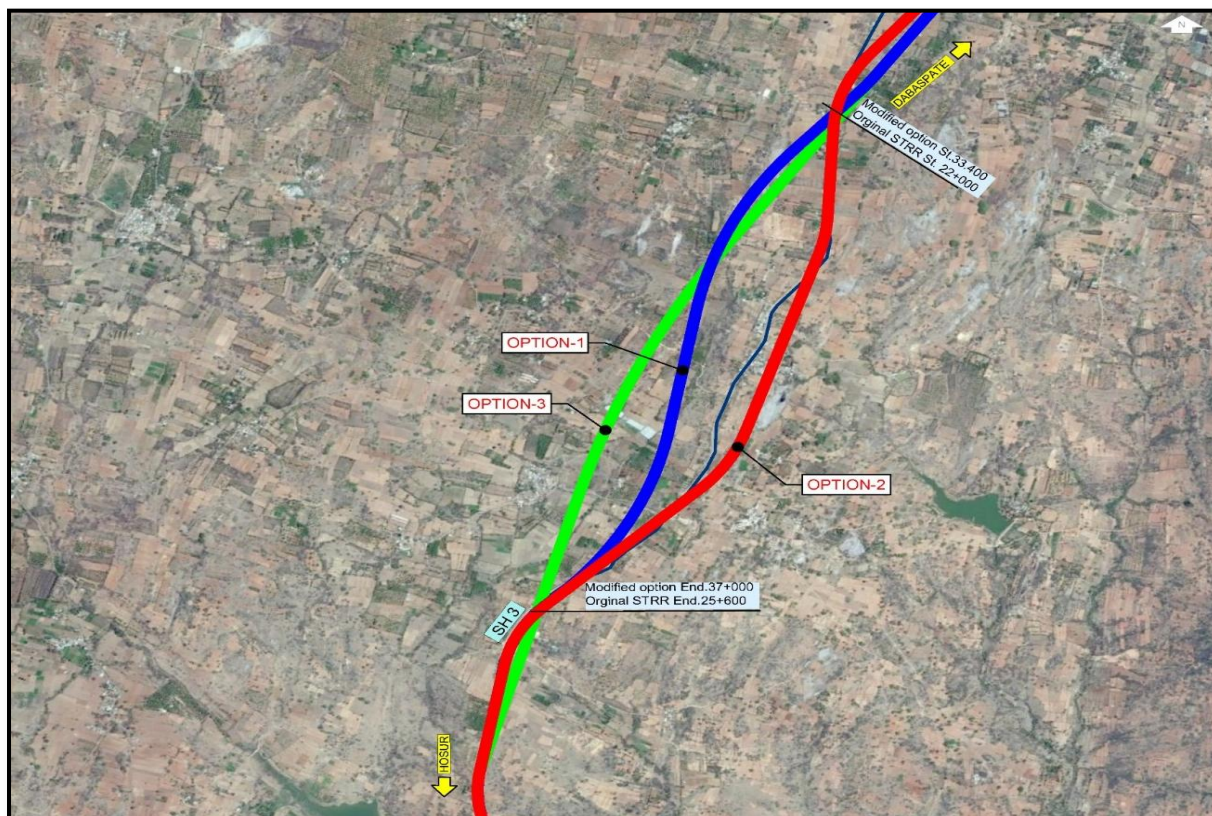


Figure 5-3: Alignment options for design chainage km 33.400 to km 37.000 (Original km 22.000 to km 25.600)

Comparative statement

The comparative statements of all four options of proposed modifications are given below Table 5.4.

Table 5-4: Comparison of Alternatives for design chainage km 33.400 to km 37.000 (Original km 22.000 to km 25.600)

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---------------------------------|---|---|---|
| 1 | Length of Alignment (km) | 3.6 | 3.6 | 5.7 |
| 2 | Built-up stretch | Nil | Nil | Nil |
| 3 | Terrain | Plain | Plain | Plain |
| 4 | Speed | 100 kmph | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. |

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---|--|--|--|
| 6 | Existing Land use pattern through proposed alignment | Agricultural Land | Agricultural Land | Agricultural Land / Forest Land |
| 7 | Proposed ROW (m) | 75 | 75 | 75 |
| 8 | Total Additional land required in Hec. | 27 | 27 | 42.75 |
| 9 | No of affected Structures (tentative) | 0 | 30 | 5 |
| 10 | ROB | 0 | 0 | 0 |
| 11 | Bridge | 0 | 0 | 0 |
| 12 | Interchange | 0 | 0 | 0 |
| 13 | Environmental Impact | No significant environmental impact is envisaged | No significant environmental impact is envisaged | No significant environmental impact is envisaged |
| 15 | Tentative civil cost (INR in crores) | 169.866 | 172.866 | 269.4545 |
| 16 | Merits | 1. Shorter alignment length 2. No built-up land is involved | | |
| 17 | Demerits | | 1. More than 30 establishments would get affected 2.Comparatively poor alignment geometry | 1. Passes through pond 2.Higher construction cost |
| 18 | Recommendation | Recommended | Not Recommended | Not Recommended |

4. Avoiding Savanadurga forest Area: DesignChkmainage km 46.000 to km 52.700 (Original km 34.700 to km 41.700)

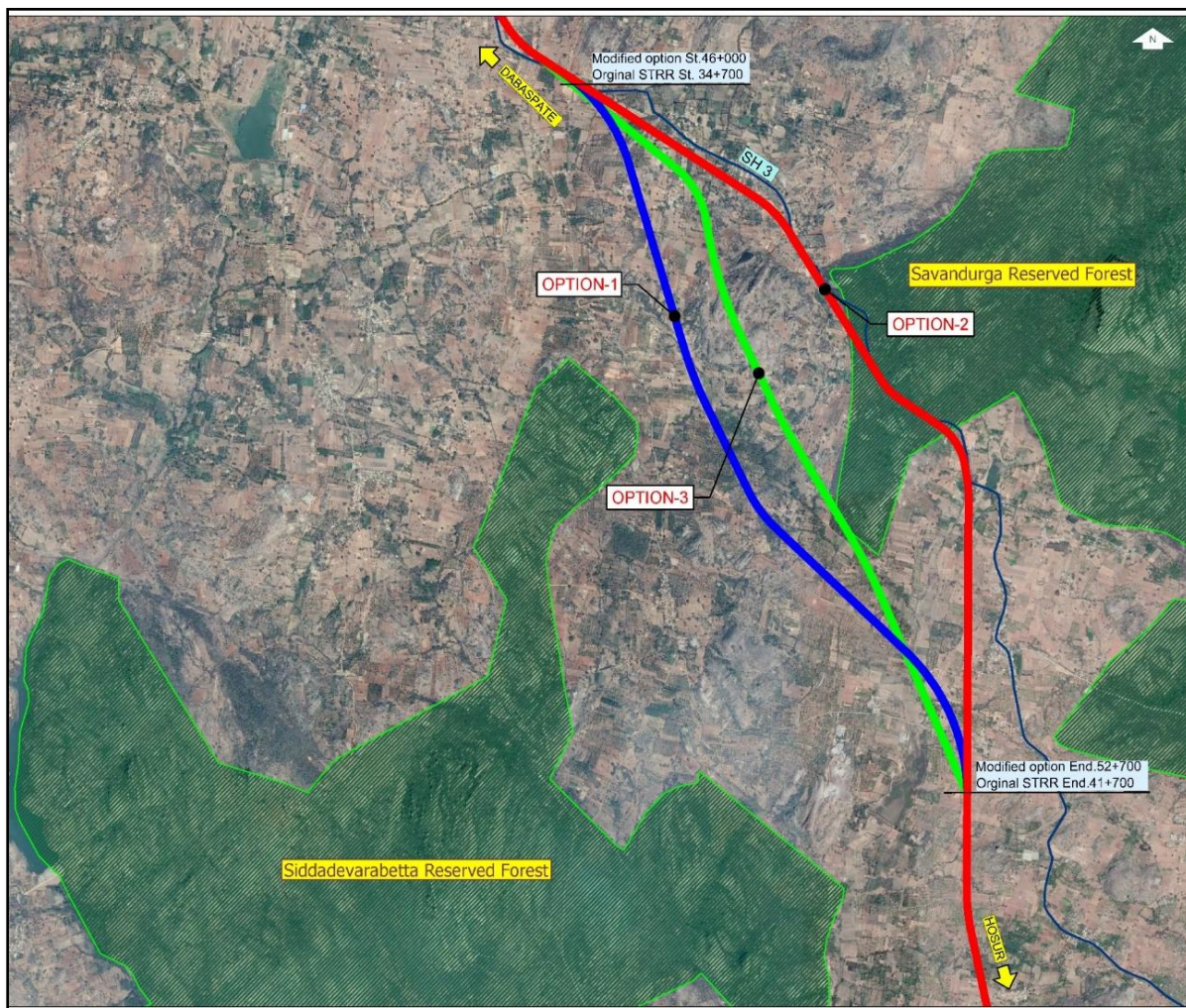


Figure 5-4: Alignment options for design chainage km 46.000 to km 52.700 (Original km 34.700 to km 41.700)

Comparative statement

The comparative statements of all four options of proposed modifications are given in **Table 5.5**.

Table 5-5: Comparison of Alternatives for design chainage km 46.000 to km 52.700 (Original km 34.700 to km 41.700)

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---------------------------------|--|---|---|
| 1 | Length of Alignment (km) | 6.7 | 7 | 8.8 |
| 2 | Built-up stretch | Nil | Nil | Nil |
| 3 | Terrain | Plain | Plain | Plain |
| 4 | Speed | 100 kmph | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, supports 100 kmph speed. | Geometry is good, supports 100 kmph speed. Good sight | Geometry is good, supports 100 kmph speed. Good sight |

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---|--|--|--|
| | | Good sight distance with curves widely spaced. | distance with curves widely spaced. | distance with curves widely spaced. |
| 6 | Existing Land use pattern through proposed alignment | Mostly Barren Land | Barren Land / Forest Land | Barren Land / Forest Land |
| 7 | Proposed ROW (m) | 75 | 75 | 75 |
| 8 | Total Additional land required in Hec. | 50.25 | 52.5 | 66 |
| 9 | No of affected Structures (tentative) | 0 | 0 | 0 |
| 10 | ROB | 0 | 0 | 0 |
| 11 | Bridge | 0 | 0 | 0 |
| 12 | Interchange | 0 | 0 | 0 |
| 13 | Environmental Impact | No significant environmental impact is envisaged | The proposed alignment passes through Savanadurga Reserve Forest. Thus, Reserve forest clearances required. | The proposed alignment passes through Savanadurga Reserve Forest. Thus, Reserve forest clearances required. |
| 15 | Tentative civil cost (INR in crores) | 316.1395 | 330.295 | 415.228 |
| 16 | Merits | 1. Away from forest land, resulting ease in construction 2. Better alignment geometry | | |
| 17 | Demerits | | The proposed alignment passes through Savanadurga Reserve Forest. Thus, Reserve forest clearances required. This will delay the project implementation | The proposed alignment passes through Savanadurga Reserve Forest. Thus, Reserve forest clearances required. This will delay the project implementation |

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|-----------------------|-------------|---------------------------|-----------------|
| 18 | Recommendation | Recommended | Not Recommended | Not Recommended |

5. Siddadevarabetta Forest Area: DesignChainage km 54.000 to km 58.000 (Original km 43.000 to km 46.700)

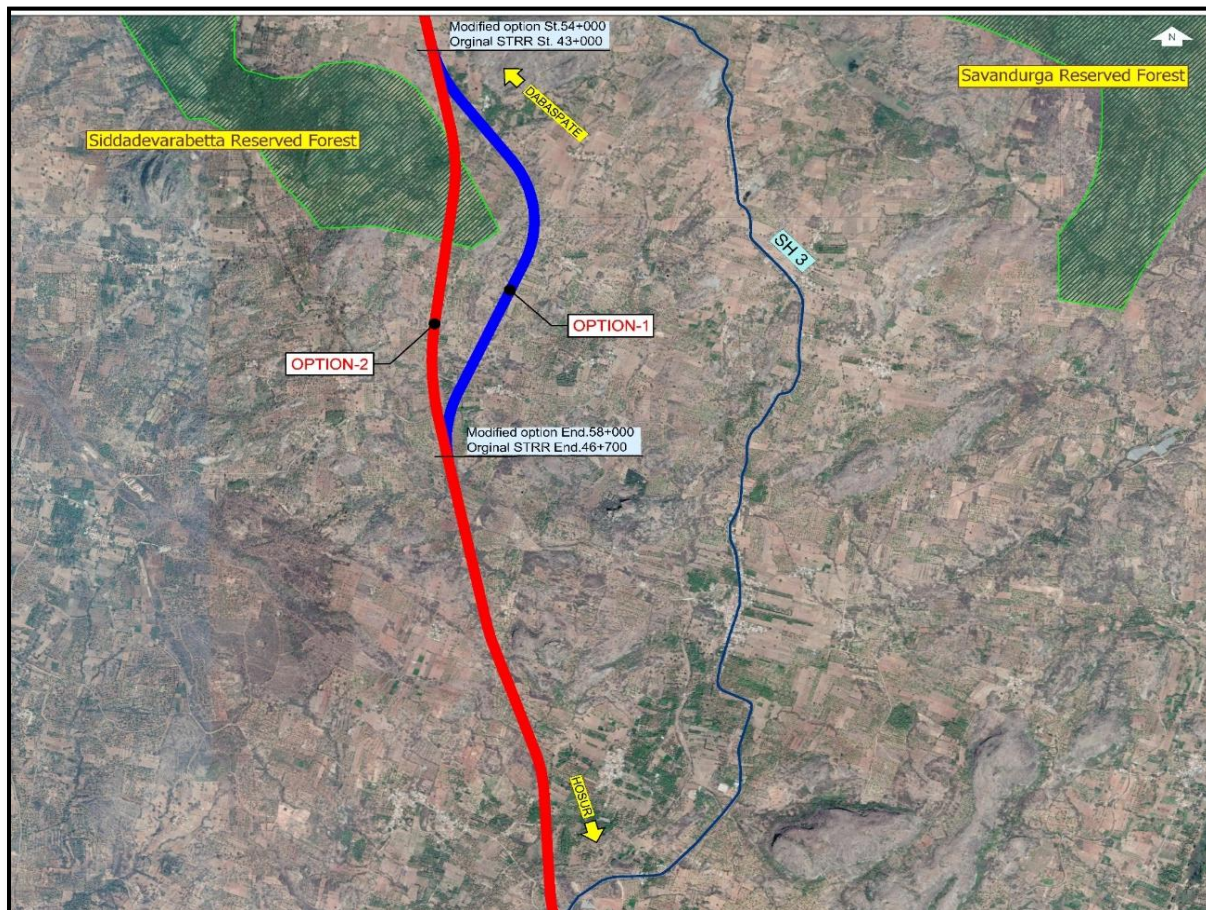


Figure 5-5: Alignment options for design km 54.000 to km 58.000 (Original km 43.000 to km 46.700)

Comparative statement

The comparative statements of all four options of proposed modifications are given in **Table 5.6.**

Table 5-6: Comparison of Alternatives options for design km 54.000 to km 58.000 (Original km 43.000 to km 46.700)

| S. No. | Description | Option-1 | Option-2 (original STRR) |
|--------|---------------------------------|----------|---------------------------|
| 1 | Length of Alignment (km) | 4 | 3.7 |

| S. No. | Description | Option-1 | Option-2 (original STRR) |
|--------|---|---|--|
| 2 | Built-up stretch | Nil | Nil |
| 3 | Terrain | Plain | Plain |
| 4 | Speed | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. |
| 6 | Existing Land use pattern through proposed alignment | Mostly Barren Land | Barren Land / Forest Land |
| 7 | Proposed ROW (m) | 75 | 75 |
| 8 | Total Additional land required in Hec. | 30 | 27.75 |
| 9 | No of affected Structures (tentative) | 0 | 0 |
| 10 | ROB | 0 | 0 |
| 11 | Bridge | 0 | 0 |
| 12 | Interchange | 0 | 0 |
| 13 | Environmental Impact | No significant environmental impact is envisaged | The proposed alignment passes through Siddadevarabetta Reserve Forest. Thus, Reserve forest clearances required. |
| 15 | Tentative civil cost (INR in crores) | 188.74 | 174.5845 |
| 16 | Merits | Away from forest land, resulting ease in construction | |
| 17 | Demerits | | The proposed alignment passes through Siddadevarabetta Reserve Forest. Thus, Reserve forest clearances required. |
| 18 | Recommendation | Recommended | Not Recommended |

6. Ramanagara vulture Sanctuary area: Design Chainage km 62.200 to km 80.800 (Original km 51.000 to km 68.000)

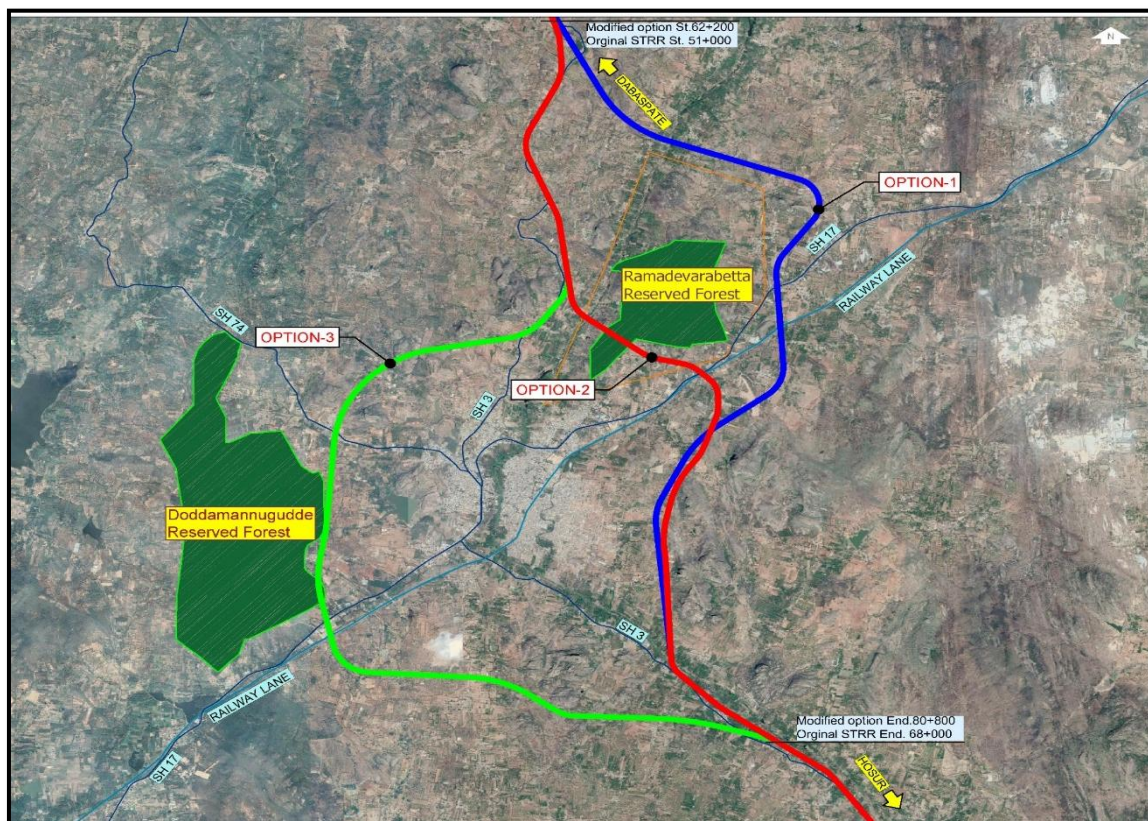


Figure 5-6: Alignment options for design chainage km 62.200 to km 80.800 (Original km 51.000 to km 68.000)

Comparative statement

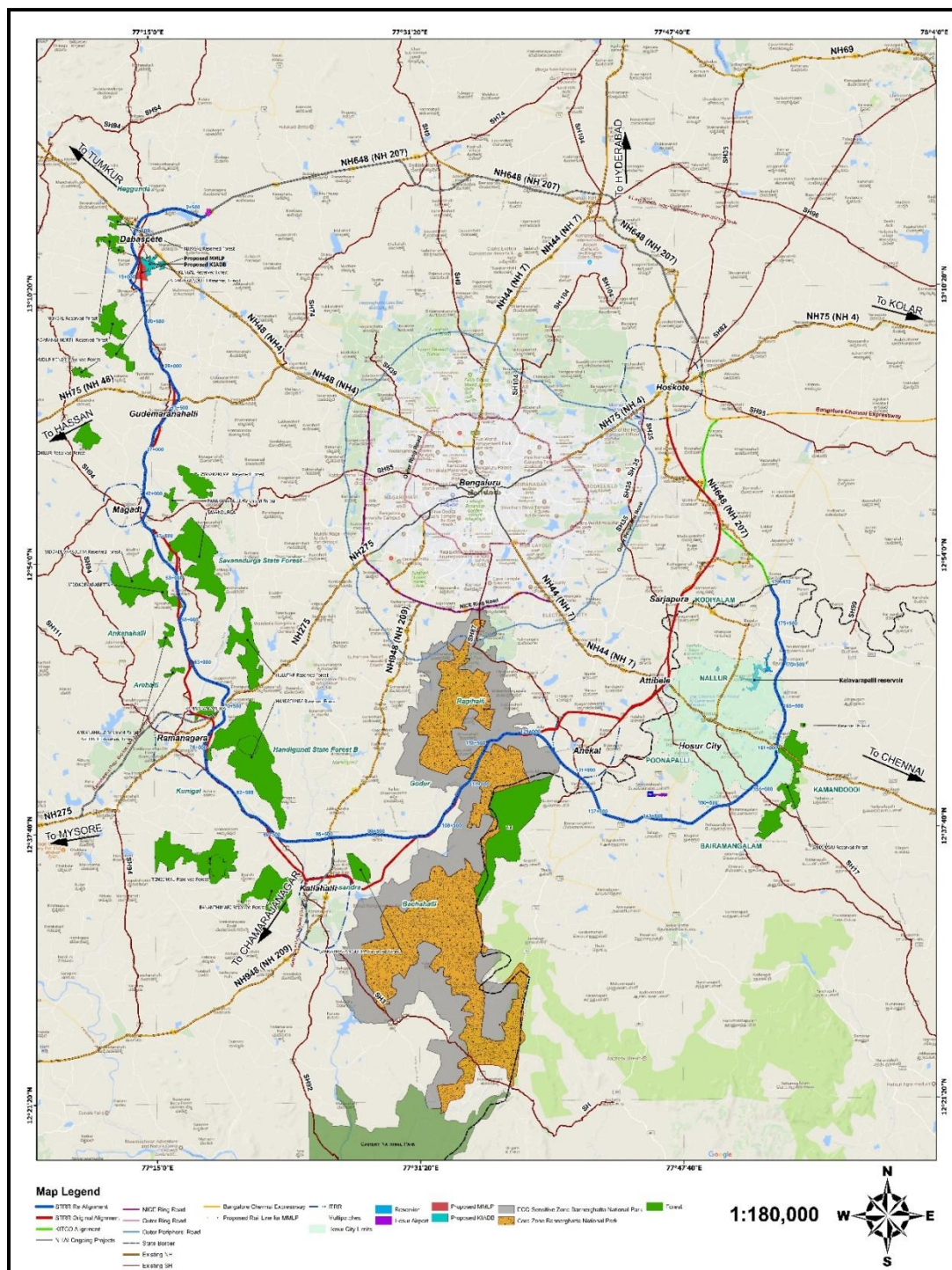
The comparative statements of all four options of proposed modifications are given in **Table 5.7**.

Table 5-7: Comparison of Alternatives for design chainage km 62.200 to km 80.800 (Original km 51.000 to km 68.000)

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---------------------------------|---|---|---|
| 1 | Length of Alignment (km) | 18.6 | 17 | 25.05 |
| 2 | Built-up stretch | Nil | Nil | Nil |
| 3 | Terrain | Plain | Plain | Plain |
| 4 | Speed | 100 kmph | 100 kmph | 100 kmph |
| 5 | Geometries | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. | Geometry is good, supports 100 kmph speed. Good sight distance with curves widely spaced. |

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|---|---|---|---|
| 6 | Existing Land use pattern through proposed alignment | Agricultural Land/Barren Land | Agricultural Land / Forest Land/Residential | Agricultural Land/Barren Land/Forest Land |
| 7 | Proposed ROW (m) | 75 | 75 | 75 |
| 8 | Total Additional land required in Hectare. | 139.5 | 127.5 | 187.875 |
| 9 | No of affected Structures (tentative) | 0 | 0 | 10 |
| 10 | ROB | 1 | 1 | 1 |
| 11 | Bridge | 1 | 1 | 1 |
| 12 | Interchange | 1 | 1 | 2 |
| 13 | Environmental Impact | No significant environmental impact is envisaged | The alignment is passing through the Ramadevarabetta Reserve forest | The proposed alignment pass through close proximity of Doddamannugudde Reserve Forest |
| 15 | Tentative civil cost (INR in crores) | 992.641 | 917.145 | 1347.98425 |
| 16 | Merits | 1.Not demolishing any major structure 2.No forest land is involved, resulting ease of construction | | |
| 17 | Demerits | | The alignment is passing through the mid of Ramadevarabetta Vulture Sanctuary | 1. Larger alignment length 2. The proposed alignment passes through close proximity of Doddamannugudde Reserve Forest. 3. the existing railway line and the National highway are in close proximity (250m) therefore vertical geometry not suitable for ROB & interchange |

| S. No. | Description | Option-1 | Option-2 (original STRR) | Option-3 |
|--------|-----------------------|-------------|--------------------------|---------------------|
| | | | | provision in NH 275 |
| 18 | Recommendation | Recommended | Not Recommended | Not Recommended |



*The proposed STRR declared as National highway with a serial number 462 and new National highway number 948A as per MORTH Gazette notification no 6, dated 02/01/2018.

Figure 5-7: Final Alignment

5.4 'WITH' AND 'WITHOUT PROJECT' SCENARIO

Considering the possible positive impacts to the economic and social infrastructure of the region, the proposed road development is imperative; however, with such development the impacts on the regional environment are also unavoidable. Hence, to understand the significance of the proposed project better "With" and "Without" Project scenarios are compared and presented in **Table 5.8**.

Table 5-8: Comparison between 'With' and 'Without Project' Scenarios

| Component | "With" Project Scenario | "Without" Project Scenario |
|---------------------------|--|--|
| Carriageway | The carriageway will be constructed to 6-lane configuration with paved and earthen shoulders on either side. This will ensure seamless traffic flow. | The Freight traffic will traverse through Bangalore City area and further lead to traffic congestion |
| Traffic Congestion | The new road will be capable of ensuring uninterrupted free flow traffic. This will ensure the Bangalore city free from long route trucks that do not need to enter just for passage. The environment parameters of the region will significantly improve besides saving in vehicle operating cost. | The heavy traffic will continue to move through the Bangalore city thereby mixing with the city traffic and increase the traffic congestion in Bangalore city |
| Road Safety | There will be a reduction in road accidents after development of the new highway, as there will be adequate space for plying safe movement of vehicles to cross and to overtake. The city traffic will be separate with through commercial traffic and thereby ensure adequate safety to light city vehicles. | Mix of city traffic with through commercial traffic lead to traffic congestion in all arterial roads. This leads to many road accidents. As per the community consultation, many accidents are taking place on the existing road stretches due to mix traffic. With increase in traffic, the situation may worsen. |
| Environmental Quality | The free flow of traffic on the new highway will improve the environmental quality, as the emissions from the plying vehicles will reduce due to seamless flow. There will be temporary increase in dust and emissions during the construction phase only and is reversible. | Environmental quality will further deteriorate due to pollution and high emission from slow traffic movement and congestions. With increase in traffic, the pace of degradation of environment will only hasten. |
| Transportation Facilities | Free flow interchanges, VUPs/LVUPs, and truck lay byes proposed along the project road for convenience of people. Thus, the travel quality will drastically improve on the road conditions. | Bad travel quality. |
| Economic Development | Economic activities will automatically improve once the new | The economic activity will remain static and local and will improve only at a |

| | | |
|--------------------------|--|--|
| | road is developed around the Bangalore city. It will also benefit farmers, as they will be able to sell their produce in distant markets due to improved transportation. | laggard pace. |
| Employment Opportunities | The proposed project will generate direct employees of 2000 numbers during construction and 250 numbers during operation phase. Apart from this, it will create considerable number of indirect employees in form of transportation of construction materials, greenbelt development, ancillary facilities like canteens, dhabas etc. Mostly local people from nearby places will be given preference. | No such opportunity |
| Development Potential | There will be higher potential for development in this area due to improvement in access and consequent increase in economic activity. Essential community infrastructures like drainage system, water supply, electricity, transportation etc. will come as consequence of current development. | Development activity will greatly hampered due to inadequate connectivity. |

It can be concluded that “With” project scenario having positive/ beneficial impacts will significantly enhance social & economic development of the region when compared to the “Without” project scenario. Hence, the “With” project scenario with some reversible impacts is a preferred and acceptable option rather than the “Without” project scenario. The implementation of the project, therefore, will definitely be beneficial for overall socio-economic environment of the impacted region.

5.5 ALTERNATIVES FOR CONSTRUCTION TECHNOLOGY

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 in **Table 5.9**.

Table 5-9: Analysis of Cold & Hot Mix Technology

| Sl.No. | Parameter | Cold Mix | Hot Mix |
|--------|-------------|--|---|
| 1 | Description | Street Cold Asphalt is a relatively new product developed in 1995 through the introduction of new polymer technology and research into the manipulation of viscosity | 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 |

| | | | |
|---|------------------|--|---|
| | | and material design, of the various components of an asphaltmix - Street Cold Asphalt is softand sticky out of the bag, but itquickly hardens after applicationand the end result is a pavementpatch with better strength butsimilar properties to hot asphalt. | plants or batch mix plants, according to the process by which the raw materials are mixed. In a batch mix plant, the aggregate isdried first, then transferred to a mixerwhereitismixedwiththeliquidasphalt. In a drum mix plant, a rotary dryer serves to dry the aggregate and mix it with the liquid asphalt cement. |
| 2 | Requireme nts | Cold patch, also known as cold mix or cold asphalt, was first recognized as a way to make road repairs quickly because it can be applied right from the container without heating. Cold asphalt also doesn't require any special heavy rolling machines or special applicators as it can be shovelled or poured into a pothole or utility cut andtamped down with a hand tool. | Hot mix asphalt concrete (commonly abbreviated as HMAC or HMA) is produced by heating the asphalt binder to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C) for virgin asphalt and 330 °F (166 °C) for polymer modified asphalt, and the asphalt cement at 302 °F (150 °C). Paving and compaction must be performed while the asphalt is sufficiently hot |
| 3 | Use | Cold mix asphalt concrete is produced by emulsifying the asphalt in water with (essentially) soap prior to mixing with the aggregate. While in its emulsified state the asphalt is less viscousand the mixture is easy to work and compactThe emulsion will break afterenough 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 | 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 | Actually less expensive to useover the life of a road repair Completely seals and patches potholes, utility cuts, edge repairs, and even overlays | Less expensive for new roadconstruction |
| 5 | Demerits | Less resilient and morevulnerable to cracking | Expensive |

5.5.1 Technological Option

- 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 too much prior to compacting)
- Instantly ready for traffic – and in fact product cures and hardens more quickly with compaction forces. Rapid access over the surface reduces down time where there are time- critical schedules
- Limited mess than other brands – product will not stick to or stain hands or shoes even when bucket is freshly opened
- No bleeding
- No drift of bitumen to the surface requiring surface preparation prior to any further overlay
- Reduced labour time and therefore cost
- No requirement for special equipment
- Environmentally beneficial as it reduces carbon emission and noxious fumes avoid wastage

CHAPTER : 6 ENVIRONMENTAL MONITORING PROGRAM

6.1 INTRODUCTION

Monitoring of environmental quality during construction and operation stages reflects the success of implementation of the mitigation measures. In addition, it provides a means to review the suggested measure and improve upon the measures. To ensure the effective implementation of the Environmental Management Plan (EMP), it is essential that an effective environmental monitoring program be designed and carried out.

6.2 MONITORING PROGRAMME OBJECTIVES

The broad objectives are:

- To evaluate the adequacy of Environmental Assessment.
- To suggest ongoing improvements in management plan based on the monitoring.
- To enhance environmental quality through proper implementation of suggested mitigation measures
- To satisfy the requirements of environmental regulatory framework and community obligations.

6.2.1 Performance Indicators

The physical, biological and social components, which are significant in affecting the environment at critical locations, have been suggested as Performance Indicators. The following specific environmental parameters can be qualitatively measured and compared over a period of time and therefore selected as Performance Indicators for monitoring due to their regulatory importance and the availability of standardized procedures and relevant expertise.

- Air quality with respect to PM₁₀, PM_{2.5}, NO_x, SO₂ and CO at selected locations.
- Water quality with reference to DO, BOD, COD, Suspended Solids, Turbidity, Alkalinity, Oil and Grease at selected water bodies.
- Noise level at selective /sensitive locations (Institutions, Hospitals, Religious places)
- Survival rates of trees planted as compensatory afforestation to compensate for removal of trees the proposed Greenfield alignment.

6.2.2 Ambient Air Quality (AAQ) Monitoring

Ambient air quality parameters which are recommended for monitoring of construction of highway projects are Particulate Matter (Size less than 10 μ m or PM₁₀ μ g /m³), Particulate Matter (Size less than 2.5 μ m or PM_{2.5} μ g /m³), Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO).

These parameters are to be monitored at selected locations such as plant and machinery sites, crusher sites, excavation works, etc. starting from the commencement of construction activity. Data should be generated at the selected monitoring locations as per the frequency given in **Table 6.1** in accordance with National Ambient Air Quality (NAAQ) Standards, 2009 since these are applicable from 18th November, 2009 onwards.

6.2.3 Ambient Noise Monitoring

The measurement for monitoring the noise levels to be carried out at selective locations and at construction sites along the proposed alignment in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board. Sound pressure level would be monitored on twenty-four hour basis. Noise shall be recorded at "A" weighted frequency using digitized noise monitoring instrument.

6.2.4 Water Quality

Water quality of local water resources that is used by local community shall be monitored. The physical and chemical parameters recommended for analysis of water quality relevant to road project are pH, total solids, total suspended solids, total dissolved solids, COD, BOD, DO, Oil and Grease, Chloride, Iron, etc. The monitoring of the water quality will be carried out at all locations identified along the proposed alignment during construction and operation phase. Monitoring parameters will be as per IS-10500:2012 for ground water quality and for surface water quality as per CPCB Guidelines for used based surface water classification.

6.2.5 Tree Survival Rate

Roadside plantation of trees and their management will be an important environmental activity for the management group. These activities will include selection of plant species, development of nurseries, protection of plants, interaction with roadside communities for plantation management, and their maintenance, etc.

The construction of the new project road requires felling of trees within the project road alignment. This loss will be duly compensated by compensatory afforestation. The compensatory afforestation will be done as per the Forest (Conservation) Act, 1980 and prevailing policy of Karnataka Forest Department.

To ensure the proper maintenance and monitoring of the compensatory afforestation, a regular maintenance and monitoring of the survival rate of the planted trees is being proposed upto a period of 5 years from the operation of the project. This will be monitored by implementing agency with the help of the Forest Department.

6.2.6 Monitoring Plan

The monitoring plan covering various performance indicators, frequency and institutional arrangements of the project in the construction and operation stages.

6.3 ENVIRONMENTAL REPORTING SYSTEM

Monitoring and evaluation are important activities in implementation of all projects. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for project management to keep the program on schedule.

The reporting system will operate linearly with the Concessionaire/Contractor, who will report to PMC/CSC, who will in turn report to the Project Implementation Unit (PIU), Bangalore, NHAI. All reporting by the Concessionaire and EO-CSC shall be on monthly/quarterly/semi-annually/annual basis. The PIU, Bangalore shall be responsible for preparing targets for each of identified EMP activities.

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

provided the project Environmental Completion Report shows that the implementation was satisfactory. Otherwise, the operation stage monitoring reports will have to be prepared as specified in the said project Environmental Completion Report.

Table 6-1: Environmental Monitoring Plan

| Environment Component | Project Stage | Environmental Monitoring | | | | Duration | Institutional Responsibilities | | | |
|-----------------------|---------------|---|--|--|--|---------------------|--------------------------------|---|---|------------------------|
| | | Parameters | Standards | Locations | Frequency | | No. of Samples | Action Plan in case criteria exceeds | Implementation | Supervision |
| Air Quality | Construction | PM ₁₀ µg/m ³ ,PM _{2.5} µg/m ³ ,SO ₂ ,NO _x ,CO | National Ambient Air Quality Standard | Batching Plant, Hot Mix Plant (HMP) and Stone Crusher (3 locations) | Once in a month in all season (excluding the monsoon) for 2.5 years | Continuous 24 hours | 3x3x3x2.5 = 68 | Check and modify control device like bag filter/cyclones of hot mix plant | Contractor through approved monitoring agency | CSC,NHAI-PIU Bangalore |
| | | PM ₁₀ µg/m ³ , PM _{2.5} µg/m ³ , SO ₂ , NO _x , CO | | At equipment yards and along the project road at 7 locations of baseline monitoring in consultation with EO-CSC. | Once in a month in all season (excluding the monsoon period) for 2.5 years | Continuous 24hours | 3x3x8x2.5 = 180 | - | Contractor through approved monitoring agency | CSC,NHAI-PIU Bangalore |
| | Operation | Along the project road at locations of baseline monitoring (7 locations) | | Once in a season excluding the monsoon for a year | Continuous 24hours | 1x3x7x1 = 21 | - | Concessionaire through approved monitoring agency | CSC,NHAI-PIU Bangalore | |
| Surface Water Quality | Construction | pH,temperature,DO, BOD,COD,Oil & Grease,Total Suspended Solid, TDS, turbidity, Total Hardness, Chlorine, Iron,Total Coliformet c. | Surface Water Quality Standard as per used based classification for Surface Water as per | At identified locations. Minimum 4 locations | Once in a season (excluding the monsoon period) for 2.5 years | Grab Sampling | 1x3x4x2.5 = 30 | Check and modify oil interceptors, silt fencing devices | Contractor through approved monitoring agency | CSC,NHAI-PIU Bangalore |

| Environment Component | Project Stage | Environmental Monitoring | | | | Institutional Responsibilities | | | | |
|-----------------------|---------------|--|--|---|--|--------------------------------|----------------|---|--|-------------------------|
| | | Parameters | Standards | Locations | Frequency | Duration | No. of Samples | Action Plan in case criteria exceeds | Implementation | Supervision |
| | Operation | pH,temperature, DO, BOD, COD, Oil & Grease, Total Suspended Solid,TDS, turbidity, Total Hardness, Chlorine, Iron, Total Coliform | CPCB Guide lines. | At identified locations. Minimum 4 locations | Once in a season (excluding the monsoon period) for a year | Grab Sampling | 1x3x4x1 = 12 | Check and modify oil interceptors, silt fencing devices | Concession aire through approved monitoring agency | CSC, NHAI-PIU Bangalore |
| GroundWaterQuality | Construction | pH, Temperature, TSS, Total hardness, Suspended Solid, Chlorine, Iron, Sulphate, Nitrateetc. | Ground Water Quality Standard as per IS-10500:2012 | Plant Construction site and Minimum 4 locations | Once in aseason (excluding the monsoon period) for 2.5 years | Grab Sampling | 1x3x4x2.5 = 30 | Check and modify oil interceptors, silt fencing devices | Contractor through approvd monitoring agency | CSC,NHAI-PIU Bangalore |
| | Operation | pH, Temperature, TSS, Total hardness, Suspended Solid, Chlorine, Iron, Sulphate, Nitrateetc. | | At identified locations. Minimum 4 locations | Once in a season (excluding the monsoon period) for a year | Grab Sampling | 1x3x4x1 = 12 | Check andmodify oilinterceptors, siltfencing devices | Concession aire through approved monitoring agency | CSC,NHAI-PIU Bangalore |

| Environment Component | Project Stage | Environmental Monitoring | | | | Institutional Responsibilities | | | | |
|-----------------------|---------------|---|---------------------------------------|--|--|--|-------------------------|---|---|------------------------|
| | | Parameters | Standards | Locations | Frequency | Duration | No. of Samples | Action Plan in case criteria exceeds | Implementation | Supervision |
| NoiseLevel | Construction | LeqdB (A) (DayandNight) Average and Peak values | National Ambient Noise Standard, 2000 | Batching Plant, Hot Mix Plant (HMP) and Stone Crusher (3 locations) | Once in a month in all season (excluding the monsoon) for 2.5 years | Readings to be taken at 60 seconds interval for every hour and then Leq are to be obtained for Day time and Night time | 3x3x3x2.5 = 67.5 say 68 | Check and modify control device like bag filter/cyclones of hot mix plant | Contractor through approved monitoring agency | CSC,NHAI-PIU Bangalore |
| | | | | At equipment yards and along the project road at 7 locations of baseline monitoring in consultation with EO-CSC. | Once in a month in all season (excluding the monsoon period) for 2.5 years | Readings to be taken at 60 seconds interval for every hour and then Leq are to be obtained for Day time and Night time | 3x3x8x2.5 = 180 | Check and modify equipment and devices used to protect noise level | Contractor through approved monitoring agency | CSC,NHAI-PIU Bangalore |

| Environment Component | Project Stage | Environmental Monitoring | | | | Institutional Responsibilities | | | | |
|-----------------------|---------------|--|-----------|---|--|---|----------------|--------------------------------------|---|-------------------------|
| | | Parameters | Standards | Locations | Frequency | Duration | No. of Samples | Action Plan in case criteria exceeds | Implementation | Supervision |
| Soil | Operation | LeqdB(A)(Day and Night) Average and Peak values | - | At the location of baseline monitoring. Minimum 7 locations | Once in a season (excluding monsoon) for a year | Reading to be taken at 60 seconds interval for every hour and then Leq are to be obtained for Daytime and Nighttime | 1x3x7x1 = 21 | - | Concessionaire through approved monitoring agency | CSC, NHAI-PIU Bangalore |
| | Construction | Physical Parameter : Texture, Grain Size, Gavel, Sand, Silt, Clay, Chemical Parameter : pH, Conductivity, Calcium, Magnesium, Sodium, Nitrogen, Absorption Ratio | - | Locations of baseline monitoring in consultation with EO-CSC. Minimum 4 locations | Once in a season (excluding the monsoon) for 2.5 years | Composite Sample | 1x3x4x2.5 = 30 | - | Contractor through approved monitoring agency | CSC, NHAI-PIU Bangalore |
| | Operation | Physical Parameter: Texture, Grain Size, Gravel, Sand, Silt, Clay; Chemical Parameter: pH, Conductivity, Calcium, Magnesium, Sodium, Nitrogen, Absorption Ratio etc. | - | At the location of baseline monitoring. Minimum 4 locations | Once in a season (excluding the monsoon) | Composite Sample | 1x3x4x1 = 12 | - | Concessionaire through approved monitoring agency | CSC, NHAI-PIU Bangalore |

| Environment Component | Project Stage | Environmental Monitoring | | | | Institutional Responsibilities | | | | |
|---|------------------------|--|--|--|--|--------------------------------|----------------|--------------------------------------|---|--|
| | | Parameters | Standards | Locations | Frequency | Duration | No. of Samples | Action Plan in case criteria exceeds | Implementation | Supervision |
| Construction Sites and Construction Camps | Construction | Monitoring of: 1.Storage Area 2.Drainage Arrangements 3.Sanitation in Construction Camps | As laid out in the Detailed Design for the project | At Storage area and construction camps | Quarterly in the construction stage. | - | - | - | Concessionaire through approved monitoring agency | CSC, NHAI-PIU Bangalore |
| Roadside plantation | Pre-Construction Stage | Monitoring of felling of tree (It should be ensured that only those trees, which are falling information width, are felled) | As laid out in the Detailed Design for the project | All along the corridor | During the felling of trees | - | - | - | Forest Department | Concessionaire .(to assist in coordination with the NHAI |
| | Operation stage | Survival rate of trees Success of re-vegetation Then number of trees surviving during monthly visit should be compared with number of sapling planted. | As laid by the concerned department. | All along the corridor | Every year for initial three years during operation phase. | - | - | - | Concessionaire & Forest Department | Concessionaire & Forest Department |

EO – Environmental Officer, CSC – Construction Supervision Consultant, PIU – Project Implementation Unit, NHAI – National Highway Authority of India.

6.4 ENVIRONMENTAL MONITORING COST

Based upon the length and existing environmental scenario of the proposed project road the environmental monitoring cost is estimated. Approx. INR 37,57,000/- (Rupees Thirty Seven Lakh Fifty Seven Thousand only) or INR 37.57 lakh for environmental monitoring cost has been allocated for construction and operation stages of proposed project road sections of NH-948A. The details are provided in **Table 6.2**.

Table 6-2: Environmental Monitoring Cost

| Component | Stages | Particular | Quantity | Unit Rate (Rs.) | Total Cost (Rs.) |
|---------------|--------------|---|--|-----------------|------------------|
| Air Quality | Construction | Monitoring near Batching Plant Site hot mix plant locations and Stone Crusher | At 3 locations, Once in a month in all season (excluding the monsoon) for 2.5 years (3x3x3x2.5 = 68) | 8,000/samples | 5,44,000/- |
| | | Monitoring at construction sites | At 8 locations, Once in a month in all season (excluding the monsoon period) for 2.5 years (3x3x8x2.5 = 180) | 8,000/samples | 14,40,000/- |
| | Operation | Ambient Air Quality Monitoring | At 7 locations, Once in a season excluding the monsoon for a year (1x3x7x1=21) | 8,000/samples | 1,68,000/- |
| Surface Water | Construction | Surface water resources | At 4 locations, Once in a season (excluding the monsoon period) for 2.5 years (1x3x4x2.5 = 30) | 6,000/samples | 1,80,000/- |
| | Operation | Surface water resources | At 4 locations, Once in a season (excluding the monsoon period) for a year (1x3x4x1=12) | 6,000/samples | 72,000/- |
| Ground water | Construction | Ground water bodies | At 4 locations, Once in a season (excluding the monsoon period) for 2.5 years (1x3x4x2.5 = 30) | 6,000/samples | 1,80,000/- |
| | Operation | Ground water bodies | At 4 locations, Once in a season (excluding the monsoon period) for a year (1x3x4x1 = 12) | 6,000/samples | 72,000/- |

| Component | Stages | Particular | Quantity | Unit Rate (Rs.) | Total Cost (Rs.) |
|--|--------------|--|---|-----------------|---------------------------------------|
| Noise | Construction | Monitoring near Batching Plant Site, hot mix plant locations and Stone Crusher | At 3 locations, Once in a month in all season (excluding the monsoon) for 2.5 years (3x3x3x2.5 = 67.5 say 68) | 3,000/samples | 2,04,000/- |
| | Construction | At equipment yards and construction site along the project road | At 8 locations, Once in a month in all season (excluding the monsoon period) for 2.5 years (3x3x8x2.5 = 180) | 3,000/samples | 5,40,000/- |
| | Operation | Along the project road | At 7 locations, Once in a season (excluding monsoon) for a year (1x3x7x1 = 21) | 3,000/samples | 63,000/- |
| Soil | Construction | At productive agricultural lands abutting traffic detours and traffic diversions, to be identified by the Engineer | At 4 locations, Once in a season (excluding the monsoon) for 2.5 years (1x3x4x2.5 = 30) | 7,000/samples | 2,10,000/- |
| | Operation | At four locations where baseline monitoring has been carried out | At 4 location, Once in a season (excluding the monsoon) (1x3x4x1 = 12) | 7,000/samples | 84,000/- |
| Construction Site and construction camps | Construction | Monitoring of: 1. Storage Area 2. Drainage arrangements 3. Sanitation in Construction camps | Quarterly in construction stage till end of construction | - | - |
| Road side Plantation | | Considered in EMP Budget | - | - | - |
| TOTAL ENVIRONMENTAL MONITORING COST (Rs.) | | | | | 37,57,000/- Say 37.57 lakh |

CHAPTER : 7 ADDITIONAL STUDIES

7.1 PUBLIC CONSULTATION

Public participation and community consultation is taken up as an integral part of social and environmental assessment process of the project. Consultation is used as a tool to inform and educate stakeholders about the proposed action both before and after the development, decisions are made. This assists in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process is helpful in reducing the public resistance to change and to enable the participation of the local people in the decision making process. The involvement of the various stakeholders ensures that the affected population and other stakeholders are informed, consulted and allowed to participate at various stages of project preparation.

Initial Public consultations have been carried out in this project during the site surveys with the objectives of minimizing probable adverse impacts of the project through alternate design solutions (alignment and cross-sectional) and to achieve speedy implementation of the project through bringing awareness amongst the community on the benefits of the project. The public/official consultation has been taken up as an integral part of social and environmental assessment process for this project.

7.1.1 Objectives of Public Consultation

Community consultations in the project are undertaken with objectives, which may be grouped into:

- Information sharing.
- Appraisal and assessment of the community needs.
- Assessment of the environmental issues in the region, and
- Development of specific design solutions and enhancement measures.

7.1.2 Consultations with Project Authorities and Other Officials

Consultation with the stakeholders and government agencies is an integral component of environmental assessment and project design. Without community consultation, a project will not reflect issues or solutions identified by local residents, and a lack of government agency consultation can result in missed data and a lack of conformity with policy and guidelines, in addition to missed opportunities to share experiences and identify solutions to difficult concerns/issues.

Consultations with government agencies and community consultations have been focused to ensure that complete and accurate data is incorporated into the screening assessment, EIA and SIA Report.

The numbers of officials from various governmental departments have been consulted to assess the actual environmental as well as social conditions of the region.

7.1.2.1 District level Consultation at site

The public, have been consulted at various level of the project stages. Photographs of the public consultation/hearing are shown below:



Public Meeting SLAO Kunigal & Project Director PIU Bangalore at Dabaspete for Nelamangala Taluk.



Public Consultation and Project Site Visit with SLAO at Kanakapura



Photographs of Public Consultation at Project Site

Figure 7-1: Photographs of public consultation

7.1.3 Continued Consultations and Participation

In order that the consultations continue till the implementation of the project, to redress the environmental issues likely to surface during construction and operational phases, a constant

communication will be established with the affected communities and the road users. To achieve this, contractors in consultation with the Supervision Consultant will organize periodical meetings with the communities before the start of work, during and before the completion of work to inform them about the construction activities, traffic management plan, and siting of labor camps etc. and to invite their suggestions/grievances.

7.1.4 Informal Consultations at site

Informal consultations with communities as well as affected households has been carried out during screening assessment stage and limited to informal contact with local residents and landowners, undertaken on an opportunistic basis during field reconnaissance, and initiation of resident and business surveys undertaken to assist with development of the resettlement action plan.

Peoples' Perception about Environment and Social issues gathered during the informal consultations are presented given in below **Table 7.1**.

Table 7-1: Peoples' Perception about Environment & Social Issues

| Sl. No. | Environmental Issue discussed | Response Received | Suggestions given by participants | Findings of the public consultation |
|---------|-------------------------------|--|---|--|
| 1 | Air quality of the area | Public are of the view that air quality is not an issue in the area as the settlement area are located away from industrial units and air pollution due to vehicular traffic will be a concern during operational stage. | Adequate vegetation cover on either side of the project road would reduce pollutants migrating to village areas | Air quality is not an issue of concern in the project area. With the proposed development there will be no impact on the air quality in the area as majority of the settlements are located away from the main road. It is anticipated that the proposed avenue plantation would be helpful in checking pollutants being dispersed to settlements. |
| 2 | Water quality | Water quality of surface water bodies' i.e. rivers and canals is satisfactory. The surface water sources are used mainly for bathing and washing purposes. | Runoff from the project road should be contained appropriately and no run off should find their path to the water resources being used by residents for cultivation as well as to meet their daily chores | Water harvesting structures on either side of the project road is a good proposition to recharge ground as well as to contain pollutants resulting from vehicular traffic. |
| 3 | Noise level of the area | Vehicular movement is the prime cause of noise generation | Adequate avenue plantation (multiple rows) would reduce the noise spreading to nearby | Noise is one of the major concern to habitations abutting the highways |

| Sl. No. | Environmental Issue discussed | Response Received | Suggestions given by participants | Findings of the public consultation |
|---------|---------------------------------|---|--|---|
| | | | settlements | |
| 4 | Drainage | Water logging at few stretches of the alignment because of the rivers and creeks make the land unsuitable for cultivation | Road construction activities should ensure that slope of road is not such that it results in flooding in the nearby settlements. | Adequate measures will be incorporated during the design stage so that flooding; waterlogging, marshy situation does not prevail. |
| 5 | Removal of large number of tree | Road projects development would result in removal of large number of trees of common occurrence. | These should be adequately compensated with the right mix of species in consultation with the affected communities and forest department | Compensatory afforestation should be carried out to make up for the loss incurred due to felling of trees for the proposed construction activity. |
| 6 | Social Issues | Apprehension to become marginalized and jobless | Adequate livelihood support to the affected persons and rearrangements for affected families who are losing residents structures | Design shall be adjusted to avoid impact on built up area and payment of compensation at market value |

7.1.5 Environmental Public Hearing

Public consultation is the process by which the concerns of local affected persons and others who have reasonable stake in the environmental impacts of the project or activity are ascertained.

The details for conducting public hearing in Ramanagara and Bangalore Rural District were advertised in the local newspaper dated 01.07.2019 and 09.07.2019 as shown below;

KARNATAKA STATE POLLUTION CONTROL BOARD
 # 49, Parisara Bhavana, Church Street, Bengaluru - 560 001
 Ph : 080-2558 6520 / 2558 9112 Fax : 080-2558 6321
 Email : ho@kspcb.gov.in Website : www.kspcb.gov.in

PCBI/CNP/07/GEN/19/2104 Dated: 01.07.2019

ENVIRONMENTAL PUBLIC HEARING NOTIFICATION

M/s. National Highway Authority of India, have proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Ramanagara District from 19.675 Km to 82.2 Km of Road from Dabaspeta (Km 0.000) to Ramanagara (Km 82.200) in Bangalore Rural and Ramanagara District in Karnataka under Bharatmala Pariyojana. The said project authority has to obtain Environmental Clearance from MOEF, Government of India as per EIA Notification dated 14.9.2006 (as amended on 1.12.2009) and also required to go through Environmental Public Hearing process. As per the MOEF, Government of India, New Delhi, Terms of Reference letter No. F.No.10-33/2018-IA.III dated 23.01.2019 and also considering the request of the project authority vide their letter dated 17.05.2019, the Environmental Public Hearing is being conducted by the Board. The details of the project are as follows:

- Name of the Company & Corporate Address.:** Sri. T. Parvateesam, DGM (T) & Project Director, NHAI-PIU, Bangalore (Expressway) # 718, 11th Cross, 20th Main, Padmanabha Nagar, Bengaluru - 560 070.
- Proposed location of the project:** Proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Ramanagara District from 19.675 Km to 82.2 Km of Road from Dabaspeta (Km 0.000) to Ramanagara (Km 82.200) in Bangalore Rural and Ramanagara District in Karnataka under Bharatmala Pariyojana.
- Details of activity:** Proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Ramanagara District from 19.675 Km to 82.2 Km of Road from Dabaspeta (Km 0.000) to Ramanagara (Km 82.200) in Bangalore Rural and Ramanagara District in Karnataka under Bharatmala Pariyojana.
- Cost of the Project:** Rs.172.866 Crores.
- Date, time and venue of public hearing:** 09.08.2019 at 11.00 AM National Highway Authority of India, project Implementation Unit Office Premises, Basavanapura (Ramadevarapada), Ramanagara - 562 128.
- Places of availability of project documents as per EIA Notification, which is kept open to public are:**
 - Office of the Deputy Commissioner, Ramanagara District, Ramanagara.
 - Chief Executive Officer, Zilla Panchayat, Ramanagara District.
 - District Industries Centre, Ramanagara District.
 - City Municipal Council, Ramanagara.
 - Tahasildar Office, Ramanagara Taluk.
 - Office of the Regional Officer, Karnataka State Pollution Control Board, Parisara Bhavan, Near D.C. Office, Bangalore - Mysore Road, Ramanagara - 562 159.
 - Ministry of Environment & Forest, South Zone Office, E-3/240, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, 2nd Block, Koramangala, Bengaluru - 560 034.
 - HELP DESK, Karnataka State Pollution Control Board, Ground Floor, No.49, Parisara Bhavan, Church Street, Bengaluru - 560 001.

NOTE: Suggestions, views, comments and objections of interested bonafide residents, environmental groups and others located at project site and likely to be affected by the proposed project are invited within 30 days from the date of publication of this Notification to make oral/written/E-Mail Suggestion to the Karnataka State Pollution Control Board or to the Chairman, Environmental Public Hearing Committee (Deputy Commissioner, Ramanagara District). Interested public can participate in the Public Hearing at the said place. For details please visit our Website: kspcb.gov.in.

Sd/-
Member Secretary

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KARNATAKA STATE POLLUTION CONTROL BOARD
 # 49, Parisara Bhavana, Church Street, Bengaluru - 560 001
 Ph: 080-25586520/25589112, Fax: 080-25586321
 e-Mail: ho@kspcb.gov.in Website: http://kspcb.gov.in

No.PCB/CNP/07/GEN/19/2326 Date: 09/07/2019

ENVIRONMENTAL PUBLIC HEARING NOTIFICATION

M/s. National Highway Authority of India, have proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Bangalore Rural District from Dabaspeta (Km 0.000) to 19.675 Km in Bangalore Rural District in Karnataka under Bharatmala Pariyojana. The said project authority has to obtain Environmental Clearance from MOEF, Government of India as per EIA Notification dated 14.9.2006 (as amended on 1.12.2009) and also required to go through Environmental Public Hearing process. As per the MOEF, Government of India, New Delhi, Terms of Reference letter No. F.No.10-33/2018-IA.III dated 23.01.2019 and also considering the request of the project authority vide their letter dated 17.05.2019, the Environmental Public Hearing is being conducted by the Board. The details of the project are as follows:

- Name of the Company & Address:** Sri. T. Parvateesam, DGM (T) & Project Director, NHAI-PIU, Bangalore (Expressway) # 718, 11th Cross, 20th Main, Padmanabha Nagar, Bengaluru - 560 070.
- Proposed location of the project:** Proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Bangalore Rural District from Dabaspeta (Km 0.000) to 19.675 Km in Bangalore Rural in Karnataka under Bharatmala Pariyojana.
- Details of activity:** Proposed to Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A jurisdiction of Bangalore Rural District from Dabaspeta (Km 0.000) to 19.675 Km in Bangalore Rural in Karnataka under Bharatmala Pariyojana.
- Cost of the Project:** Rs. 172.866 Crores.
- Date, time and venue of public hearing:** 16.08.2019 at 11.30 AM
Venue: Basava Sri Shivashree Katyana Mantapa, Chandanavana Village, Shivagange Road, Sompura Hobli, Nelamangala Taluk, Bengaluru Rural District - 562 111.
- (a) Office of the Deputy Commissioner, Bangalore Rural - District; (b) Chief Executive Officer, Zilla Panchayat, Bangalore Rural - District; (c) District Industries Centre, Bangalore Rural - District; (d) City Municipal Council, Bangalore Rural - District; (e) Tahasildar Office, Nelamangala Taluk; (f) Mane village Panchayath Office; (g) Shivagange Village Panchayath Office; (h) Agalakunde Village Panchayath Office; (i) Sompura Village Panchayath Office; (j) Honnehahalli Village Panchayath Office; (k) Office of the Regional Officer, Karnataka State Pollution Control Board, Nelamangala - Urban Eco-Park, 1st Floor, 100 Feet Road, 3rd Phase, Peenya Industrial Area, Bengaluru - 560 058; (l) Ministry of Environment & Forest, South Zone Office, E-3/240, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, 2nd Block, Koramangala, Bengaluru - 560 034; (m) HELP DESK, Karnataka State Pollution Control Board, Ground Floor, No.49, Parisara Bhavan, Church Street, Bengaluru - 560 001.**

NOTE: Suggestions, views, comments and objections of interested bonafide residents, environmental groups and others located at project site and likely to be affected by the proposed project are invited within 30 days from the date of publication of this Notification. They can also make oral/written/E-Mail suggestions to the Karnataka State Pollution Control Board/Chairman Environmental Public Hearing Committee (Deputy Commissioner, Bangalore Rural District). Interested public can participate in the Public Hearing at the above place. For details please visit our Website: <http://kspcb.gov.in>.

Sd/-
MEMBER SECRETARY

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Figure 7-2: Newspaper advertisement of Ramanagara and Bangalore Rural district

Accordingly, the public hearing in Ramanagara and Bangalore Rural district was conducted on 09.08.2019 and 16.08.2019 respectively as per the EIA Notification, 2006 and its subsequent amendments. Details are furnished in below table:

Table 7-2: Details of Public Hearing

| S. No. | State | District | Date of PH Conducted | Time | Venue | Presiding Officer |
|--------|-----------|-----------------|----------------------|----------|---|--|
| 1. | Karnataka | Ramanagara | 09.08.2019 | 11:00 AM | National Highway Authority of India, Project Office premises, Basavanapura (Ramadevarapada), Ramanagara-562128. | Capt. Dr. K. Rajendra, IAS Deputy Commissioners and District Magistrate, Ramanagara |
| 2. | Karnataka | Bangalore Rural | 16.08.2019 | 11:30 AM | Basava Sri Shivashri Kalyana Mantapa Chanadanahodalli Village, Shivagange road, Bengaluru Rural District | Sri Dr. Jagadish K Naik, KAS, Additional Deputy Commissioner and Additional District Magistrate and Chairman, Environment Public Hearing Panel |

Issues raised & their reply with action plan & budgetary allocation for both the districts Ramanagara and Bangalore Rural is given in below **Table 7.3** and **Table 7.4**, respectively.

Table 7-3: Public Hearing Proceeding of Ramanagara District

| Name of the Person | Issues | Reply | Budgetary Support |
|---|--|---|--|
| <p>Sri. R Anand, Alur Village, Banawadi post, Magadi Taluk, Ramanagara District</p> | <p>He stated that he owns agricultural lands in Sy. No. 98 & 99 of Alur village. He informed that developing the National Highway is a good proposal. However, he requested to clarify whether suitable service roads are provided at regular intervals along the highway so that the farmers can easily reach their agricultural fields. He informed that farmers shall not travel a long distance to reach to their agricultural lands and service road shall be near given near the villages. He stated that as per the project proposal, the total length of service road is only 17.08 KM which is very less. He also stated that there is huge scope for harvesting rain water from the highway and requested the authorities to clarify whether any arrangements are being made to construct suitable rain water harvesting structures and provide the harvested rain water to the nearby farmers. He requested the authorities to clarify the environment protection measures proposed during construction and</p> | <p>The service road of length about 2.05 km has been provisioned near village at design chainage km 18.900 to facilitate the local traffic.</p> <p>Further as per Indian Road Congress guidelines, provisions will be made to enter/exit the highway at every two KM intervals. Hence, though it is an access-controlled road, there is no problem of approachability.</p> <p>The provision of suitable rain water harvesting structures along the alignment will be kept. Rainwater harvesting pit will be provided on either side of road at 500 m interval subject to the first aquifer below 10m.</p> <p>Water sprinkling will be done to minimize the dust during construction phase.</p> <p>There is no excess soil generation from the project and the dug up soil will be utilized for filling at low lying areas along the alignment.</p> <p>To avoid air/dust/noise pollution, plantation along the alignment will be carried out as per the IRC: SP: 21-2009. Apart from this compensatory afforestation will be t as per the State Forest guidelines.</p> <p>The monitoring of air, noise, water and soil will be</p> | <p>Rs. 105.00 lakh for RWH structures including maintenance</p> <p>Water sprinkling cost is considered under civil costs.</p> <p>Rs. 14.96 Cr. for plantation including maintenance.</p> <p>Rs. 37.57 lakh. is estimated for environmental monitoring during construction and operation phase.</p> |

| Name of the Person | Issues | Reply | Budgetary Support |
|--|--|--|-------------------|
| | <p>operational phase. He stated that his family owns about 6 acres of land adjacent to the alignment where they have grown mango and horticultural crops.</p> <p>He requested the authorities to clarify about how the dug up soil from the project is managed and he apprehended that the soil may be dumped in their lands/adjacent to their lands which may flow into their lands during rains. Further, he sought clarification on measures taken to avoid dust during construction affecting the crops.</p> <p>He also requested the project authorities to clarify whether any online monitoring equipments are provided to monitor the air quality during construction and operational phase. He requested clarification on measures taken to avoid noise pollution and what kind of barricades are provided.</p> | <p>carried out during construction and operation phase by the concerned contractor as per scope of agreement for submission of half-yearly compliance report to the Regional Office.</p> <p>To mitigate noise pollution, there is a provision of noise barrier near sensitive locations.</p> | |
| Sri Ramakrishna, Kempegowdanadoddi, Ramanagara Taluk | He informed that the mulberry plantation is being affected due to the Bangalore Mysore NH widening work. he also directed the Project Director of Bangalore Mysore Road (NH 275) | The presiding officer informed that the present public hearing is w.r.t the proposed STRR Phase-I and only objections/views w.r.t to the proposed project may be expressed. | - |

| Name of the Person | Issues | Reply | Budgetary Support |
|---|--|---|-------------------|
| | widening project to look into the issue and make necessary arrangements for dust suppression. He also directed the NH authorities to explore whether any crop loss compensation may be given to the affected farmers. | | |
| Sri T G Kodandaramu, Thyagarapalya, Magadi Taluk | He informed that, Sy No.9 of Thyagarapalya Village belongs to his family. However, in the RTC it is showing as Govt. land and requested to rectify the same. | The Presiding Officer informed that this public hearing is being conducted to collect public opinion/views w.r.t proposed STRR project and only matters related to that shall be discussed. He directed Sri Kodandarmu to approach the Revenue Department for rectifying his problem. | - |
| Sri Shankarappa, Gudemaranahalli, Solur Hobli, Magadi Taluk | He informed that, some announcements were made in their area regarding the compensation w.r.t land acquisition for National Highway. | The presiding officer clarified that this hearing is w.r.t environmental issues only and compensation issues will be dealt separately. | - |
| Sri Sadiq Ahmed, Regional SEO, Bangalore South, KSPCB | He addressed the gathering and informed that as per the draft EIA report about 416 structures are being demolished and the report says the impact is not very significant. He directed the NH authorities and their consultants to re look into the matter and include details of construction and demolition waste management scientifically as per Construction and Demolition Waste Management Rules, 2016. | Details of impacted structure of proposed ROW further studied after public hearing on the direction of Chairperson of Deputy Commissioner & District Magistrate of Ramanagara District. The total impacted structure is 310. Out of them, some of the structure partially affected. The dismantle structure will be disposed off by the concerned contractor after obtaining permission from appropriate authority to the dumping site. | - |

Table 7-4: Public Hearing Proceeding of Bangalore Rural District

| Name of the Person | Issues | Reply | Budgetary Support |
|--|---|---|-------------------|
| Additional Deputy Commissioner and Chairperson | He informed the public about the action taken by the departments on publishing the information in news papers on scheduled Environmental Public Hearing to be conducted today. During this time, few person in the meeting hall complained that there is proper intimation given to the public about this Public hearing meeting. | The Environmental Officer of the Karnataka State Pollution Control Board and Tahasildar of Nelamangala Taluk have tried to convince the general public by telling about the action taken by the Board to publish the information on scheduled public hearing meeting in leading Kannada and English news papers. Sri K.M. Ramesh, Environmental Officer, Karnataka State Pollution Control Board, addressed the gathering and said that 30 days well before to the date of this Environment Public Hearing that means on 15/7/2019 itself a notice was published in one of the State level Kannada daily & English newspaper as per the provisions of the Environmental Impact Assessment Notification, 2006 for information to the general public. The Draft Environmental Impact Assessment report, executive summaries both in Kannada & English & Compact Disc (CD) related to the proposed project were kept in each of the concerned Village Panchayath offices 30 days prior to the date of this hearing itself for public references and also to communicate the public more about this meeting in a larger way, handouts were distributed and announcements were made by using loud speakers, on 15/08/2019. | - |
| Sri Srinivasa, resident | He said that there are 35 villages around the proposed project area but only few people have come over here to attend | Sri K.M. Ramesh, Environmental Officer, Karnataka State Pollution Control Board, addressed the gathering and said that 30 days well before to the date of this | - |

| Name of the Person | Issues | Reply | Budgetary Support |
|--|---|--|-------------------|
| | <p>this meeting that to they are only from 5-6 villages. Suppose, in case of any water bodies & other structures are there in their lands then in such cases the concerned farmers/people only have to express their grievances/objection/suggestions. Due to deficit of information to the farmers about this today's hearing, the concerned all farmers could not come to this meeting. He urged to conduct the meeting by giving proper information about the meeting to all surrounding people and urged to postpone the hearing.</p> | <p>Environment Public Hearing that means on 15/7/2019 itself a notice was published in one of the State level Kannada daily & English newspaper as per the provisions of the Environmental Impact Assessment Notification, 2006 for information to the general public. The Draft Environmental Impact Assessment report, executive summaries both in Kannada & English & Compact Disc (CD) related to the proposed project were kept in each of the concerned Village Panchayath offices 30 days prior to the date of this hearing itself for public references and also to communicate the public more about this meeting in a larger way, handouts were distributed and announcements were made by using loud speakers, on 15/08/2019.</p> | |
| <p>Since no other person came forward to talk about the proposed project, the chairperson concluded the meeting. The public have denied to put signature in the attendance register.</p> | | | |

Proceedings of both districts along with attendance sheet are attached as **Annexure-12**.

Some photographs of the Public hearing are also shown in **Figure 7.3** and **Figure 7.4**.



Figure 7-3: Photographs of Public Hearing of Ramanagara District



Figure 7-4 : Photographs of Public Hearing of Bangalore Rural District

7.1.6 Future Considerations

The initial screening and Preliminary Environmental Assessment reveals that the project implementation will result in appreciable social and economic benefits to the people in the project affected area in terms of easy access to the schools, hospitals, government offices, markets etc., increase in land value; reduced travel time & cost and traffic congestion. The proposed road would act as the prime artery for the economic flow to this region.

7.2 RISK ASSESSMENT & MITIGATION PROCEDURES

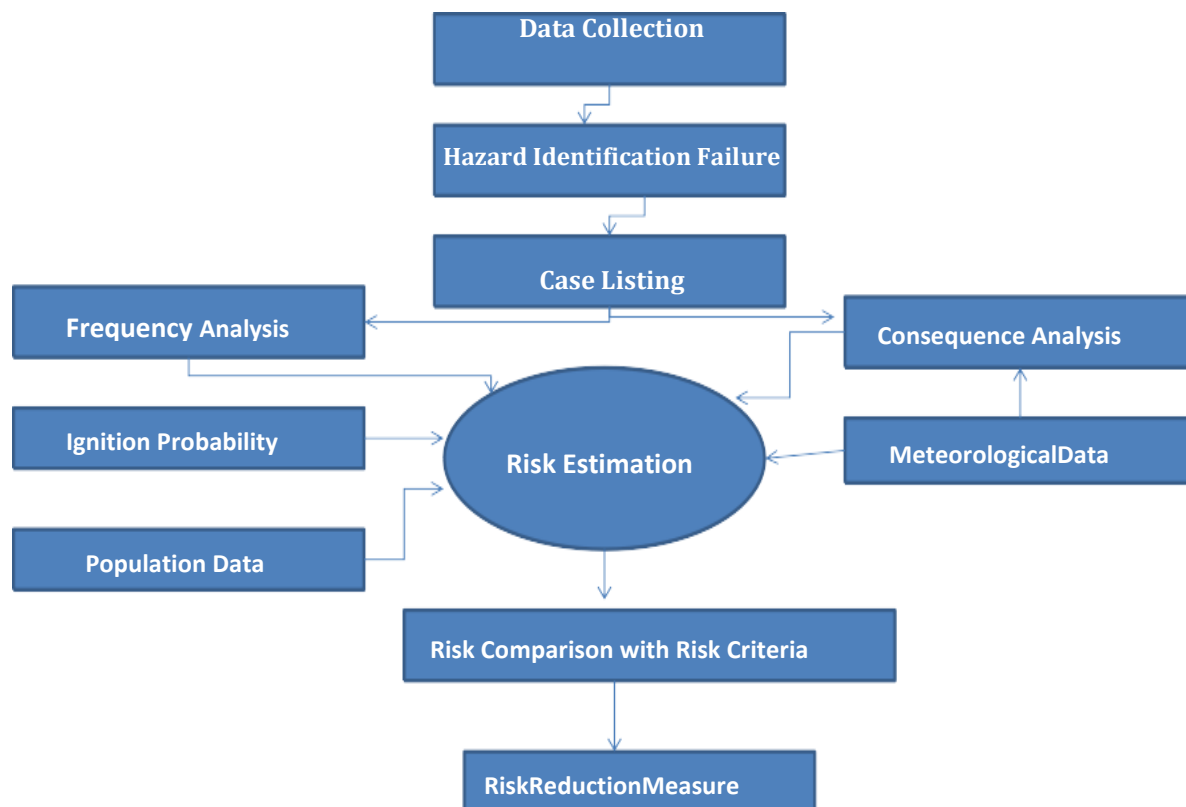
Risk assessment is a process that seeks to estimate the likelihood of occurrence of adverse effects as a result of major road mishaps, gas tanker explosions, fire hazards, floods, cyclones, earth quakes etc. at Highway projects. Fatality rate on Indian highways is very high mainly due to road accidents. The other adverse impacts due to gas tanker explosions, fire hazards, floods, cyclones, earth quakes etc. are nominal. Elimination of the risk (avoidance of accidents) is given prime importance and NHAI has introduced road safety provisions during the design of highway with the help of Road Safety Manual. Some of these are listed below:

- Safety barriers/delineators hard shoulders on main roads
- Traffic signs and pavement markings
- Underpasses and other grade separators at congested junctions
- Removal of junctions and direct access points on main roads
- Improved median openings with stacking lanes
- Separate provisions and direct access point
- Service roads in towns and villages for segregating local and highways traffic.

Contractor shall conduct Risk Assessment for all works to decide on priorities and to set objectives for eliminating hazards and reducing risks.

7.2.1 The Risk Assessment

A critical observation/study of the structure/process/site under consideration by the risk assessment team is an essential part of hazard identification as is consultation with the relevant section of the workforce. It is important that unsafe conditions are not confused with hazards, during hazard identification.



7.2.2 Person(s) at Risk

On a construction/ plant area, the persons at risk could be site operatives, supervisors, transport drivers, other visitors and the general public. The risk assessment must include any additional controls required due to mitigate vulnerability of any of these groups, perhaps caused by inexperience or disability.

7.2.3 Risk Control Measures and Hierarchy of Risk Control

The next stage in the risk assessment is the control of the risk. When assessing the adequacy of existing controls or introducing new controls, a hierarchy of risk controls should be considered. The principles are:

- Avoiding risks.
- Evaluating the risks which cannot be avoided.
- Combating the risks at source.

Adapting the work to the individual, especially as regards the design of the workplace, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work rate and to reducing their effects on health.

7.2.4 Adapting to technical progress

Replace the dangerous by the non-dangerous or the less dangerous. Developing a coherent, overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors relating to the working environment. Giving collective protective measures priority over individual protective measures and giving appropriate instruction to employees.

In addition to the above the following principles shall also to be employed:

- Eliminating;
- Substitution;
- Applying engineering controls (e.g. isolation, insulation and ventilation);
- Reduced or limited time exposure;
- Good housekeeping;
- Safe systems of work, Method Statement, Permit to work,
- Training and information;
- Personal protective equipment;
- Welfare;
- Monitoring and supervision;
- Review

The purpose of the risk assessment, therefore, is to reduce the remaining risk after taking into consideration of risks already addressed. This is called the residual risk.

The goal of risk assessment is to reduce all residual risks to as low as reasonably practicable (ALARP).

In a relatively complex workplace, this will take time so that a system of ranking risk is required the higher the risk level the sooner it must be addressed and controlled. For most situations, an alliterative risk assessment will be perfectly adequate.

For all high-risk activities, a quantitative risk assessment shall be conducted to quantify the risk level in terms of the likelihood of an incident and its subsequent severity. Clearly the higher the likelihood and severity, the higher the risk will be. The likelihood depends on such factors as the control measures in place, the frequency the exposure to the hazard and the category of person exposed to the hazard.

The severity will depend on the magnitude of the hazard (e.g. voltage, toxicity etc.). A simple matrix shall be used to determine risk levels at Construction / erecting sites as given in below **Table 7.5**.

7.2.5 Matrix for Risk Assessment

Table 7-5: Consultations with Community / Primary Stakeholders

| Probability | Consequence | | | | |
|-------------|-------------|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

7.2.5.1 Severity of hazard (Consequence)

Severity is the degree or extent of injury or harm caused by the hazards, or as a result of an accident. Severity of hazard is classified as per the table given below in **Table 7.6**.

Table 7-6 : Consequence Descriptions

| Value | Result of Hazard to personnel | Result of Hazard to Assets/Progress |
|-------|--|---|
| 1 | Single or multiple fatalities | Catastrophic damage, Critical Delay, May result in fatality |
| 2 | Serious Injury requiring hospitalization | Major Damage, Serious Delay |
| 3 | Lost time Accident | Serious Damage, Moderate Delay |
| 4 | Injury requiring medical treatment but not lost time | Moderate Damage, Minor delay |
| 5 | First Aid Treatment Only | Minor Damage, No Delay |

7.2.5.2 Likelihood of occurrence (Probability)

Likelihood of occurrence of an accident or incident or ill health is classified as per the table given below in **Table 7.7**.

Table 7-7 : Classification of Occurrence of likelihood

| Value | Status | Description |
|-------|---------------|---|
| 5 | Inevitable | Happens regularly on this site |
| 4 | Most Likely | Known to have occurred on this site in the past |
| 3 | Likely | Known to occur on other sites |
| 2 | Unlikely | Known to Occur in the industries |
| 1 | Most Unlikely | Never known before |

7.2.5.3 Hazard Identification Risk Assessment

The procedure for preparing the Hazard Identification Risk Assessment is as follows:

- Risk involved in each activity and existing control measures are analyzed and Impact Rating and probability rating are given in Hazard Identification Risk Assessment sheet.
- Risk level is identified from the matrix based on the rating given.
- Control measures are evolved to bring the risk level to ALARP (as low as reasonably practicable and residual risk is also identified.
- If the residual risk is not an acceptable level, then assessment process shall be repeated to bring the residual risk at ALARP.
- This activity is done for activities identified as Medium & High Risk.
- The lists of control measures for the activities are handed over to the concerned execution engineer for implementation and the HIRA shall be explained to the concerned workmen/supervisors and engineer for implementation.

7.2.6 Emergency Response Plan

The Emergency Response Plan is prepared to deal with emergencies arising out of:

7.2.6.1 Fire and Explosion

Fire Safety Procedures will be developed and shall be integrated into Emergency Response Plan.

7.2.6.2 Road Accident

In case of Road Accident the following contact no should be contacted given in **Table 7.8**.

Table 7-8 : Emergency Contact Number

| Help Line no. | Description |
|---------------|--|
| 100 | Police |
| 101 | Fire |
| 102 | Ambulance |
| 103 | Traffic Police |
| 1033 | Emergency Relief Centre on National Highways |
| 104 | State level helpline for Health |
| 104 | Hospital On Wheels |
| 1066 | Anti-poison |
| 1070 | Central Relief Commissioner for Natural Calamities |
| 1070 | Relief Commissioners of Central/State/Union territory |
| 1073 | Road Accident |
| 1073 | Traffic Help Line |
| 1077 | Control room of District Collector/Magistrate |
| 108 | Disaster management |
| 1090 | Anti-terror Helpline/Alert All India |
| 1091 | Women in Distress |
| 1092 | Earth-quake Help line service |
| 1096 | Natural disaster control room |
| 1099 | Central Accident and Trauma Services |
| 1099 | Catastrophe & Trauma service |
| 112 | General emergency Department of Telecommunications (DoT) |
| 112 | All in one Emergency Number |
| 155233 | Indian Oil Help Line |
| 1906 | LPG emergency helpline number |
| 1910 | Blood bank Information |
| 1911 | Dial a doctor |
| 1913 | Tourist Office (Govt.of India) |

Source: <http://www.newincept.com/helpline-numbers-all-over-in-india.html>

7.2.7 Operation Control Procedure for Traffic Management

7.2.7.1 Hazards Due To External Traffic Are As Follows

- Construction workers hit by external vehicles while working.
- Injury to Pedestrians:
- Due to fall in excavated trenches.
- Hit by construction equipment / vehicle.
- As they use carriageway due to blockage / absence of footpath.
- Collision due to improper traffic management.
- Between external vehicle and construction equipment / vehicle.
- Between external vehicles.
- External vehicle with other stationery objects in the side of the road

7.2.7.2 Objectives

- Warn the road user clearly and sufficiently in advance.
- Provide safe and clearly marked lanes for guiding users.
- Provide safe and clearly marked buffer and work zones.
- Provide adequate measures that control driver behaviour through construction zones

7.2.7.3 Traffic Control Plan

This plan gives the detailed guideline for traffic management in most of the common situations at our Projects. Traffic Control Plan for a specific road sections should be prepared based on this general guideline and applying the following variables, which may vary from project to project. The variables are:

- Average Vehicular Traffic Density in peak and non-peak hours.
- Maximum width of lane required for construction during various activities.
- Number and types of junctions in the road.
- Availability of standard footpath and its location and dimensions.
- Change in the lane width if any and its location.
- Regulatory and advisory speed limits etc.

7.2.7.4 Traffic Control Devices

Traffic control devices used to regulate the traffic in Road Construction Zones include,

- Road Signs
- Delineators
- Barricades
- Cones
- Pylons
- Pavement markings
- Flashing lights

Table 7-9 : Minimum sightline distance and the minimum size of the signs

| Average Speed (Km/h) | Distance of first sign in advance of the first channelizing device (m) | Size of Warning Sign (mm) | Minimum no of signs in advance of the hazard |
|----------------------|--|---------------------------|--|
| Under 50 | 100 | 600 | 3 |
| 51 – 60 | 100 – 300 | 750 | 3 |
| 61 – 80 | 120 – 300 | 900 | 3 or 4 |
| 81 – 100 | 300 – 500 | 1200 | 4 |
| Over 100 | 1000 | 1200 to 1500 | 4 |

Source: Draft source traffic and work zone safety manual

7.2.7.5 Cautionary / Warning Signs

In case of divided carriage ways, the signs should be provided both adjacent to the shoulder and on the central median so as to be visible from all lanes.

7.2.7.6 Delineators

Delineators are devices or treatment which outlines the roadway or portion thereof. They include Safety Cones, Traffic Cylinders, Tapes, Drums, Painted lines, Raised Pavement Markers, Guide Posts, and Post-mounted Reflectors etc. They are used in or adjacent to the roadway to control the flow of traffic. Delineators are basically driving aids and should not be regarded as a substitute for warning signs or barriers for out-of-control vehicles.

7.2.7.7 Guide Post

They are intended to delineate the edges of the midway so as to guide driven about the alignment ahead, particularly where it might be confusing. Guideposts can be of metal, concrete, cut stone, amber or plastic. The posts can be made of Circular, Rectangular or Triangular Cross-section but the side facing traffic should be at least 10 cm wide..

7.2.7.8 Drums

Drums of height 800 mm to 1000 mm high and 300 mm in diameter can be used as either channelizing or warning devices. Both plastic and metallic drums (e.g. Bitumen drums) can be used for this purpose. Drums need to be filled up with earth or sand to increase its stability. Drums should be reflective and painted as shown in the figure.

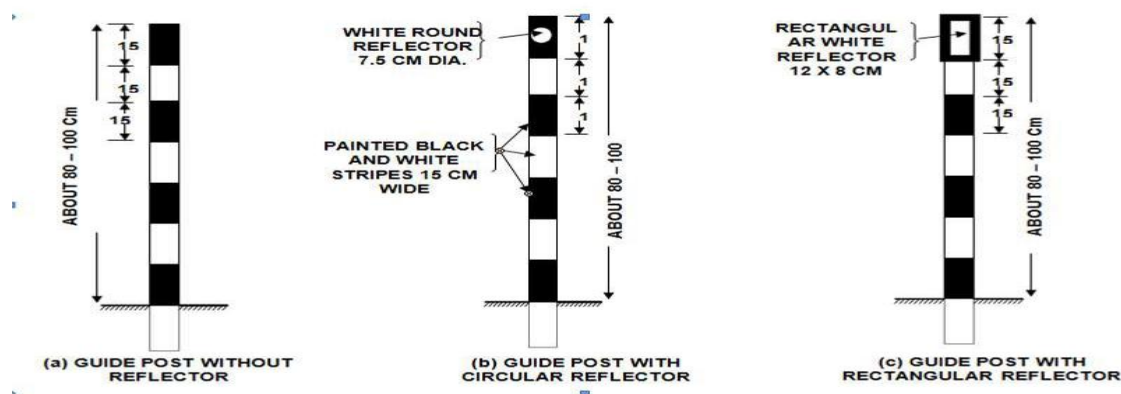


Figure 7-5: Drum Reflections

7.2.7.9 Safety Cones

Safety cones are 500 mm, 750 mm and 1000 mm high and 300 mm to 500 mm in diameter. They are usually made of plastic, rubber, HDPE, PVC and have retro reflectors red and white bands. Safety cones would be displaced or blown unless their bases are anchored or loaded with ballast. This can be avoided by, using sand bag rings to provide increased stability. Using heavier weighted cones. Using cones with special weighted bases. Doubling the cones to provide added weight.

7.2.7.10 Barricades

CMRL prescribed standard barricades are used.

7.2.7.11 Flagmen

- An authorized personnel at least average intelligence, be mentally alert and good in physical condition be selected, since flagmen are responsible for public and workmen safety.

- Flagmen should be equipped with yellow helmet with green reflective sticker fixed around and reflective jacket along with hand signalling devices such as flags and sign paddles. The typical specification are given below,
- Flagmen need to maintain the flow of traffic continuous past a work zone at relatively reduced speeds by suitably regulating the traffic. He shall stop the traffic for a short while whenever required (e.g. for entry and exit of construction equipment in to work zone).
- Flagman should be positioned in a place where he is clearly visible to approaching traffic and at a sufficient distance to enable the drivers to respond for his flagging instructions. A flagman never leaves his post until properly relieved,
- The standard distance shall be maintained at 60 – 100 m but can be altered depending upon the approach speed and site conditions. In urban areas this distance shall be taken as 20 m to 50 m.

7.2.8 Traffic Management Practices

7.2.8.1 Definitions

Road traffic control involves directing vehicular and pedestrian traffic around a construction zone, accident or other road disruption, thus ensuring the safety of emergency response teams, construction workers and the general public.

7.2.8.2 Working zone:

The Plant Site, construction zone of road etc. at which workmen will be working.

7.2.8.3 Working space:

The space around the works area that will require storing tools, excavated material and other equipment. It is also the space to allow workmen, movement and operation of plant, (e.g. swing of jibs, excavator arms) to move around to do the job. Materials and equipment must not be placed in the zone either. Workmen will only need to enter the zone to maintain cones and other road sign.

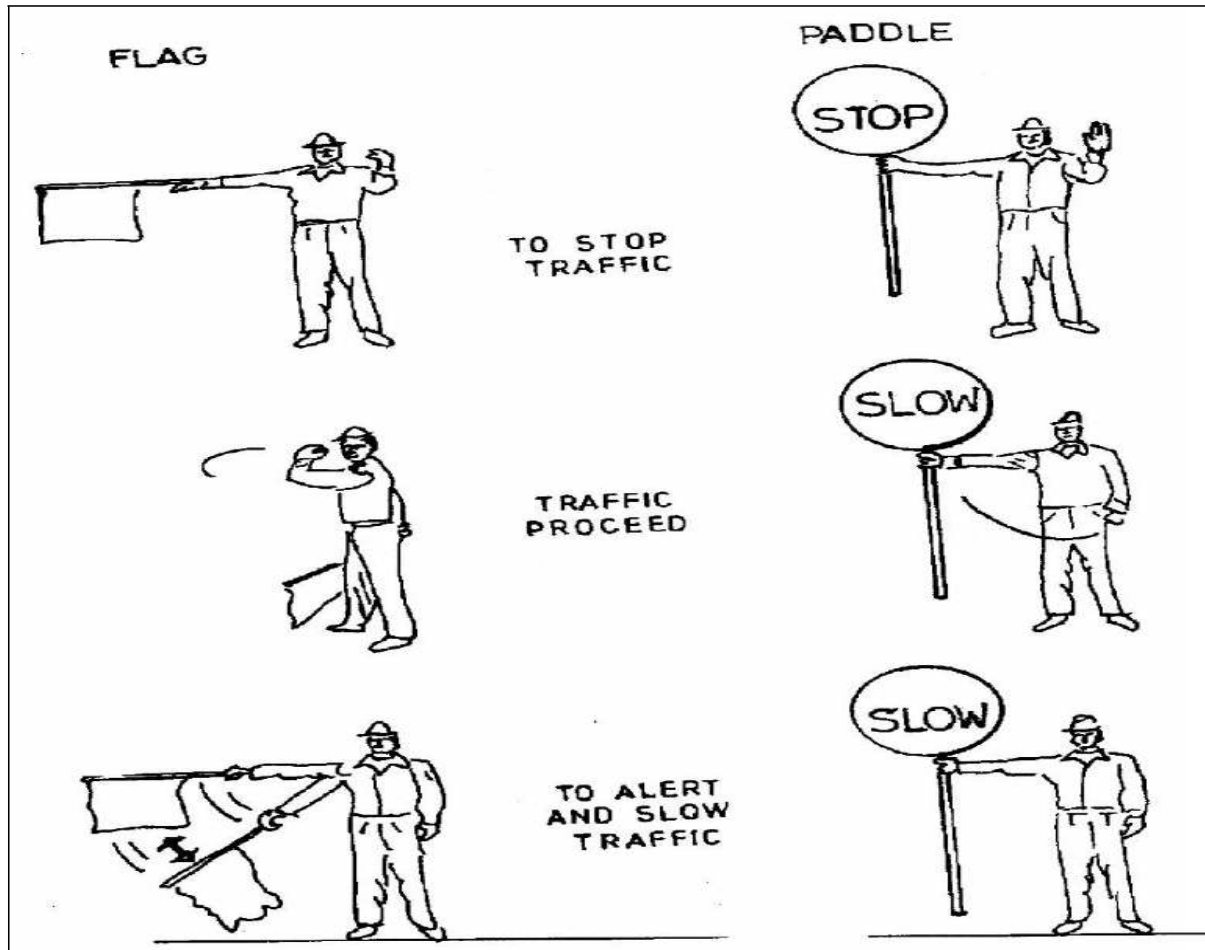


Figure 7-6: Road Traffic Signals

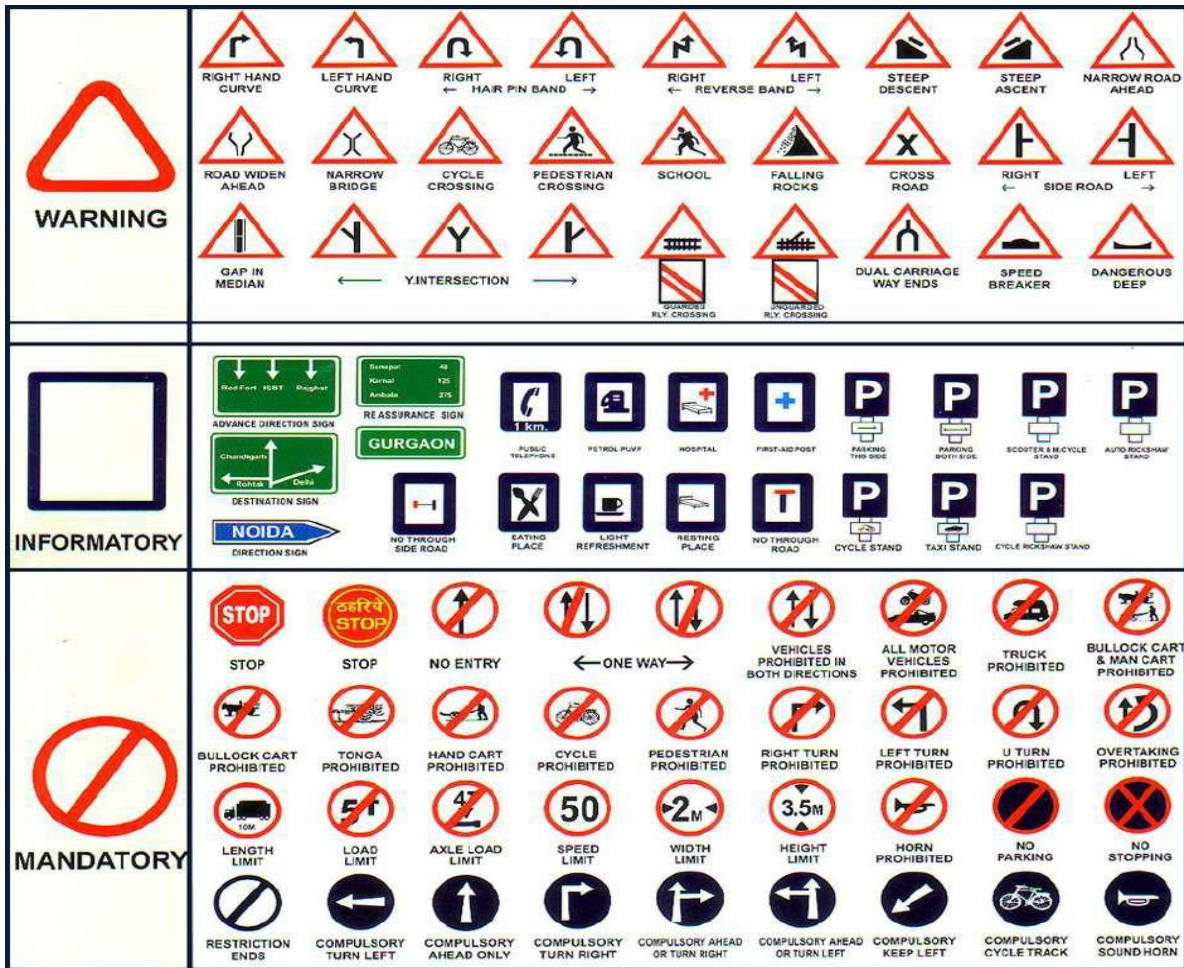


Figure 7-7: Traffic Signals

7.2.8.4 Approach Transition zone:

This will vary with the speed limit and the width of the works as given in (diag: Traffic Control zone)

7.2.8.5 Longitudinal buffer zone:

This is the length between the end of the lead-in taper of cones (T) and the working space. It will vary with the speed limit as given in table (Traffic Control zone)

7.2.8.6 Lateral buffer zone:

This is the width between the working space and moving traffic. It will vary with the speed as given in table (Traffic Control zone). The lateral buffer zone safety clearance is measured from the outside edge of the working space to the bottom of conical sections of the cones on the side nearest to the traffic.

7.2.8.7 Works on Strengthening of Existing Carriageway

- Approached diversion would be taken out of the works zone for the movement of construction supervision vehicles.
- The construction zone shall be barricaded with standard CMRL barricade.
- The 'works traffic' shall be governed by the location of base camp where workmanship less than 20, a flagman shall be kept for controlling traffic, public and workmen safety or more

than 20 in addition to that a safety steward shall be kept for continuous monitoring to identify and removal of unsafe acts and conditions.

7.2.8.8 Traffic Management on Road Junction

- Where vehicles are more to the approach junction from the side road, permission shall be seek for providing speed breaker at junction from local traffic police and road-authority.
- The layout for signs and traffic control devices.
- Flag man shall be kept in the peak time provided with the traffic circle painted with red and white at the corner at a height of 500 mm, clearly visible to approaching traffic for a distance provided with while gloves and STOP, GO Paddle. And night time flagman should use LED Batons.
- All vehicles from approaching road should be STOP, LOOK and GO.
- Spillage of earth / Gravel / Aggregates / Bituminous mix from the tipper shall be cleaned on regular basis, if required 2 coolies permanently posted for booming.
- All Construction vehicles must follow lane discipline and road signs.
- The traffic would discontinue from plying temporarily on the carriageway; for 2 min for reversing & dumping earth / stones / etc., , by the direction of helper and the flagman controls the traffic as shown in Picture- 01 and made continue the traffic and for the next trip repeating the same.
- The construction zone shall be barricaded with standard CMRL barricade.
- One Flagman (refer flag man clause) shall be appointed at traffic coming side of the transition zone.
- No personnel are allowed to come out of the safety zone, unless flagman guidance.

7.3 DISASTER MANAGEMENT PLAN

7.3.1 General

During Monsoon period there is absolute possibility of rains resulting in inundation, floods etc. The rains may cause heavy inflow of water in the rivers and jungle streams etc. Therefore, the water overflows thereby breaching embankments, causes enormous damages to houses, huts, agricultural lands, roads, telephone lines, railway tracks, electricity lines and other public properties. It is not feasible to completely prevent nature's fury at one stroke. However, to minimize the damage caused by nature's onslaught and to ensure speedy relief thereby mitigating the sufferings of the people. The plan can be set in motion when the need arises with the active coordination of inter departmental officials.

7.3.2 Community Awareness and Involvement

Following steps to be taken by public when a warning for Cyclone threatening the area is received:-

Keep your T.V., Radio on and listen to latest weather warnings and advisories from the Doordharsan All India Radio station. Pass on the information to others as quickly as possible.

Avoid being misled by rumours. Pass on only the official information you have got from the T.V. Radio to others. Move away from low-lying beaches or other location, which may be swept by high tides or storm waves. Leave sufficiently early before your way to high ground gets flooded. Do not delay and run the risk of being marooned.

If your house is out of danger from high tides and flooding from the river and it is well built it is then probably the best place to weather the storm. However, please act promptly if asked to evacuate.

Be alert for high water in areas where streams of rivers may flood due to heavy rains.

Bolt up glass windows or put storm shutters in place. Use good wooden blanks securely fastened provide strong suitable support for outside doors.

If you do not have wooden boards handy, paste paper strips on glasses to prevent splinters flying in to the house.

Get extra food, especially items which can be eaten without cooking or with very little preparation. Store extra drinking water in suitably covered vessels. Make provision for children and adults requiring special diets.

If you are in one of the evacuation areas, move your valuable articles to upper floors to minimise flood damages.

Have hurricane lantern, flash lights and other emergency lights in working condition and keep them ready.

Check on everything that might blow away or be born loose. Kerosene tins, canes, agricultural implements, garden tools, road signs and other objects become weapons of destruction in strong winds. Remove them and store them in a covered room.

Be sure that a window or door can be opened on the left side of the house [i.e] the side opposite the one facing the wind.

Remove cattle to safe place as far away as possible.

If the centre of eye of the storm passes directly over your place, there will be wind and rain lasting for half an hour or more. During this period stay in a safe place. Make emergency repairs during the pre-monsoon period, if necessary, but remember that strong winds will return suddenly from the opposite direction, frequently with even greater velocity.

Be calm your ability to meet any emergency which will inspire and help others.

7.3.3 Trigger Mechanism & Operational Direction

Every operation must be aimed at a direction so as to get desirable results. Disaster Management Plan aimed at to face any eventuality with confidence. It is not only guidance but also provide various insights towards disaster management and mitigation. Every new experience and instances that encountered every year are added so as to take a cue and derive a lesson. So that Disaster Management Plan is prepared and updated.

7.3.4 Damage Assessment and Immediate Restoration / Rehabilitation

In the aftermath of rescue operations are over, the rehabilitation process has to be taken up. A quick assessment of damages to houses eligible for grant of relief for house damages, financial assistance to the families, who have lost their kith and kin, should be done pragmatically. The Revenue Divisional Officers should allocate the work of intensive enumeration to designated staff that should be fixed with the responsibility of collecting data of People death if any and

Cattle death if any Damages to the houses/damages to crops etc. The correctness and promptness of report preparation and transmissions to higher ups are important. A duty chart should be devised involving all revenue personnel and earmarking area if possible in batches of Revenue Staff should be listed out and kept ready to depute them to the affected areas as soon as the calamities are over. As far as possible, the personnel assigned with rescue operations may be left out from enumeration work as the enumeration will have to be undertaken quickly and simultaneously. As and when the assessment of damages is over, the payment of cash doles, issue of free rice and distribution of clothing shall follow according to standing orders on the subject amended from time to time.

7.3.5 Mitigation Measures Undertaken

7.3.5.1 Relief Measures

Relief measures are taken with co-ordination of all Departments are given in **Table 7.10**.

Table7-10: Role and Action Plan of Various Departments

| S.No. | Department | Disaster Specific Action Plan |
|-------|---|--|
| 1. | Disaster Management & Relief (DM&R) | <ul style="list-style-type: none"> • Ensure coordinated movement of all departments, officials and agencies for combating the disaster • Issue necessary directions and ensure effective and coordinated response of all departments. • Arrange regular meetings for updating the apex body on a daily basis. • Provide inputs to concerned departments for effective implementation of the rehabilitation plans. • Document the experiences and best practices. |
| 2. | Animal Husbandry | <ul style="list-style-type: none"> • Prepare contingency plan • Constitute veterinary mobile teams with required resources like medicines, doctors, subordinate staff, laboratories, protective gears, antibiotics, vaccines and antitoxins, etc. in abundance. • Constitute technical groups at state, zone and district levels. • Identification of affected areas. • Disposal of dead carcasses. • Focused attention to veterinary health. • Mass vaccination programme of animals in affected areas Make arrangements for rescue and evacuation of stranded livestock. • Pool in sufficient doctors for treatment of sick animals/poultry. |
| 3 | Public Health Engineering Department (PHED) | <ul style="list-style-type: none"> • Prepare Contingency plan • Enforce ground water legislation • Strict monitoring and vigilance on water for drinking purpose only. |

| S.No. | Department | Disaster Specific Action Plan |
|-------|----------------------------------|--|
| | | <ul style="list-style-type: none"> • Identify additional sources of water for maintenance of regular supply. • Ensure supply of sufficient water through tankers for habitats and cattle camps. |
| | | <ul style="list-style-type: none"> • Provide household water purification tablets. • Augmentation of existing Resources • Hiring of Private Wells • Hand Pump repair programme • Installation of New Hand Pumps and Tube wells • Revival of traditional water sources like Wells, Bawdis, Tankas, etc. • Transportation of water through road tankers and by Rail • Earmark water for drinking purpose available in the tanks and ensure no illegal pumping takes place. • Provide adequate quantity of bleaching powder to PRI, especially Gram Panchayats to protect spread of water and vector borne diseases. • Promote awareness on safe hygienic practices and sanitation. |
| 4 | Department of Medical and Health | <ul style="list-style-type: none"> • Health and epidemiology surveillance • Constitute mobile teams with required resources like medicines, doctors, subordinate staff, laboratories, protective gears, antibiotics, vaccines, etc. in abundance. • Mobile clinics for health checkups • Organise regular rural health camps and keep public informed of such camps. • Check the nutritional status especially for women and children and give treatment. • Check samples of food grains, cooked food in community kitchens, etc. • Promote general awareness of health and hygiene • Issue warnings to all officials/ staff. • Manning of control room 24x7. • Maintain regular contact with EOC. • Keep all ambulances, mobile teams, specialists, blood, medicines, paramedics, etc. in a state of readiness. • Carry out triage. • Provide first aid to minor injuries. • Evacuate injured to hospitals. |
| | | <ul style="list-style-type: none"> • Constitute and effectively deploy mobile teams having Doctors paramedical, |

| S.No. | Department | Disaster Specific Action Plan |
|-------|--------------------------------------|---|
| | | <ul style="list-style-type: none"> • Set up health centers in relief camps and assure hygiene and sanitation. • Prevention/ control of epidemics and vaccination, availability of adequate x-ray machines and orthopedic, neurology equipment. • Availability of stretchers, blood, medicines, ambulances. • Arrange additional beds and medical treatment in local and nearby hospitals as required. • Psychosocial counseling to distressed people. • Health and epidemiology Surveillance • Monitor nutrition status of affected people and take appropriate actions. • Maintain continuous supply of medicines and emergency services till normalcy is restored. |
| 5 | Disaster Management & Relief (DM& R) | <ul style="list-style-type: none"> • Ensure coordinated movement of all concerned departments, officials and agencies for combating Drought. • Make sufficient funds available for Drought response • Arrange regular meetings for updating the apex body and issue directions to all concerned departments regularly. • Document experiences and best practices. |
| 6 | Public Works Department (PWD) | <ul style="list-style-type: none"> • Listing of works that could be done as relief programmes - pond desilting, excavation of water structures, construction of Government infrastructures, etc. • Carry out sudden checks and supervise the relief works. • Generate employment through cash for work/ food for work relief programmes, Issue warnings to all officials/ staff. • Manning of control room 24x7. • Maintain regular contact with EOCs at district/ state levels. • Keep all resources in the state of readiness. • Assessment of damage to infrastructure, roads, bridges and buildings and commencement of restoration work. • Carry out search, rescue, evacuation, relief operation. • Clearance of roads and debris of collapsed infrastructures. • Identification and demolition of unsafe buildings/ infrastructures. |

| S.No. | Department | Disaster Specific Action Plan |
|-------|---|--|
| | | <ul style="list-style-type: none"> • Barricade the disaster site and unsafe areas. • Identification and demarcation of safe areas and preparation of temporary shelters for relief camps. • Prepare temporary roads and bridges, helipads and air strips on the need basis for effective relief operations. • Deployment of heavy equipment like dozers, excavators, cranes, pulleys, power saws, gas cutters, L&Ts, JCBs and other specialist equipment and vehicles. • Restoration of buildings, roads, bridges and other Government buildings. • Ensure close monitoring of response and rehabilitation operations and relief camps. |
| 7 | Civil Supplies and Public Distribution System (PDS) | <ul style="list-style-type: none"> • Distribution of food packets, dry rations, fuel, oil and lubricants • Take precautionary steps against hoarding and profit mongering and ensure normal prices of commodities in the market. • Adequate supply and reserves of FOL and coordinate with all the national agencies for smooth transportation of food and civil supplies. • Supply daily necessities of food items, stock position and ensure continuous supply, in relief camp too. • Coordination with FCI/ warehouses. • Make public aware through media about food distribution and also about the availability of items at subsidized rates. |
| 8 | Municipal Corporation | <ul style="list-style-type: none"> • Coordination and supply of safe drinking water using tankers, etc. • Manning of control room 24x7. • Issue warnings to all Fire Service stations. • Keep all resources in a state of readiness • Assist in evacuation, search and rescue operations. • Ensure availability of all types of extinguishers for fire following earthquakes. • Appoint labourers for excavation works; dismantle unsafe buildings, disposal of solid garbage and liquid waste, disposal of dead persons and carcasses. • Control other potential hazardous situations that might arise from oil, gas and hazardous material spills. • Organise relief camps wherever required; ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and needs. |
| | | <ul style="list-style-type: none"> • Assist in post disaster response and rehabilitation work |

| S.No. | Department | Disaster Specific Action Plan |
|-------|---|---|
| 9 | District Administration | <ul style="list-style-type: none"> • Prepare Drought Contingency Plan. • Issue necessary directions/ instructions to all concerned departments to combat the upcoming situation in an effective and coordinated manner. Ensure effective coordination with all departments, agencies, NGOs and stakeholders. • Arrange/mobilize equipment and resources like water tankers, trucks/ vehicles to transport food supply, fodder, mobile medical vehicles, ambulances, etc. • Arrange for disposal of dead carcasses. • Generate daily reports of relief activities and disseminate. • Organise relief camps wherever required; ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and need. • Media Management • Procure tents, sanitation block, essential materials, etc. for relief camps. • Generate daily reports of relief activities and disseminate. |
| 10 | Department of Information and Public Relation | <ul style="list-style-type: none"> • Information dissemination, issue periodic bulletins to media. • Ensure information given to media are facts and true to avoid rumours. Arrange visit for local and foreign journalists in affected areas. • Information dissemination, update public on various relief interventions. • Operate the Control Room round the clock. • Nodal person to be designated as spokesperson for the Government. • Information dissemination, issue periodic bulletins to media. |
| 11 | Emergency Operation Centre (EOC) | <ul style="list-style-type: none"> • Coordinate and issue direction to all concerned stake holders/ departments regularly • Brief the Disaster Management & Relief Commissioner regularly. • Coordinate the relief and rescue operation. • EOC to function as control room where all SDMA members and experts from various departments are available and take charge for effective coordination monitoring and implementation of rescue operations. |
| | | <ul style="list-style-type: none"> • Prepare, forward and compile reports and returns from time to time. |

| S.No. | Department | Disaster Specific Action Plan |
|-------|------------------------------------|--|
| | | <ul style="list-style-type: none"> • Brief media regularly about the situation' • Brief/ Update the chief minister and cabinet about the situation. |
| 12 | Police | <ul style="list-style-type: none"> • Manning of control room 24x7. • Maintain regular state of readiness • Communication to EOC and stakeholders instantly. • As first responder assume command for security and law and order • Demarcate entries and exits for rescue and relief operation and proper traffic management. • Support SDRF, Civil Defence, Home Guard, Army, Sainik Kalyan and other first responders for search and rescue. • Take necessary actions to avoid rumours. • Ensure prevention of theft and loot. • Provide effective communication network work. • Deployment and monitoring of 108 ambulances. • Deployment of lady police personnel in relief camps for Gender concerns |
| 13 | Electricity Board | <ul style="list-style-type: none"> • Issue warnings to all officials/ staff. • Manning of control room 24x7. • Keep all resources in a state of readiness • Immediately shut down the supply of electricity in the area • Start restoration work of the damaged lines • Simultaneously, make electricity arrangements at the rehabilitation, relief camp areas. |
| 14 | Rural Development Department (RDD) | <ul style="list-style-type: none"> • Issue warnings to all officials/ staff. • Manning of control room 24x7. • Keep all resources in a state of readiness. • Distribution of relief materials to Panchayats, • Relief equipment, tractors, labour, digging/ excavation tools, etc. to be arranged to mobilising and raising fund |
| | | <ul style="list-style-type: none"> • Support PRI in organising relief camps wherever required • Ensure pure drinking water, Sanitation, food, temporary shelters, basic relief materials as per requirements and needs. • Arrangement of Rural relief camps • Arrangement of community kitchens. • Assist in post disaster response and rehabilitation work |
| 15 | Indian Meteorological Department | <ul style="list-style-type: none"> • Transmit updated information to EOC |

| S.No. | Department | Disaster Specific Action Plan |
|-------|------------|--|
| | | <ul style="list-style-type: none"> • Mass media publicity/ issue bulletins at regular intervals. |
| 16 | Railways | <ul style="list-style-type: none"> • Manning of control room 24x7. • Alert officials/ staff and keep all resources in a state of readiness. • Search, rescue and evacuate injured persons to safer places. • Assess the situation for appropriate actions. • Regulate the movement of all trains • Carry out inspection of railway bridges and lines. • Deployment of equipment like generators sets, pump sets, cranes pulleys, dozers, gas cutters, earthmovers, labourers for clearance of fallen bogies, electricity Poles, damaged tracks, etc. • Transport and provide emergency tents, water, medicines, food, etc. to the accident site. • Adequate arrangement of specialized trains for transportation of rescue and relief material. • Restoration of damaged railway lines, electricity poles to restart services as soon as possible. |
| 17 | NGO | <ul style="list-style-type: none"> • Provide first aid, health services, financial assistance and relief materials etc. |

7.4 SOCIAL IMPACT ASSESSMENT (SIA) AND RESETTLEMENT ACTION PLAN (RAP)

7.4.1 Methodology

The action plan is based on the primary and secondary data sources. Secondary data source include Gazetteer of project districts, maps and District Census details, 2011.

This Resettlement Action Plan (RAP) report has been prepared as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, (New LARR 2013 Act), National Highways Act (NH Act), 1956 and is based on data collected from field survey. The primary purpose for preparing SIA (Social Impact Assessment and Resettlement Action Plan (RAP) is to assess the socio-economic condition of the Project Affected Persons (PAPs) in order to minimise and provide mitigative measures. Since the displacement is indispensable, rehabilitation shall be done in such a manner so that the standard of living of PAPs is restored. Special attention will be paid to the vulnerable groups. RAP has provisions to ensure that PAPs are compensated at replacement value for the assets lost and to enable them to regain or improve their socio-economic status enjoyed prior to the project. The RAP is a live document and will be updated as and when necessary. Implementation of the RAP will be done on data so modified.

7.4.2 Objective of the study

The objective of social screening is to create a baseline database containing the features and populace in the immediate vicinity of proposed roads as well as the structures to be affected by the development of this project. Social screening during the feasibility stage helps to avoid, reduce or mitigate likely negative impacts of project action and enhance positive impacts, sustainability and development benefits. The report aims to highlight the social problems and suggests general and typical mitigation measures to alleviate social problems that the project-affected people may face such as loss of livelihood, displacement and loss of access to community facilities through construction of service roads, underpasses and other facilities.

7.4.3 Scope of the Study

- Carry out Structure Verification Survey of the structures likely to be affected and Socio-economic Survey of the Project Affected Persons (PAPs) to get the base line information about the level of impact and to get the base line socio economic status of the PAPs.
- Preparation of Strip Plan showing existing structures likely to be affected along the project roads.
- Conducting Social Impact Assessment including Rehabilitation and Resettlement (R&R) studies
- Preparation of detailed Land Acquisition (LA) Plans with the help of Village Revenue Maps (RVMs) to undertake the land acquisition along the proposed project corridors.
- Preparation of Land Plan Schedules (LPS) of ownership thereof and costs as per revenue authorities and also based on realistic rates.
- Preparation of Social Impact Assessment (SIA) report and Resettlement Action Plan (RAP) for the selected roads.

7.4.4 Social and Rehabilitation Issues

Most of the infrastructure improvements planned for the Urban/Rural areas will take place within the existing Right of Way (RoW) except at some of the congested settlements and densely builtup areas where bypasses/change in alignment/grade separation are proposed and at locations where minor improvements are required for accommodating road safety measures. Since, along the existing National Highways lot of settlements/habitations are developed and further Land Acquisition will result in displacement of affect persons to reduce the negative impact of public and to reduce the displacement, the option of Green field alignment were being studied where, displacement will be less. Social screening surveys need to be conducted in the DPR stage. It was obvious that in majority sections of the project roads, ROW is limited and not enough to accommodate/fit in design standards. Further, it has been identified that RoW is not fully free from encumbrances and at many places it is encroached and squatted upon by the people for various purposes mainly, near habitations and in market places. These issues may compound leading to delay of project and escalation of project cost. Hence, in order to face or overcome these consequences, a preliminary idea of Social and Rehabilitation issues need to be acquired and should be considered while selection of corridors. The key social issues considered would be as below.

- Loss of fertile agricultural land;

- Loss of structures used for residential, commercial and other purposes and associated loss of livelihood i.e., loss of livelihood due to impacts on sources of earning;
- Loss of other properties and assets such as boundary walls, hand pumps, bore wells, dug wells, ponds etc.;
- Disruption of livelihood due to clearing of RoW particularly, petty shop owners; Loss of common property resources such as religious places, government buildings, market, arch, statue, shopping complex, bus stops, compound walls etc.;
- Likelihood of increased accidents due to road widening;

7.4.5 Land use along the Project Road

The preliminary social assessment was carried out, considering Proposed Right of Way of 70M all along the project roads except at the proposed facilities such as Interchanges, RoBs, Bridges etc. Most of the land use categories along this section are of either Agricultural land or Barren land and various activities are being carried out by the local residents. The proposed project road passes through Ramnagara and Bangalore Rural Districts and in the state of Karnataka, where some pucca, semi pucca and kutcha structures are found at some locations along the alignment. These settlements are like as private, government and community assets. The major portion is predominantly agricultural land. Common Property Resources along the sections of the project road include some religious structures, community/village bushy land, grazing lands, water resources, etc.

7.4.6 Legal Policy Frame Work & Entitlement Matrix

All strategic interventions on human development, spread across all social issues, need directives of policies and legal support to operationalize the appropriate actions. These policies and legislations help to overcome the constraints and support administrator, implementer, community and individual in delivery of justice. This section includes the World Bank as well as National policies and Acts applicable to the proposed Project are detailed under in subsequent stages:

The main objective of the Legal and Entitlement Policy Framework is to appropriately identify, address and mitigate all adverse socio-economic impacts accrued to the communities, families or people due to the implementation of the Project within the purview of the existing law and regulations of the country and state those are applicable to the proposed project.

National Acts and policies applicable to this project include:

- National Highways Act (NH Act), 1956;
- Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, (New RFCTLARR 2013, Act)

The following provisions from the above mentioned policies are likely to be applicable for the project.

7.4.6.1 Land Acquisition

Land acquisition in India refers to the process by which the Central or any State government, except the Government of Jammu & Kashmir, in India acquires private land for the purpose of industrialization, development of infrastructural facilities or

urbanization of the private land, and provides compensation to the affected land owners and their rehabilitation and resettlement.

In case where a State Government through any Act or Gazette Notification or as approved by any authority of State Government (duly authorized for the purpose) as per their approved procedure has fixed a rate for compensation of land and for resettlement and rehabilitation assistance and is higher than the provisions under the RCFTLARR Act 2013, the same may be adopted by the Competent and Executive Authority respectively in determining the compensation for land.

Land acquisition for the proposed project will be done as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR) and NHA Act, 1956.

7.4.7 Social Impact

As the proposed project roads are passing through 61 villages in Ramanagara and Bangalore Rural districts of Karnataka state consists of high impact zones are the settlements through which the proposed alignment is passing where some pucca, semi pucca and kutcha structures are found. As per the social impact assessment and base line verification survey, 310 number of structures (includes private, government, community, panchayat) are either partially/completely affected. Also, 260 numbers of PAHs, 468 PAFs and 1170 numbers of PAPs will be getting affected. Total land required for the proposed project is 685.367 ha. The land required by the project for the construction falls under two classifications: (1) Public land owned by the State Government and administered by other departments such as Revenue Department etc; and (2) Private Land.

7.4.7.1 Identification of Structures

The structures existing within the proposed RoW belong to encroachers as well as title and non-title holders. The total number of structures within proposed RoW to be impacted is 310 (includes residential, commercial, community and panchayat). Of the total likely to be affected structures, significant number (268) of private properties comprising Residential, Commercial, sheds, toilets, petty shops etc. Structures of various types (Pucca/Semi-Pucca/Kutcha) are existing along the project road followed by CPRs (41) and minor assets (172 numbers) which are affected due to the development of proposed project.

7.4.7.2 Ownership of the Affected Structures

The estimated number of structures identified and verified of which are affected completely or partially along STRR Phase-I Road is about 310 numbers of structures. Of the total affected structures, 268 (86.45%) are private, 10 (3.23%) are owned by the government and 31 (10%) are owned by the community and 1 (0.32%) is owned by Panchayat. Apart from it, 41 CPRs and 172 minor assets (includes bore wells, wells, water tanks, pump house, hand pumps etc.) are affected in this project road. Ownership wise details of likely affected structures are presented in below **Table 7.11**.

Table 7-11: Ownership Status of the Affected Structures

| Sl. No. | Ownership | No | % to total |
|---------|-----------|-----|------------|
| 1 | Private | 268 | 86.45 |

| | | | |
|--------------|------------|------------|---------------|
| 2 | Government | 10 | 3.23 |
| 3 | Community | 31 | 10.00 |
| 4 | Panchayat | 1 | 0.32 |
| Total | | 310 | 100.00 |

7.4.7.3 Impact on Private Properties

The estimated land requirements are resulting in complete or partial displacement of 268 private structures. Of the total affected private structures, 94 (35.07%) are used for residential purpose, 43 (16.04%) are used for commercial purposes, 11 (4.10%) used for both residential cum commercial purposes and 120 (44.78%) are used for other purposes (includes toilets, sheds, petty shops etc.). A considerable number 172 of affected minor assets are wells, borewells, hand pumps, water tanks etc. Most of the commercial establishments are provisional (kirana) shops. The usage wise details of all private structures likely to be affected are presented in below **Table 7.12**.

Table 7-12: Usage of the Private Properties Affected

| Sl. No. | Usage | No | % to total |
|--------------|---|------------|---------------|
| 1 | Residential | 94 | 35.07 |
| 2 | Commercial | 43 | 16.04 |
| 3 | Residential + Commercial | 11 | 4.10 |
| 4 | Others (incl. Toilets, Sheds, Petty Shops, CWs, etc.) | 120 | 44.78 |
| Total | | 268 | 100.00 |

7.4.7.4 Impact on Common Property Resources

A total of 41 common properties are affected across the project road. Of which 14 (34.15%) are religious structures in the form of small temples and 15 (36.59%) of other religious structure in the form of mosques/tombs are affected in this project road. In addition, 6 (14.63%) of Government buildings and 8 (14.63%) of other structures such as market, arch, statue, shopping complex, bus stops, compound walls etc are affected. Details of the usage of these common properties such as religious places and other structures are given in **Table 7.13** below:

Table 7-13: Common Properties Affected

| Sl. No. | Usage | No | % to total |
|--------------|---|-----------|---------------|
| 1 | Religious Places (Temples) | 14 | 34.15 |
| 2 | Mosques/Tombs | 15 | 36.59 |
| 3 | Government Buildings | 6 | 14.63 |
| 4 | Others (Market, Arch, Statue, Shopping Complex, Bus Stops, Compound Walls etc.) | 6 | 14.63 |
| Total | | 41 | 100.00 |

7.4.7.5 Other Assets and Minor Structures Affected

In addition to the above listed properties other minor assets which includes well, bore well, water tanks, taps, Hand pumps and Overhead Tanks etc. around a total of 172 minor assets are affected in this road. Details are given in the **Table 7.14** below.

Table 7-14: Details of Other Minor Assets Affected

| Sl. No. | Usage | No | % to total |
|--------------|---|------------|---------------|
| 1 | Well | 32 | 18.60 |
| 2 | Bore Wells | 14 | 8.14 |
| 3 | Water Tanks | 60 | 34.88 |
| 4 | Pump House | 34 | 19.77 |
| 5 | Hand Pumps | 2 | 1.16 |
| 6 | Others (Over Head tanks, Sump, Pits, Taps etc.) | 30 | 17.44 |
| Total | | 172 | 100.00 |

7.4.7.6 Type and Area of the Affected Structures

Of the total 310 structures affected under both private, government and community, a majority 101 (32.58%) are Pucca, 102 (32.90%) structures are Semi-Pucca, 96 (30.97%) are Kutcha and 11 (3.55%) are movable type of structures. The total area affected excluding Compound Walls Length is about 18294.45 square meters. Details are presented in **Table 7.15** below.

Table 7-15: Type and Area of Structures Affected along Project

| Sl. No | Type | Total Structures Affected | | Total Area affected (Sq.mts) | |
|---|------------|---------------------------|--------------|------------------------------|---------------|
| | | No | % | No | |
| 1 | Pucca | 101 | 32.58 | 5219.02 | 28.53 |
| 2 | Semi pucca | 102 | 32.90 | 7194.61 | 39.33 |
| 3 | Kutcha | 96 | 30.97 | 5752.12 | 31.44 |
| 4 | Movable | 11 | 3.55 | 128.70 | 0.70 |
| Total | | 310 | 96.45 | 18294.45 | 100.00 |
| Area affected is excluding affected compound walls area. | | | | | |

7.4.7.7 Usage with type of total affected structures

Observed across the type and usage of the total affected structures, majority of the residential, commercial, structures used for both residential cum commercial purposes are Semi-Pucca in nature. Details of usage with type of likely affected structures including common resources properties etc are presented in **Table 7.16** below.

Table 7-16: Usage with Type of Total Affected Structures

| Sl. No. | Usage | Type of affected property (%) | | |
|---------|----------------|-------------------------------|------------|--------|
| | | Pucca | Semi-Pucca | Kutcha |
| 1 | Residential | 28 | 37 | 29 |
| 2 | Commercial | 8 | 23 | 11 |
| 3 | Res+Commercial | 4 | 5 | 2 |

| | | | | |
|---|---|----|----|----|
| 4 | Others (Incl. Common property resources etc.) | 61 | 37 | 65 |
|---|---|----|----|----|

7.4.7.8 Extent of Loss by Usage

Table 7.17 presents the percentage of loss for the total affected properties by their usage. From the table below it is seen that out of the total area of 19769.39 square meters the affected area is 18294.45 square meters thus resulting in a loss of 92.54 % of the total area excluding the affected length 1122.68 Metres of Compound walls.

Table 7-17: Percentage of loss by Usage

| Sl. No | Type of usage | Total | | |
|--------------|--|----------------------|--------------------------|--------------|
| | | Total Area (Sq.mts.) | Affected area (sq. mts.) | % of loss |
| 1 | Residential | 6532.88 | 5792.54 | 88.67 |
| 2 | Commercial | 5692.96 | 5220.48 | 91.70 |
| 3 | Res+Commercial | 1280.68 | 1202.96 | 93.93 |
| 4 | Others (incl. Common property resources) | 6262.87 | 6078.47 | 97.06 |
| 5 | Compound Walls (Length in Mtrs) | 1122.68 | | |
| Total | | 19769.39 | 18294.45 | 92.54 |

7.4.7.9 Project Impacted PAPs and PAFs

The acquisition of private land and the affected structures by the project are indicators of impact on the social environment. To estimate the exact number of impacted persons at this stage is not possible. Generally, the impact of project is evaluated on magnitude of land loss and other immovable assets/ structures.

Here, the impacted persons are calculated on the basis of affected structures in project road. The affected persons can be derived by multiplying the average members of household in the project influence districts into likely to be affected structures. The district average of the family size is considered as the base. According to the estimation, approx. 468 project affected families (PAFs) and 1170 project-affected persons (PAPs) of 260 households (PAHs) are likely to be impacted directly or indirectly by the development of proposed project road.

7.4.8 MITIGATION MEASURES

The total land need to be acquired for the proposed project is 685.367 Ha. For development of proposed project road. The agricultural land price has been calculated as an average of the Circle/Guidance Value in the respective villages. While calculating the cost irrespective of type and usage, we considered the cost of all structures/buildings and other assets to avoid any further issues in future.

The valuation of losses has been considered on the basis of prevailing Circle/Guidance rate derived from Department of Stamps and Registration of Government of Karnataka. While calculating the Land cost for each village, average of the all types of lands in that particular village was considered. Further, as the Land rates are not available for some of the villages, land rate in nearby village was considered for the same. However, the

compensation for the other assets (Bore well/Well/Hand Pumps etc.) likely to be affected was obtained from the local public. According to RFCTLARR Act-2013, the market value of land as mentioned under section 26 of act needs to be multiplied by the radial factor (based on the distance of project from urban area as notified by the appropriate government- e.g multiplication of 2 in Rural area, 1.5 in semi-urban area and Multiplication of 1 in Urban area) plus value of assets attached to land or building (mentioned in Section 29 of RFCTLARR Act-2013) Plus Solatium (solatium includes 100% market value multiplied by 2 plus value of assets in Rural area and multiplied by 1 plus value of assets in urban area).

7.4.8.1 Compensation for Structures

The replacement cost of structure is estimated based upon the average of prevailing market value (collected during site visits from local public) of the structure. Most of the existing structures are either semi-pucca or kutcha. As per survey, a total number of 310 structures including 268 private structures are estimated for the social budget. Maximum numbers of the structures which are likely to be impacted are Semi-Pucca (102 Nos.) Followed by Pucca (101 Nos.), Kutcha (96 Nos.) and Movable (11 Nos.). However, while calculating compensation for structures we considered all structures as pucca in nature irrespective of their usage. Apart from private structures; religious and govt. structures are also considered for R&R compensation. The solatium of 100 percent of the rate of affected structures is included for final compensation. The estimated budget calculation details are appended in below **Table 7.18**.

Table 7-18: Impact on structures along the proposed project

| Sl. No. | Typology | No. of Structures | Approx. Affected Area of the Structure (Sq.M.) | Avg. Unit at Rs./ (Sq.M.) | Total Structure Cost (Rs.) | Compensation as per RFCTLARR Act, 2013 |
|--------------|-----------|-------------------|--|---------------------------|----------------------------|--|
| 1 | Pucca | 101 | 5219.02 | 7500 | 39,142,650 | 78,285,300 |
| 2 | SemiPucca | 102 | 7194.61 | | 53,959,575 | 107,919,150 |
| 3 | Kutcha | 107 | 5880.82 | | 44,106,150 | 88,212,300 |
| TOTAL | | 310 | 18294.45 | | 137,208,375 | 274,416,750 |

7.4.8.2 Compensation for Other Minor Assets

The replacement cost of other minor assets is estimated based upon the actual cost incurred by the affected persons which was collected from the public during site visits. As per survey and estimation a total number of 172 other minor assets are likely to be affected which includes Wells, Bore Wells, Hand Pumps, Pump Houses, Sump, Pits, Taps etc. The estimated budget calculation details are appended in below **Table 7.19**.

Table 7-19: Impact on Other Minor Assets

| Sl. No. | Type of Asset | Number Affected | Unit Cost (Rs.) | Total Cost (Rs.) |
|---------|---------------|-----------------|-----------------|------------------|
| 1 | Well | 32 | 800,000 | 25,600,000 |
| 2 | Bore Wells | 14 | 200,000 | 2,800,000 |

| | | | | |
|--------------|---|------------|---------|-------------------|
| 3 | Water Tanks | 60 | 75,000 | 4,500,000 |
| 4 | Pump House | 34 | 100,000 | 3,400,000 |
| 5 | Hand Pumps | 2 | 150,000 | 300,000 |
| 6 | Others (Over Head tanks, Sump, Pits, Taps etc.) | 30 | 50,000 | 1,500,000 |
| Total | | 172 | | 38,100,000 |

A total of Rs. 2034.54Cr. Crores has been estimated for compensation towards Land, structures and other minor assets which are likely to be affected due to proposed project road. The NHAI guidelines recommend that the compensation for the lost land and structures be paid through the competent authority. For structures valuation, the concerned government department may be requested to assess the value. The detail of estimated LA budget is presented in below **Table 7.20**.

Table 7-20: Estimated LA Cost and R&R Budget

| Sl. No. | Item | Unit | Quantity | Land / Structure Cost (INR) | Compensation as per RFCTLARR Act, 2013 (INR) |
|---|---|--------|----------|-----------------------------|--|
| A. Compensation for Land | | | | | |
| 1 | Basic/Circle Rate | Acre | 1692.86 | 2,843,391 | 4,813,462,888 |
| | Multiplication Factor (2.00) | | | | 9,626,925,777 |
| | Solatiun @ 100% | | | | 9,626,925,777 |
| | Addl. Compensation @ 12% per Annum (on Basic/Circle Rate) | | | | 577,615,547 |
| | Total Compensation for Land | | | | 19,831,467,100 |
| B. Compensation for Structures | | | | | |
| 1 | Compensation for Structures | Sq.Mt. | 18294.5 | 7,500 | 274,416,750 |
| C. Compensation for Other Structures | | | | | |
| 1 | Well | Number | 32 | 800,000 | 25,600,000 |
| 2 | Bore Wells | Number | 14 | 200,000 | 2,800,000 |
| 3 | Water Tanks | Number | 60 | 75,000 | 4,500,000 |
| 4 | Pump House (incl. Connection) | Number | 34 | 100,000 | 3,400,000 |
| 5 | Hand Pumps | Number | 2 | 150,000 | 300,000 |
| 6 | Others (Over Head tanks, Sump, Pits, Taps etc.) | Number | 30 | 50,000 | 1,500,000 |
| Sub Total (A+ B+ C) | | | | | 20,143,983,850 |
| D. Contingency | | | | | |
| 1 | Contingency at 1 % of the Sub Total | | | | 201,439,838 |
| TOTAL (A+B+C+D) | | | | | 20,345,423,688 |
| Approx. LA Cost per Hectare | | | | | 29,685,382 |
| Approx. LA Cost per Acre | | | | | 12,018,373 |

For loss of structures, all PAPs will be compensated for their affected structures at replacement cost, for which provision has been kept in the Entitlement Matrix. All the squatters with structures and only vulnerable encroachers will be eligible for assistance for loss of their structures.

7.4.9 Institutional Arrangement

The action plan provides a detailed mechanism for the appropriate organisation and implementation of the plan. A social cell will be created which will be responsible for the implementation of the action plan. There will be a Resettlement and Rehabilitation (R&R) Officer and a Land Acquisition Officer, who will be supported by R&R Manager. In addition Non-government Organisations (NGOs), which have relevant experience in implementation of R&R projects, will be contracted to provide assistance to implementing authority as well as affected persons. The district level committees will be set up to facilitate the finalization of replacement value and all grievances of the people.

7.4.9.1 Implementation Arrangements and Schedule

It is envisaged that the land acquisition and the R&R activities will be completed before initiating the civil works. Details of implementation arrangement are given in R&R report.

CHAPTER : 8 PROJECT BENEFITS

8.1 INTRODUCTION

The proposed highway Satellite Town Ring Road newly declared National Highway NH-948A will be developed under Bharatmala Pariyojna (Lot-3) in Karnataka and Tamil Nadu States of India. It passes through several habitat areas viz. Dabaspet, Banawadi, Gudemaranahalli, Rangenahalli, Magadi, Attingere, Melehalli, Ramanagara, Kunagal, Kanakapura, Banavasi, Indalawadi, Anekal, Perandapalli, Devaripalli, Kalkunte Agrahara. It will be beneficial to the community by way of improvement social infrastructure, physical infrastructure, development of economy, reduced pollution, vehicle maintenance, fuel saving, lesser carbon footprint, employment potential and other tangible benefits. The plantation along the corridor will enhance the aesthetic view of the road and improves the air quality of the region as well.

The proposed facility will satisfy following objectives.

- It will improve the road connectivity to Bangalore city and eight satellite towns around it.
- Ensure safe and seamless traffic corridor to Bangalore city
- To cater future traffic demand and growth
- Uniform growth of towns around city
- To prevent ribbon development
- Reduce traffic black spots and accidents

8.2 ECONOMIC DEVELOPMENT

The proposed highway project will provide better connectivity in the region and other areas of Karnataka state. It will enhance economic development by encouraging attraction of business to site equipped with good access and by improving the travel efficiencies of the existing business and to start new avenues. This also helps in developing the following:

- Development of Infrastructure projects
- Development of new industries
- Development of new educational institutions and hospitals / health centres
- Development of IT parks
- Development of real estates

8.3 SOCIAL BENEFITS

It is expected that after construction there will be change in land use (especially along the new Highway). There will be more commercial establishments such as shops, dhaba/ restaurants/, small workshop serving the vehicles moving along the highway. These activities will provide additional socio-economic development and increased wages in the project area.

Additional job opportunities may also be developed due to the development of proposed industrial and infrastructure activities along the highway. As discussed above, the community

people will get huge job opportunities due to the development of the planned highway, which in turn will further improve their living status and overall social paradigm of the district.

8.4 ENVIRONMENTAL BENEFITS

The construction of new highway will ensure the smooth flow of traffic, which reduces the emissions and noise level. Plantation of trees along the proposed highway will improve the tree density along the RoW which will improve aesthetics and act as a pollution absorber as well. Roadside plantation shall further improve the air quality of the region. Hence overall environment improvement in the region is envisaged.

8.5 TRAFFIC DECONGESTION AND COST

A traffic study has been carried out at various junctions of existing NHs and SHs to understand the traffic scenario. Accordingly, geometry of the road has been designed with provision of various suitable structures in order to provide better level of service in terms of improved riding quality and smooth traffic flow. Further, it ensures the diversion of traffic of existing roads and provides smooth, efficient and faster transportation which ultimately leads to massive savings in the form of reduced wear and tear of vehicles, reduced vehicle operating cost (VOC) and total reduction in transportation costs.

8.6 ROAD SAFETY

The construction of the new highway shall ensure smooth flow of the traffic. Installation of proper road safety system through signage, barricades, and crash barriers enhance road safety to the traffic.

8.7 EMPLOYMENT GENERATION (direct and indirect)

During the construction phase, the employment opportunities will be created for skilled (engineers, transport, mechanical), semi-skilled (technician, road Inspectors, plant operator, office support etc.) and unskilled (general labour) labourers. Most of the skilled labourers may come from other parts of the country; the opportunities for semi-skilled and unskilled sections of the work force will primarily be available from the local communities.

However, it is estimated that approx. 2000 numbers of direct employees will be required during construction stage of the project. Further, it will also create considerable indirect employment opportunity in the form of transportation of construction materials, greenbelt development, ancillary facilities like canteens, dhabas etc.

During operation phase, approx. 250 numbers of direct and indirect employees shall be required for highway amenities as well as economic & social hubs development.

CHAPTER : 9 ENVIRONMENTAL COST BENEFIT ANALYSIS

As per EIA Notification dated 14th September, 2006, it is required to include “Environmental Cost Benefit Analysis” as chapter-9 in the EIA Report, if recommended by EAC at scoping stage.

Therefore, no specific condition with respect to Environmental Cost Benefit Analysis for this project is mentioned anywhere in the TOR issued by MoEFCC on 23rd January, 2019.

CHAPTER : 10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

The Environmental Management Plan (EMP) consists a set of environmental impacts, monitoring, mitigation and institutional measures to be taken during the design, construction and operational phases of the project to eliminate adverse environmental impacts, to offset them, or to reduce them to acceptable levels in addition to environmental enhancement during construction and operation stage of the project.

10.2 OBJECTIVES OF EMP

The main aim of the Environmental Management Plan is to ensure that the various adverse impacts are mitigated and the positive impacts are enhanced. The objectives of the EMP at various stages of the project planning and implementation are as follows:

Pre-Construction/Design Stage

(a) Pre-construction activities by PIU/PMC/CSC

Prior to the contractor's mobilization, NHAI will ensure that an encumbrance free Corridor of Impact is handed over to enable the start of construction. Clearance involves the following activities:

- Removal and felling of trees at very minimal possible level.
- Relocation of common property resources and community assets like telephone poles, electric poles and hand pumps will be impacted.
- Formal arrangements for maintenance of enhancement sites. This includes plantation of trees and barricades along the highway.
- Modification (if any), of the contract documents by the Engineer of the NHAI
- NOC/Clearance related to the project such as Environmental Clearance, Tree Cutting etc.

(b) Pre-construction activities by Contractor

- Pre-construction stage involves mobilization of the contractor and the activities undertaken by the contractor pertaining to the planning of logistics and site preparation necessary for commencing construction activities. The activities include:
 - Joint field verification of EMP by the Environment Specialist of the Construction Supervision Consultant and Contractor.
 - Identification and selection of material sources (quarry and borrow material, water, sand etc).
 - Procurement of construction equipment / machinery such as crushers, hot mix plants, batching plants and other construction equipment and machinery.
 - Selection, design and layout of construction areas, hot mix and batching plants, labour camps etc.
 - Apply for and obtain all the necessary clearances/ NOCs/ consents from the agencies concerned.

- Planning traffic diversions and detours including arrangements for temporary land acquisition.

Construction Stage

(a) Construction activities by the Contractor

Construction stage is the most crucial stage in terms of activities that require careful management to avoid environmental impacts.

Several other environmental issues have been address as part of good engineering practices, the costs for which have accounted for in the Engineering Costs. They include providing roadside drainage, provision of cross drainage structures etc.

(b) Construction activities by the PIU/PMC/CSC

The PIU/PMC/CSC shall be involved in the smooth execution of the project and assisting the contractor during this phase. Their work shall include but not limited to:

- Monitoring and guiding the contractor on adopting good environmental and engineering practices.
- Arrangement of plantation through the Forest Department
- Arranging training to the contractor and other stakeholders according to the needs arising.
- Making changes in the design if need arises

Operation Stage

The operational stage involves the following activities by PIU:

- Monitoring of environmental conditions through approved monitoring agency.
- Monitoring of operational performance of the various mitigation/enhancement measures carried out.

10.3 IMPLEMENTATION OF EMP

An EMP has been devised to control and mitigate adverse impact during construction phase of the proposed project. The Contractor of each package will be responsible for effective implementation, management and maintenance of various provisions of the EMP. For successful implementation of the mitigation and control measures described in the EMP, the contractors will deploy necessary personnel and other resources.

The Contractors will set-up an Environment, Health and Safety Cell for implementation and compliance of EMP provisions which should be available at the site through-out the project execution. This Cell shall be headed by a qualified Environmental Officer along with supporting staff. The Environmental officer shall interact with NHAI Officer/CSC/PMC and other concerned departments to ensure the mitigation and enhancement measures mentioned in the EMP. The Environmental officer will submit periodic reports to the Environmental expert of the PMC/CSC/NHAI Officer.

The Environmental expert of the PMC/CSC/NHAI Officer or the Resident Engineer will apprise the Project Director on the status of the implementation and compliance of the EMP. The Project

Director of NHAH or his authorized representatives shall be the official, responsible for the compliance of the EMP from the project proponent's side at the site level.

10.4 RESPONSIBILITY FOR IMPLEMENTATION OF EMP

Various authorities are responsible for implementation of EMP on specific time and location. Details are given in below table:

Table 10-1: EMP Responsibility Matrix

| System | Authority | Responsibility |
|--|---|---|
| Co-ordinating/ Facilitating Agency | Co-ordinator/NHAI PIU | <ul style="list-style-type: none"> ✓ Overview of the project implementation ✓ Coordination with different state level committee, to obtain regulatory clearances ✓ Participate in state level meetings ✓ Ensure timely budget for the EMP ✓ Monthly review of the progress |
| | PMC- Environmental Officer (ECO). | <ul style="list-style-type: none"> ✓ Overall responsible for EMP implementation ✓ Responsible for obtaining regulatory Clearances ✓ Coordination with PIU Staff (Environmental officer). ✓ Reporting to various stakeholders (Regulatory bodies) on status of EMP implementation ✓ Review of the progress made by contractors ✓ Ensure that BOQ items mentioned in EMP are executed as per contract provisions |
| | Construction supervision consultant (CSC) | <ul style="list-style-type: none"> ✓ Assisting SE in overall implementation of EMP ✓ Review of periodic reports on EMP implementation and advising SE in taking corrective measure. ✓ Preparing environmental training program and conducting the same for field officers and engineers of contractor Conducting periodic field inspection of EMP implementation. ✓ Assisting SE to reporting various stakeholders (Regulatory bodies) on status of EMP implementation. |
| Implementing/ Monitoring Agency | Environmental Monitoring Consultants | <ul style="list-style-type: none"> ✓ Work in close coordination with ERRS (PIU) and contractor. ✓ Responsible for supervision of effective implementation of EMP measures by the contractor. ✓ Review progress reports and periodic reporting to PIU about the status of EMP implementation. |
| | Safety and Environmental Officer | <ul style="list-style-type: none"> ✓ Conducting awareness campaign for all construction personnel (including labourers, supervisors, engineers and consultants) about |

| | | |
|------------|----------------------------------|---|
| | | <p>HIV/AIDS/STDs in the construction and labour camps.</p> <p>✓ Facilitating the medical testing/ routine check-up for labours.</p> |
| Contractor | Safety and Environmental Officer | <p>✓ Responsible for ensuring the implementation of EMP as per provision in the document.</p> <p>✓ Discussing various environmental/social issues and environmental/social mitigation, enhancement and monitoring actions with all concerned directly or indirectly.</p> <p>✓ Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers along with sensitization on social issues that may be arising during the construction stage of the project.</p> <p>✓ Directly reporting to the Project Manager of the Contractor.</p> <p>✓ Assisting his project manager to ensure social and environmentally sound and safe construction practices.</p> <p>✓ Assisting the PIU on various environmental monitoring and control activities including pollution monitoring; and</p> <p>✓ Preparing and submitting monthly reports to PIU on status of implementation safeguard measures.</p> |

10.5 ENVIRONMENTAL ACTION PLAN

The action plan for EMP is presented in below **Table 10-2**.

Table 10-2: Environmental Management Action Plan

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---|--|---|--|-------------------------|---|-------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| PRE-CONSTRUCTION STAGE | | | | | | |
| Pre-construction activities by PIU | | | | | | |
| P.1 | Alignment, Width of the highway and structures | The proposed corridor is six-lane divided carriageway with raised median of width 5m. Provision of paved and earthen shoulder of 1.50m and 2.50m by width, respectively. The proposed structures are 17 VUP, 6 VUP with canal crossings, 9 LVUP, 10 VOP, interchanges at 6 locations, 1 Major Bridge, 13 Minor Bridge, 3 ROBs, Viaduct at 4 locations, and 119 culverts. | Final Feasibility Report | Throughout the Corridor | PIU/NHAI Bangalore, Revenue Dept., NGOs, Collaborating Agencies | EO-CSC |
| P.2 | Land Acquisition and affected properties | <p>Total 685.367 hectare land is required to develop the proposed project in which 619.294 hectare. in private and 66.073 hectare in government land. Proposed alignment is passing through mostly agricultural land. Land acquisition will be done as per procedure and rules lay down in RFCTLARR Act, 2013 and NHAI Act, 1956.</p> <p>The estimated R&R budget including LA cost is Rs. 2034.54 crores. It shall be ensured that all R&R activities including implementation of Environment Management Plan are completed before the start of work.</p> <p>Total 310 structures, 260 household and 41 CPRs (29 religious, 6 govt. buildings and 6 other) are affected due to proposed project.</p> | EIA & SIA Report /Final Feasibility Report | Throughout the Corridor | PIU/NHAI Bangalore, Revenue Dept., NGOs, Collaborating Agencies | EO-CSC |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|---|---|--|-------------------------|--|-------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| P.3 | Preservation of Trees | <p>Aout 5,401 non-forest trees and 16,806 numbers of poles (girth size having less than 30 m are categorized as poles) are falling under Corridor of Impact. However, maximum efforts will be given to save the trees especially those which are falling outside the construction zone.</p> <p>The cutting of trees will take place only after obtaining permission from the competent authority as per the Forest (Conservation) Act, 1980 and local law.</p> | Clause No. 201.2 MORT&H Specifications for Road and Bridge works | Throughout the Corridor | PIU/NHAI Bangalore, Forest Department, Contractor | EO-CSC |
| P.4 | Relocation of Community Utilities and Common Property Resources | All community utilities and properties i.e., water supply lines, sewer lines, hand pumps will be relocated before construction starts, on any section of the project corridor. The PIU Bangalore will be responsible for relocation of these properties in consultation and written agreement with the agency/ owner/community. Environmental considerations with suitable/required actions including health and hygiene aspects will be kept in mind while relocating all community utilities and resources. | As in RAP | Throughout the Corridor | PIU/NHAI Bangalore, Concerned Agencies, Contractor | EO-CSC |
| P.5 | Orientation of Implementing Agency and Contractors | <p>The NHAI-PIU Bangalore shall organize orientation sessions and regular training sessions during all stages of the project. This shall include on-site training (general as well as in the specific context of a sub-project).</p> <p>These sessions shall involve all staff of CSC, field level implementation staff of PIU and Contractor, Environmental</p> | Project Requirements | Throughout the Corridor | Contractor | EO-CSC |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|---|---|-------------------------|---|-------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | Experts. The contractor will ensure that his staff including engineers, supervisors and operators attend the training sessions. | | | | |
| P.6 | | | | | | |
| P.6.1 | Assessment of Impacts due to Changes/Revisions/Additions in the Project Work | The Environmental Expert of CSC will assess impacts and revise/ modify the EMP and other required sections of the project documents in the event of changes/ revisions (including addition or deletion) in the project's scope of work. | Project Requirements | Throughout the Corridor | Contractor/ Environmental Expert of CSC | PIU/NHAI Bangalore |
| P.6.2 | Crushers, hot-mix plants and Batching Plants Location | Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1000m away from the waterbody, nearest village/ settlement preferably in the downwind direction. The Contractor shall submit a detailed layout plan for all such sites and approval of Environmental Expert of CSC shall be necessary prior to their establishment. The Contractor shall not initiate plant/s operation until the required legal clearances are obtained and submitted. The engineer will ensure that the regulatory and legal requirements are being complied with. | Clause No 111.1 MoRT&H Air (P&CP) Act 1981, | Throughout the Corridor | Contractor | Engineer, EO-CSC |
| P.7 | | | | | | |
| 7.1 | Borrow Areas | Borrow area at 8 locations have been identified which is | Clause No. 111.2 | Borrow | Contractor | EO-CSC, |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|------------------------------|---|--|----------------------------------|------------------------|----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | <p>within 5 km of project site at chainages 19.800 km, 23.500 km, 24.800 km, 30.400 km, 35.400km, 61.200 km, 61.100 km.</p> <p>The Contractor will start borrowing earth from select borrow area after having formal agreement signed between the landowner and contractor and a copy is submitted to the EO-CSC/PIU Bangalore through the Engineer.</p> <p>The SC will make sure that each site is in line with IRC and other Project Guidelines.</p> | & 305.2.2 MORT&H Specifications for Road and Bridge works | Areas | | PIU/NHAI Bangalore |
| P.7.2 | Quarry | <p>Quarries have been identified at 4 locations along the alignment. Details of the same are given in Table-2.19 of Chapter 2.</p> <p>In case, the contractor decides to use quarries other than recommended by the DPR consultants, then it will be selected based on the suitability of the materials and as per established law.</p> <p>The contractor will procure necessary permission for procurement of materials from the concerned department and shall submit a copy of the approval and the rehabilitation plan to the PIU Bangalore through Engineer.</p> | Clause No. 111.3 & MORT&H Specifications for Road and Bridge works | Along the Project Influence Area | Contractor | EO-CSC, PIU/NHAI Bangalore |
| P.7.3 | Arrangement for Construction | Apprx. 31,33,233 KL or 3436 KLD of water will be required during construction phase of the project. The source will | Clause No. 1010 MORT&H | Along the Project | Contractor | EO-CSC, PIU/NHAI |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|---|---|--|----------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | Water | be tankers and surface water which will be utilized after obtaining permission from the concerned department. NHAI will purchase water tankers from the approved empanelled agencies of respective districts. | Specifications for Road and Bridge works | Corridor | | Bangalore |
| P.7.4 | Labor Requirements | It is estimated that approx. 2000 workers including temporary and permanent will be required during construction stage and 250 workers (includes permanent and temporary) will require during operation stage of the project. | Conditions of Contract | Along the Project Area | Contractor | EO-CSC, PIU/NHAI Bangalore |
| P.7.5 | Construction Camp Locations – Selection, Design and Lay-out | <p>Siting of the construction camps will be selected by the contractor as per the guidelines.</p> <p>Construction camps will not be proposed within 500 m from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community applies only in case where a construction camp does not house plant sites and shall be located 200m away from water sources to avoid contamination and spread of water borne disease.</p> <p>Location for stockyards for construction materials will be identified at least 1000m from watercourses.</p> <p>The waste disposal and sewage system for the camp will be designed, built and operated such that no odor is generated.</p> | Appendix-7.5 Guidelines for Siting and Layout of Construction Camp | Along the Project Corridor | Contractor | EO- CSC, PIU/NHAI Bangalore |
| P.7.6 | Arrangements | The contractor as per prevalent rules will carry out | Project | Along the | Contractor | EO- CSC, |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------------------------|--------------------------------|---|---|---|------------------------|----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | for Temporary Land Requirement | <p>negotiations with the landowners for obtaining their consent for temporary use of lands for construction sites/hot mix plants/traffic detours/borrow areas etc.</p> <p>The Contractor will submit a copy of agreement to the Environment Expert of CSC.</p> <p>The Environmental Expert of CSC will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the contract.</p> | Requirements | Project Corridor | | PIUPIU/NHAI Bangalore |
| CONSTRUCTION STAGE | | | | | | |
| C.1 | | | | | | |
| C.1.1 | Clearing and Grubbing | <p>Vegetation will be removed from the construction zone 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 minimum.</p> <p>Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works will be removed with prior approval from the Environmental Expert of CSC.</p> <p>The Contractor under any circumstances will not cut trees other than those identified for cutting and for which he has written instructions from the PIU Bangalore. The PIU will</p> | Clause No. 201 MORT&H Specifications for Road and Bridge works, Chapter 3 | Along the project Corridor work in progress | Contractor | EO-CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|---|--|----------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | issue these instructions only after receiving all stages of clearances from the Forest Department/ MoEF&CC. | | | | |
| C.1.3 | Construction Wastes Disposal | Contractor will ensure that any spoils of material unsuitable for embankment fill will not be disposed of near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and low-lying areas located in barren lands along the project corridors (if so desired by the owner/community and approved by the Environment Expert SC). Location of disposal sites will be finalized prior to initiation of works on any particular section of the road. | Clause No. 301.3.2 MORT&H Specifications for Road and Bridge works | Along the Project Corridor | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.1.4 | Stripping, stocking and preservation of top soil | The topsoil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the temporarily acquired area and/or Right of Way will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Environmental Expert of CSC. The stored topsoil will be spread back to maintain the soil physico-chemical property and biological activity. The preserved top soil will be used for restoration of sites, in landscaping and avenue plantation. | Clause No. 301.2.2 MORT&H Specifications for Road and Bridge works | Along the Project Corridor | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.1.5 | Accessibility | The contractor will provide safe and convenient passage for | Along the Project | Contractor | EO- CSC, PIU | C.1.5 |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|---|---|---|----------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project corridor, providing temporary connecting road. | Corridor | | | |
| C.1.6 | Planning for Traffic Diversions and Detours | Detailed Traffic Control Plans will be prepared and submitted to the Resident Engineer for approval before commencement of works on any section of road. The traffic control plans shall contain details diversions; traffic safety arrangement during construction; safety measures for night - time traffic and precautions for transportation of hazardous materials. Traffic control plans shall be prepared as per IRC:SP:55. The Contractor will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. | Clause No. 112 MORT&H Specifications for Road and Bridge works IRC; SP 55 | Along the Project Corridor | Contractor | EO-CSC, PIU/NHAI Bangalore |
| C.2 | | | | | | |
| C.2.1 | Earth from Borrow Areas for Construction | No borrow area will be opened without permission of the Environmental Expert of CSC. Total 8 locations have been identified for borrow area which is within 5 km of project site at chainages 19.800 km, 23.500 km, 24.800 km, 30.400 km, 35.400km, 61.200 km, 61.100 km. The IRC code is recommended for borrow pits for road embankments (IRC:10-1961). The borrowing operations will be carried out as specified in the guidelines for siting and | Clause No. 305.2.2 MORT&H Specifications for Road and Bridge works | Borrow Areas | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|--|--|----------------|------------------------|-------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | <p>operation of borrow areas.</p> <p>Contractor will rehabilitate the borrow areas as soon as borrowing is over from a particular borrow area in accordance with the Guidelines for Redevelopment of Borrow Areas or as suggested by Environmental Expert of CSC.</p> | | | | |
| C.2.2 | Quarry Operations | <p>Quarries have been identified at 4 locations along the project road. Details of the same are given in Table-2.19 of Chapter 2.</p> <p>The contractor will develop a Comprehensive Quarry Redevelopment plan, as per the Mining Rules of the state and submit a copy to PIU Bangalore and CSC prior to opening of the quarry site.</p> <p>The quarry operations will be undertaken within the rules and regulations in force in the state.</p> | Clause No. 111.3 MORT&H Specifications for Road and Bridge works | Quarry Areas | Contractor | EO- CSC, PIU Bangalore |
| C.2.3 | Transporting Construction Materials and Haul Road Management | <p>Contractor will maintain all roads (existing or built for the project), which are used for transporting construction materials, equipment and machineries as precised. All vehicles delivering fine materials to the site will be covered to avoid spillage of materials.</p> <p>Contractor will arrange for regular water sprinkling as necessary for dust suppression of all such roads and surfaces</p> | Project Requirement | All Roads Used | Contractor | EO- CSC, PIU Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|---|--|---|--------------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | with specific attention to the settlement areas. The unloading of materials at construction sites/close to settlements will be restricted to daytime only. | | | | |
| C.2.4 | Construction and drinking Water | Approximate 3133233 KL or 3436 KLD water will be required during construction stage of the project which will be fulfilled through surface water and water tankers. NHAI will purchase water tankers from the approved empanelled agencies of respective districts. Necessary permission will be obtained from concerned department before utilization of surface water. The contractor will take all precaution to minimize the wastage of water in the construction process/ operation. | Clause No. 1010 EP Act 1986 MORT&H Specifications for Road and Bridge works | Along the Project Corridor | Contractor | EO- CSC, PIU Bangalore |
| C.3 | | | | | | |
| C.3.1 | Drainage | Contractor will ensure that no construction materials like earth, stone, ash or appendage is disposed off in a manner that blocks the flow of water of any water course and cross drainage channels. Contractor will take all-necessary measures to prevent any blockage to water flow. In addition to the design requirements, the contractor will take all required measures to prevent temporary or permanent flooding of the site or any adjacent area. | Clause No. 501.8.6 MORT&H Specifications for Road and Bridge works | Drainage line along the road | Contractor | EO- CSC, PIU Bangalore |
| C.3.2 | Siltation of Water Bodies and Degradation | The Contractor will not excavate beds of any stream/rivers/ any other water body for borrowing earth for embankment | Clause No. 501.8.6 MORT&H Specifications for | All Surface Water bodies along | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|--|--|----------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | of Water Quality | <p>construction.</p> <p>Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body adjacent to the ROW and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthwork and continue till the stabilization of the embankment slopes, on the particular sub-section of the road. The contractor will also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay byes and bus bays.</p> <p>Contractor will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby watercourse.</p> | Road and Bridge works Water (P & CP) Act 1981 Chapter-3 | the project corridor | | |
| C.3.4 | Slope Protection and Control of Soil Erosion | <p>The contractor will take slope protection measures as per design, or as directed by the Environmental Expert of CSC to control soil erosion and sedimentation.</p> <p>Contractor will ensure the following aspects:</p> <ul style="list-style-type: none"> • During construction activities on road embankment, the side slopes of all cut and fill areas will be graded and covered with stone pitching, grass and shrub as per design specifications. • Turfing works will be taken up as soon as possible | Clause No. 306 & 305.2.2 MORT&H Specifications for Road and Bridge works | Along the Project Corridor | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|--------------|---|---|--|----------------------------|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | <p>provided the season is favorable for the establishment of grass sods. Other measures of slope stabilization will include mulching, netting and seeding of batters and drains immediately on completion of earthworks.</p> <ul style="list-style-type: none"> In borrow pits, the depth shall be so regulated that the sides of the excavation will have a slope not steeper than 1 vertical to 2 horizontal, from the edge of the final section of the bank. Along sections abutting water bodies, stone pitching as per design specification will protect slopes. | | | | |
| C.4 | | | | | | |
| C.4.1 | | | | | | |
| C.4.1.1 | Water Pollution from Construction Wastes, Fuel and Lubricants | <p>The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies. Contractor will avoid construction works close to the streams or water bodies during monsoon.</p> <p>The contractor will also ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from rivers and other streams.</p> <p>All waste arising from the project is to be disposed off as per the norms.</p> | Clause No. 501.8.6 MORT&H Specifications for Road and Bridge works Water (P & CP) Act 1974 | Along the Project Corridor | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|--|---|---|------------------------|------------------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| C.4.2 | | | | | | |
| C.4.2.1 | Dust Pollution | <p>The contractor will take every precaution to reduce the level of dust from crushers/hot mix plants, construction sites involving earthwork by sprinkling of water, encapsulation of dust source and by erection of screen/barriers.</p> <p>All the plants will be sited at least 1 km in the downwind direction from the nearest human settlement.</p> <p>The contractor will provide necessary certificates to confirm that all crushers used in construction conform to relevant dust emission control legislation. Alternatively, only crushers licensed by the SPCB shall be used.</p> <p>Dust screening vegetation will be planted on the edge of the RoW for all existing roadside crushers. Hot mix plant will be fitted with dust extraction units.</p> | <p>Clause No. 111 & 501.8.6 MORT&H Specifications for Road and Bridge works</p> <p>Air (P & CP) Act 1981</p> | <p>Along the Project Road, Construction Site/ Camps</p> | <p>Contractor</p> | <p>EO- CSC, PIU/NHAI Bangalore</p> |
| C.4.2.2 | Emission from Construction Vehicles, Equipment and Machineries | <p>Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of SPCB.</p> <p>The Contractor will submit PUC certificates for all vehicles/equipment/machinery used for the project. Monitoring results will also be submitted to PIU Bangalore through the CSC.</p> | <p>Clause No. 501.8.6 MORT&H Specifications for Road and Bridge works</p> <p>Air (P & CP) Act, 1981 Central Motor & Vehicle Act, 1988</p> | <p>Along the Project Road, all vehicles used/ Camps</p> | <p>Contractor</p> | <p>EO- CSC, PIU/NHAI Bangalore</p> |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|---|---|---|---|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| C.4.3 | | | | | | |
| C.4.3.1 | Noise Pollution: Noise from Vehicles, Plants and Equipment | <p>The Contractor will confirm the following:</p> <ul style="list-style-type: none"> All plants and equipment used in construction shall strictly conform to the MoEF&CC/CPCB noise standards. All vehicles and equipment used in construction will be fitted with exhaust silencers. Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. Maintenance of vehicles, equipment and machinery shall be regular to keep noise levels at the minimum. At the construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, concrete mixing, batching will be stopped during the nighttime between 10:00 pm to 6:00 am. Provision of noise barrier near sensitive receptors. No construction activities will be permitted around educational institutes/health centers (silence zones) up | Clause No. 501.8.6 MORT&H Specifications for Road and Bridge works EP Act 1986 Noise Rules 2002 | Along the Project Road, all vehicles used/Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|-------------------------------------|---|--|--|------------------------|------------------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | <p>to a distance of 100 m from the sensitive receptors i.e., school, health centers and hospitals between 10:00 am to 6:00 pm.</p> <ul style="list-style-type: none"> Monitoring shall be carried out at the construction sites as per the monitoring schedule presented in Table-6.1 Chapter-6. | | | | |
| C.5 | | | | | | |
| C.5.1 | Personal Safety Measures for Labour | <p>Contractor will provide:</p> <ul style="list-style-type: none"> Protective footwear, headwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime, mortars & concrete etc. Welder's protective eye-shields to workers who are engaged in welding works Protective goggles and clothing to workers engaged in stone breaking activities and workers will be seated at sufficiently safe intervals. Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. Adequate safety measures for workers during handling of materials. The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. | <p>The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and cess Act of 1996 Factories Act 1948</p> | <p>Along the Project Road , all vehicles used/ Camps/quarry area</p> | <p>Contractor</p> | <p>EO- CSC, PIU/NHAI Bangalore</p> |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|---------------------|--|--|---|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | <p>The contractor will not employ any person of adolescent age (14-18 yrs) for any work and no woman will be employed on the work of painting with products containing lead in any form.</p> <p>The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance. These will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and will be approved by 'SC' and NHAI-PIU Bangalore.</p> | | | | |
| C.5.2 | Traffic and Safety | <p>The contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan for information and protection of traffic approaching or passing through the section of any existing cross roads.</p> <p>The contractor will ensure that all signs, barricades, pavement markings are provided as per the MORT&H specifications. Before taking up of construction on any section of the project corridor, a Traffic Control Plan will be devised and implemented to the satisfaction of EO-CSC.</p> | IRC: SP: 55 | Along the Project Road , all vehicles used/ Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.5.4 | Risk Force Measure | <p>The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities.</p> <p>The contractor will make required arrangements so that in</p> | The Building and other construction workers (Regulation of | Along the Project Road, construction Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|---------------------------------|--|---|--|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | | case of any mishap all necessary steps can be taken for prompt first aid treatment. Construction Safety Plan prepared by the Contractor will identify necessary actions in the event of an emergency. | Employment and Conditions of Service) Act 1996 and Cess Act of 1996 Factories Act 1948 | | | |
| C.5.5 | First Aid | <p>The contractor will arrange for –</p> <ul style="list-style-type: none"> • A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone • Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital • Equipment and trained nursing staff at construction camp. | The Building and other construction workers (Regulation of Employment and Conditions of Service) Act 1996 and Cess Act of 1996 Factories Act 1948 | Along the Project Road, construction Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.5.6 | Informatory Signs and Hoardings | The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required as per IRC and MORTH specifications. | IRC:SP:55 | Along the Project Road, construction Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.6 | | | | | | |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|--------------------------------------|---|--|--|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| C.6.1 | Road side Plantation Strategy | <p>Avenue plantation approx. 33215 numbers along the alignment will be planted whereas about 43796 shrubs will be carried out in the median. Plantation will be carried out as per IRC:SP:21-2009 and Green Highway Policy, 2015.</p> <p>Compensatory pantation will be done as per the prevailing guidelines of MoEF&CC and Karnataka State.</p> <p>The Environmental Expert of CSC will inspect regularly the survival rate of the plants and compliance of tree plantation guidelines.</p> | <p>Forest Conservation Act 1980</p> <p>Guideline for median plantation and grass turfing of MORT & H</p> | Along the Project Road | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.6.2 | Flora and Fauna | <p>The Forest officials were consulted for their necessary suggestion and mitigation measures with specific focus on elephants and mitigation measures finalized accordingly. The Wildlife Management Plan along with Comprehensive Environmental Management Plan has been prepared for STRR Phase-I and Phase-II and the same is attached as Annexure- 5 and Annexure-6 respectively.</p> | <p>Forest Conservation Act 1980</p> <p>Wild Life Act 1972</p> | Along the Project Road | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.6.3 | Chance Found Archaeological Property | <p>No archeological structures are present along the road. However, the contractor will take reasonable precautions to prevent from removing and damaging any such article or thing. The CSC will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.</p> | <p>The Ancient Monument and Archaeological Site Remains Act 2010</p> | Along the Project Road, construction sites/Camps | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.7 | | | | | | |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|---------------------|---|---|---|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| C.7.1 | Accommodation | <p>Contractor will follow all relevant provisions of the Factories Act, 1948, the Building, and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labor camp.</p> <p>The location, layout and basic facility provision of each labor camp will be submitted to 'EO-CSC and 'PIU' prior to their construction.</p> <p>The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the CSC.</p> | <p>The Building and other construction workers (Regulation of Employment and Conditions of Service) Act 1996 and Cess Act of 1996 Factories Act 1948</p> <p>Guidelines II Guidelines for Siting and Layout of construction camp</p> | Along the Project Road, construction Camps/site | Contractor | EO- CSC, PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|------------|------------------------------|--|--|--|------------------------|-----------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| C.7.2 | Potable Water | <p>The Contractor will construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.</p> <p>The Contractor will also provide potable water facilities within the precincts of every workplace in an accessible place, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Regular Maintenance of such facilities will be taken care.</p> | <p>The Building and other construction workers (Regulation of Employment and Conditions of Service) Act 1996 and Cess Act of 1996</p> <p>Factories Act, 1948</p> | Along the Project Road, construction Camps/cons truction site | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.7.3 | Sanitation and Sewage System | <p>The contractor will ensure that -</p> <ul style="list-style-type: none"> • The sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place • Separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women. • Adequate water supply is to be provided in all toilets and urinals.All toilets in workplaces are with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition. | Project Specific Requirement | Along the Project Road, construction Camps/Cons truction Sites | Contractor | EO- CSC, PIU/NHAI Bangalore |
| C.8 | | | | | | |
| C.8.1 | Clean-up | Contractor will prepare site restoration plans, which will be | Guidelines for | Along the | Contractor | EO- CSC, |

| Sl. No. | Environmental Issue | Management Measures | Reference | Location | Responsibility | |
|---------|--|--|--------------------------------------|----------------------------------|------------------------|-------------------------|
| | | | | | Planning and Execution | Supervision/ Monitoring |
| | Operations, Restoration and Rehabilitation | <p>approved by the Environmental Expert of SC. The clean-up and restoration operations are to be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL waste as per Comprehensive Waste Management Plan and as approved by CSC.</p> <p>All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed in pre identified approved areas or in places suggested by the 'EO - CSC' areas in a layer of thickness of 75 mm-150 mm. All construction zones including river-beds, culverts, road-side areas, camps, hot mix plant sites, crushers, batching plant sites and any other area used/affected by the project will be left clean and tidy, at the contractor's expense, to the entire satisfaction to the Environmental Expert of CSC and PIU/ NHAI will certify in this regard.</p> | Disposal Site management of 6 MORT&H | Project Road, construction Camps | | PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Time Frame | Location | Responsibility | |
|--|----------------------------------|---|-----------|-----------------|------------------------|------------------------|-------------------------|
| | | | | | | Execution / Civil Work | Supervision/ Monitoring |
| OPERATION STAGE | | | | | | | |
| Activities to be carried out by the PIU | | | | | | | |
| 0.1 | Monitoring Operation Performance | The PIU, Bangalore will be responsible for monitoring the operational performance of the various mitigation/ enhancement measures | | Operation Phage | Along the Project Road | PIU Bangalore | PIU/NHAI Bangalore |

| Sl. No. | Environmental Issue | Management Measures | Reference | Time Frame | Location | Responsibility | |
|---------|-------------------------|---|--------------|-----------------|------------------------|---|-------------------------|
| | | | | | | Execution / Civil Work | Supervision/ Monitoring |
| | | <p>carried out as a part of the project.</p> <p>The Construction Supervision Consultant (CSC) selected for monitoring include the survival rate of trees; utility of enhancement provision, status of rehabilitation of borrow areas and disposal sites,</p> | | | | | |
| 0.2 | Maintenance of Drainage | <p>PIU, Bangalore will ensure that all drains (side drains, median drain and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding.</p> <p>PIU ensures that all the sediment and oil and grease traps set up at the water bodies will be cleared at regular interval of time.</p> | | Operation Phase | Along the Project Road | PIU Bangalore | PIU/NHAI Bangalore |
| 0.3 | Pollution Monitoring | <p>The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination in the selected locations as suggested in pollution monitoring plan (Table-6.1 of Chapter-6) or as recommended by CSC-EO (Refer Chapter 3 for Monitoring Locations of air, water and noise) will be responsibility of PIU Bangalore.</p> | | Operation Phase | Along the Project Road | PIU Bangalore through Pollution Monitoring Agency | PIU/NHAI Bangalore |
| 0.3.1 | Atmospheric | Ambient air concentrations of various pollutants | Air (P & CP) | Operation | Along the | PIU Bangalore | |

| Sl. No. | Environmental Issue | Management Measures | Reference | Time Frame | Location | Responsibility | |
|---------|---|---|------------------------------------|-----------------|------------------------|---|-------------------------|
| | | | | | | Execution / Civil Work | Supervision/ Monitoring |
| | Pollution | shall be monitored as envisaged in the pollution-monitoring plan | Act 1981 | Phase | Project Road | through Pollution Monitoring Agency | |
| 0.3.2 | Noise Pollution | Noise pollution will be monitored as per monitoring plan at sensitive locations. Noise control programs are to be enforced strictly. | Noise Rules 2002 | Operation Phase | Along the Project Road | PIU Bangalore through Pollution Monitoring Agency | |
| 0.3.3 | Water Pollution | Water Quality will be monitored as per monitoring plan | Water (P & CP) Act 1974 | Operation Phase | Along the Project Road | PIU Bangalore through Pollution Monitoring Agency | |
| 0.4. | Soil Erosion and Monitoring of Borrow Areas | Visual monitoring and inspection of soil erosion at borrow areas, quarries (if closed and rehabilitated), embankment and other places expected to be affected, will be carried out regularly as suggested in monitoring plan. | IRC/Environmental Conservation Act | Operation Phase | Along the Project Road | PIU Bangalore | |
| 0.5 | Road Safety | Road Safety will be monitored during operation especially at location where traffic-calming measures have been proposed. | IRC Guidelines | Operation Phase | Along the Project Road | PIU Bangalore | PIU/NHAI Bangalore |

10.6 GREENBELT DEVELOPMENT PLAN

Green belt development plan is formulated as a part of new road construction project. As a part of greenbelt development, plantation shall be carried out in entire open space on the both side of the road and median to enhance floral cover and scenic beauty as well as sink of air pollution and act as noise barrier. Plantation will be carried out as per Green Highways (Plantation, Transplantation, Beautification and Maintenance) Policy -2015 and IRC: SP: 21-2009 guidelines.

The general consideration involved while developing the greenbelt are:

- Trees growing up to 10.0 m or above in height with perennial foliage should be planted around various appurtenances of the proposed project.
- Planting of trees should be undertaken in appropriate encircling rows around the project
- Generally, fast growing species should be planted.

The species recommended for greenbelt development are given in **Table 10.3**.

Table 10-3: Species recommended for Plantation

| Sl. No. | Botanical name/Scientific Name | Local/Kannada name | Location |
|---------|---------------------------------|--------------------|-------------------|
| 1. | <i>Caesalpinia pulcherrima</i> | Peacock flower | Median Plantation |
| 2. | <i>Cassia Siamea</i> | Seemathangadi | Median Plantation |
| 3. | <i>Lawsonia aspera</i> | Thumbe | Median Plantation |
| 4. | <i>Dodonaea viscosa</i> | Bandarike | Median Plantation |
| 5. | <i>Plumeria acutifolia</i> | Kangalu | 1st ROW |
| 6. | <i>Lagerstroemia lanceolata</i> | Nandi | 1st ROW |
| 7. | <i>Annona squamosa</i> | Challe | 1st ROW |
| 8. | <i>Cassia fistula</i> | Kakke | 1st ROW |
| 9. | <i>Bauhinia purpurea</i> | Kanchuvala | 1st ROW |
| 10. | <i>Acacia concinna</i> | Seege | 1st ROW |
| 11. | <i>Aegle marmelos</i> | Bilvapatre | 2nd ROW |
| 12. | <i>Emblica officinalis</i> | Nelli/Amla | 2nd ROW |
| 13. | <i>Butea monosperma</i> | Muthuga mutigina | 2nd ROW |
| 14. | <i>Bauhinia racemosa</i> | Kanchuvala, Achiga | 2nd ROW |
| 15. | <i>Pongamia glabra</i> | Honge | 2nd ROW |
| 16. | <i>Buchanania latifolia</i> | Marukalu, Murke | 2nd ROW |

Source: Ramanagara and Bangalore Rural Forest Division Working Plan and Green Corridor Planning for Highways Project by Green Highways Division, NHAI, 2018

10.7 EMP BUDGET

The estimated budgetary cost for environmental management activities is presented in **Table 10.4**.

Table 10-4: Environmental Management Cost

| Components | Particulars | Estimated Rate | Total Cost (INR) |
|---|--|-----------------------------|------------------|
| A. Pre-Construction Stage | | | |
| Socio-Economic | Land Acquisition, R&R, Compensation to PAFs | Covered in Engineering Cost | |
| Water Tank/Reservoir and utilities shifting | Shifting of Water Tank, Bund Construction and Tank Protection, and utilities shifting such as Electric Poles, Cables, Telephone lines, Water pipes, etc. | Covered in Engineering Cost | |

| B. Construction Stage | | | |
|------------------------------|--|--------------------------------------|------------------|
| Environmental Training | - | Lump sum | 1000000 |
| Environmental Monitoring | Monitoring of air, water, soil, and noise (as per Table 6.2) | As per environmental monitoring plan | 3757000 |
| | Compensatory Afforestation as per State Forest guidelines | Lump Sum | 40000000 |
| Flora | Avenue plantation (approx. 33215 nos. of trees) in the available ROW along the alignment as per IRC:SP:21-2009 and Green Highway (Plantation, Transplantation, Beautification & Maintenance), Policy-2015. | INR 1517/Tree | 50387155 |
| | Plantation of shrubs (approx. 43796 nos. of plants) in the median @666 per Km as per IRC:SP:21-2009 and Green Highway (Plantation, Transplantation, Beautification & Maintenance), Policy-2015. | INR 800/plant | 35036800 |
| | Tree guard for protection of plantation | INR 700/tree | 23250500 |
| Air | Dust suppression by watering for 2.5 years | Considered under Civil Costs | |
| Noise | Noise Barriers along the stretches of project roads near habitations | Considered under Civil Costs | |
| Construction Camp | Environmental measures in Worker's camp | Lump sum | 2000000 |
| RWH | Rain water Harvesting Structures @ every 500m (Approx. 100 structures) | INR 95,000 per structure | 9500000 |
| Safety | Provision for helmet, gumboots, jackets, goggles etc. to labours | Lump sum | 2000000 |
| | Provision of health checks at construction sites | Lump sum | 1000000 |
| | Provision of Hoarding /Posters at construction camps | Lump sum | 500000 |
| Solid Waste disposal | Disposal of Sewage and other wastes in the construction yard and labour camps | approx. 15000 | 450000 |
| Sub-total (B) | | | 168881455 |
| Contingency @2% | | | 3377629.1 |
| Total (B) | | | 172259084 |
| C. Operation Stage | | | |
| Environmental Training | - | lump sum | 500000 |
| Environmental Monitoring | Monitoring of air, water, soil, and noise (refer Table-6.2) | As per environmental monitoring plan | 407000 |
| Solid Waste | Solid waste disposal | lump sum | 500000 |
| Flora | Maintenance for greenbelt plantation | lump sum | 1000000 |
| RWH | Maintenance of RWH structures during defect as liability period | lump sum | 1000000 |
| Miscellaneous | logistic and other cost | - | 100000 |
| Sub-total (C) | | | 3507000 |
| Contingency @2% | | | 70140 |
| Total(C) | | | 3577140 |

| | |
|--------------------------|-----------------------------------|
| Grand Total (B+C) | 175836224 or 17.58 Cr. |
|--------------------------|-----------------------------------|

10.8 CORPORATE ENVIRONMENT RESPONSIBILITY (CER)

As per the OM File No. 22-65/2017-IA.III dated 30th September, 2020, the budgetary amount Rs. 1626.74 lakh has been allocated for CER activity. The cost for CER has been estimated as per the concerns raised during the public hearing meeting, which have been considered as a part of CER activity also. CER activity with budgetary provision is provided in **Table 10-5**.

Table 10-5: CER Activity with Budget

| S. No. | CER activities | Cost (INR) | Cost (INR lakh) |
|--------------|---|----------------------------------|-----------------|
| 1. | Tree Plantation (including maintenance) | 149674455 | 1496.74 |
| 2. | Rain Water harvesting | 10500000 | 105 |
| 3. | Water Sprinkling and Noise Barrier | Already considered in civil cost | |
| 4. | Vulture Conservation | 2500000 | 25 |
| Total | | 162674455 | 1626.74 |

CHAPTER : 11

SUMMARY & CONCLUSION

11.1 INTRODUCTION

The Ministry of Road Transport and Highways (MORTH), Government of India has proposed the “Bharat Mala Pariyojana”, an umbrella scheme of road development projects which would be executed through the National Highways Authority of India (NHAI), National Highway and Industrial Development Corporation (NHIDC) and the respective State Public Works Departments (PWD).

In pursuance of the above program, NHAI is undertaking “Satellite Town Ring Road (West Side), a newly declared highway as NH-948A” under the Bharatmala Pariyojana (Lot-3) and has appointed M/s Louis Berger Consulting Private Limited, New Delhi. The proposed Greenfield highway starts from km. 0.000 in Dobbaspeta in Karnataka and ends at km. 179.969 near Devarapalli village in Tamil Nadu/Karnataka Border.

This Report is for the Environmental Impact Assessment of Phase-I of the Satellite Town Ring Road starting from Dabaspet (Km. 0.000) to Ramnagra (Km. 82.200) and having length 82.200 Km. As it is a Greenfield highway, the proposed Project falls under “Category A” and attracts the conditions of obtaining prior Environmental Clearance from Ministry of Environment, Forest & Climate Change (MoEF&CC).

The objective of the Project is to improve the performance of the State road and regional transport network and make it a part of the ongoing Bharatmala Pariyojana (Lot-3) by improving road conditions and capacity, as well to avoid traffic congestion of Bangalore city in terms of heavy vehicles.

11.2 PROJECT DESCRIPTION

With an estimated civil cost of INR 2077.66 crore, total length of 82.200 km, the alignment traverses through 61 villages of Karnataka State. The proposed alignment comprises sections of newly declared National Highway-948A vide MoRTH Gazette notification S.O.6(E) dated 1st January, 2018. The proposed alignment section of NH-948A starts at Obalapura village near Dabbaspeta (km 0.000), terminates at Kailanchara village near Ramanagara (km 82.200). The project road intersects the SH-3 at its existing km 52.700 and further connects to Phase-II to Satellite Town Ring Road.

Further, the Project is anticipated to be of a 6-lane divided carriageway with a design speed of 100 Kms per hour. The proposed ROW is 70 m, with land requirement of 685.367 Ha. No tunnels are proposed, while 6 interchanges, 3 ROB, 1 major bridge, 13 minor bridges, 32 underpasses, 4 viaducts and 119 culverts are considered in proposed development. Also, 260 households, 310 numbers of structures and 172 minor assets will be affected in 61 villages due to proposed development. An overview of the project location is provided in **Figure 11-1**.

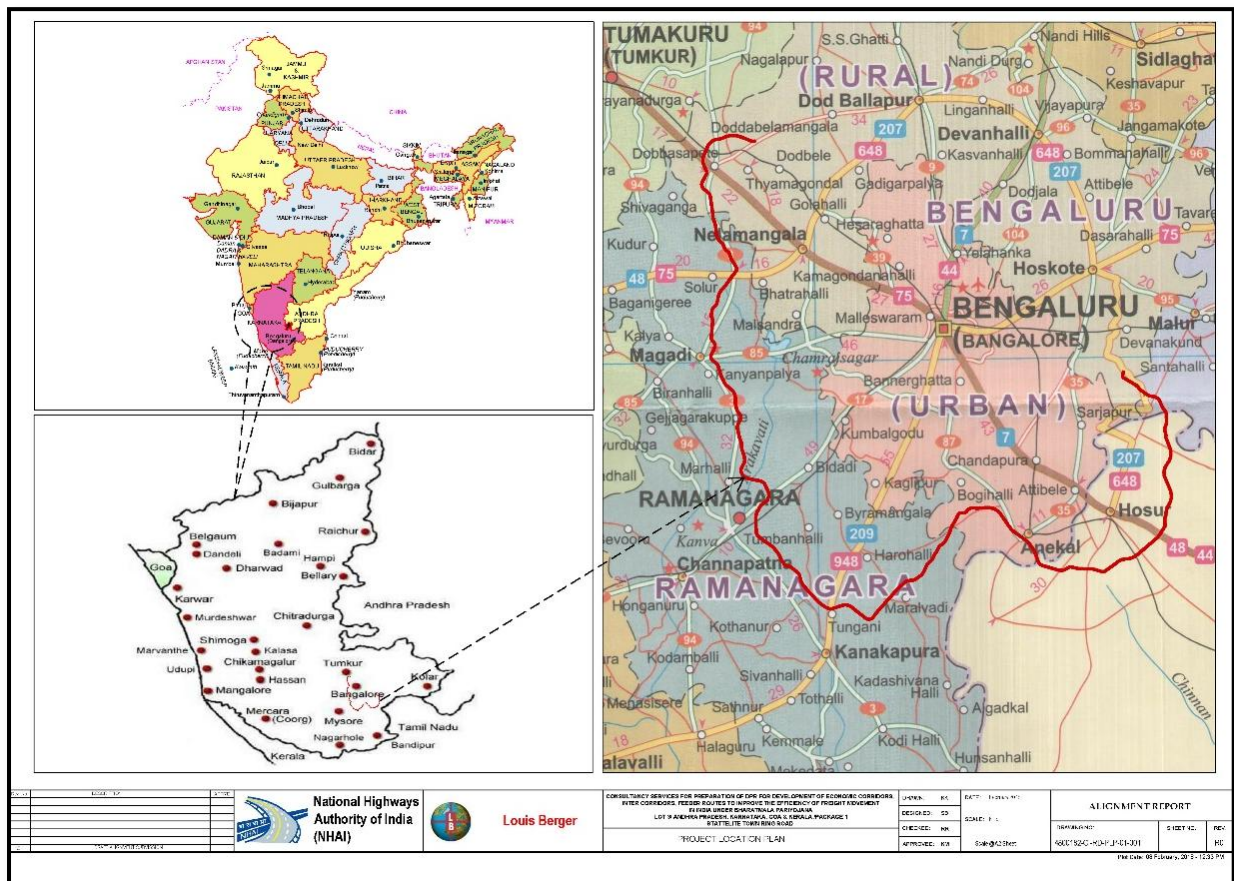


Figure 11-1: Project location of STRR Phase-I

11.3 BASELINE ENVIRONMENT

From an Environmental and Social perspective, the Project does not pass through any Wildlife area/ protected area or CRZ and has no Protected Monuments/ Structures. The land use pattern of project district is primarily agricultural/ vegetation (87%) with an estimated presence of 5401 nos. of non-forest trees and 16806 nos. of poles (girth size less than 30m called poles). The alignment will affect 61 villages and 310 structures and 172 minor assets.

Coming to the description of the present physical environment, the project road section of NH 948A passes mainly through rolling terrain while few stretches pass through plain terrain. Arkavati River is the major water body traversing the proposed alignment at chainage of 65.250 and 78.100. In addition, the geological formation of Bangalore Rural district consists largely of hard granites, basic dykes and laterites etc., However, Ramnagara district is underlain by gneisses and granites. As far seismicity is concern, the project influence area falls under the least active to moderate damage risk Zone II. Soil tests conducted by the Consultant indicates that, the soil in the project area is fertile with high agricultural productivity with appropriate use of fertilizer. Lastly, 8 borrow areas have been identified while the Fly Ash for construction will be procured from three thermal Power Plant located within 300 Kms radius.

The Project area receives average rainfall between 824 mm and 854 mm. About 76 percent of the total rainfall is concentrated during the months of July to November. Mean daily maximum temperature is about 33°C in the month of April-May and the mean daily min. is about 15°C in

the month of Dec-Jan. The predominant winds are from west side. Further, the results of ambient air quality in terms of particulate matter (both PM₁₀ & PM_{2.5}) in the vicinity of the greenfield alignment corridor area are found to be much lesser than the prescribed permissible limits of CPCB at all the locations. SO₂, NO_x and CO levels are also lower and within prescribed permissible limit. These low values of particulate matter near the vicinity of the project side is attributed due to no major activity and low traffic volume plying near the project road.

Further, Ambient Noise levels were monitored during the study period from 6:00 am to 10:00 pm (Day) and from 10:00 pm to 6:00 am (Night). The noise levels were found to be marginally exceeding the prescribed limits of CPCB at few monitored locations.

The surface water quality was monitored, and it was found that the water quality of the study area falls in the range of Class B-E water prescribed by CPCB (as per the overall result) and hence recommended for Irrigation, Industrial cooling, Controlled waste Disposal. Also, in general ground water quality of project area is good except for few parameters, also quality of ground water for location GW1 to GW4 are fit for drinking.

As far ecological sensitivity of the project area, there is no forest land in the project alignment, however tree will be affected due to proposed project. Predominant tree species found along the proposed alignment are Acacia, Tectona, Zizyphus etc. About 5,401 non-forest trees and 16,806 numbers of poles (girth size having less than 30 m are categorized as poles) are falling under Corridor of Impact. However, maximum efforts will be given to save the trees especially those which are falling outside the construction zone.

The fauna in the Project vicinity is reported to be not rich. No habitat fragmentation is likely to take place as a result of the proposed Project.

From a Socio-Economic standpoint, 61 villages, 310 structures and 172 minor assets will be affected due to proposed project. Also, the land requirement for the proposed development is 685.367ha. The major agricultural crops in the district are grown Paddy, Ragi, Redgram, Cowpea, Maize, Cumbu, Groundnut, Horsegram and minor millets. People are also employed in constructions, government jobs, agriculture and household activities.

11.4 IMPACTS AND MITIGATION

For the Project Impact Mitigation, prevention or avoidance of impact is better than mitigation of impact. Hence, avoidance and reduction of adverse impacts approaches were adopted during the design stage through continued interaction between the design and environmental teams. This is resulted with designs having least social and environmental impacts. In-depth site investigations have been carried out so that sensitive environmental resources are effectively avoided, leading to the environmentally best-fit alignment option. Lastly, during the construction activities, there would be some impacts on environmental factors such as air& noise pollution, wastewater and solid waste etc. which would be mitigated based on the Environmental Management Plan (EMP).

However, major impact is on the land as discussed 685.367hectare of land and 310 structures and 172 minor assets to be affected due to proposed development. The compensation for the affected land, property and other structures would be provided on the basis of the RCFTLARR Act, 2013. Most of the people in affected villages depend on agriculture for their livelihood.

The other major impact is on ecology as discussed earlier, about 5,401 numbers of trees and 16,806 numbers of poles are falling under Corridor of Impact. Details of affected trees are attached as **Annexure-7**. However, construction will be done in such a way that minimum trees will be affected. Also, compensatory plantation will be carried out as per the MoEF&CC and Karnataka State Forest guidelines. There is no involvement of forest and wildlife in STRR Phase-I hence there would be no direct impact on it.

The waste water and municipal solid waste (MSW) will be managed through engaging vendor for wastewater and MSW.

The regular water sprinkling will be carried out. All construction machinery & vehicles will be operated after obtaining PUC. Routine maintenance will be carried for all vehicles and machinery.

11.5 STAKEHOLDERS CONSULTATION

As is standard practice, initial Public Consultations have been carried out in this Project during the site surveys with the objectives of minimizing probable adverse impacts of the Project through alternate design solutions (alignment and cross-sectional) and to achieve speedy implementation of the Project through bringing awareness amongst the community on the benefits of the Project. Items of discussions included pollution, drainage, tree felling, irrigation, land and affected properties. Also, the public hearing was conducted as per the procedure mentioned in the EIA notification. The major issues raised during public hearing were related to land issues, properties, water bodies, employment and pollution. The concern of the people recorded and considered in design for implementation and mitigation.

11.6 PROJECT BENEFITS

In all, the project will give significant economic benefits to the region. Construction of the project road will lead to better connectivity and will also play a significant role in changing the socio-economic condition of the people living in the region. Installation of proper road safety system through signage, barricades, crash barriers and by providing adequate bus bays, truck lay byes, underpasses, etc. on project road will further enhance the road safety on these project roads. The Project will also generate direct and indirect employment to the local people of the State. The indirect benefits include savings in vehicle operating costs, less fuel consumption and decreased cost of passenger travel.

11.7 PROJECT COST AND ENVIRONMENTAL COST

The total cost of the Project are expected to cost INR 4112 crore for 6-lane carriageway with raised median, 82.200 Km stretch of proposed alignment. The Environmental Management Plan (EMP) is proposed for the mitigation of adverse impacts and enhances the positive impacts. The EMP budgetary provision has been made with a cost of INR 17.58 crore. CER budget is proposed as per public requirement. R&R budget including LA cost is INR 2034.54 crores.

CHAPTER : 12

DISCLOSURE OF CONSULTANTS ENGAGED

12.1 DISCLOSURE OF CONSULTANTS

M/s Louis Berger Consulting Pvt. Ltd., have been entrusted with the Consultancy services for obtaining environmental clearance from the Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India.

Modern Highway infrastructure is essential to facilitating economic growth and improving quality of life. With increasing traffic congestion world-wide, improving travel conditions, constructing new highways and upgrading existing infrastructure is critical.

Louis Berger has worked in the highway transportation market since 1953, when the firm undertook its first highway assignment with the design of major segment of the Pennsylvania Turnpike-the first superhighway in the United States.

The firm's team of transportation planners and engineers work collaboratively with our environmental scientist, economist, financial analysts and program and construction managers to provide our clients with full lifecycle support for their transportation projects.

Louis Berger is one of the largest multi-disciplinary consulting organizations in the world, being amongst the leaders in the transportation (urban roads, highways, expressways, bridges etc.), urban infrastructure development (water supply, sewerage, solid waste management, etc.) and environmental engineering sectors (as per rankings of the Engineering News Record published by McGraw Hill). With over fifty five (55) years of experience worldwide including about 50 years in South Asia, the Berger Group can draw upon the experience, versatility and innovativeness of over 5,000 professional staff members in all facets of planning, design, design vetting, supervision, project management, monitoring, evaluation, technical assistance, operation and maintenance, independent engineering, impact assessment and management of multi-faceted and complex projects worldwide.

Specialized expertise:

Highways and expressways, Airports, Smart Cities, Metros, Tunnels, Biodiversity Projects, etc.

12.2 DISCLOSURE OF PROJECT AND EIA/EMP REPORT

In order to enable timely project implementation, continued dialogue and coordination will need to take place between the Client, Consultant and relevant agencies.

Intimation on the availability of the report to the public will be made through mass media. The English version of the document will be available in the offices of Project office NHAI/SPCB and Concerned Collectors.

This EIA report will also be made available on the websites of the NHAI/MoEF&CC.

12.2.1 Approved Key Professional from QCI

The LBG is NABET accredited Consultancy Company and accredited for Sector-34, category A projects. Mohammad Akhtar worked as Environmental coordinator for the EIA. He is NABET accredited EIA coordinator for sector 34.

DECLARATION BY EXPERTS CONTRIBUTING TO THE EIA

Declaration by Expert contributing to the Environmental Impact Assessment study for Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana.


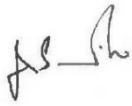
I, hereby, certify that we were part of the EIA team in the following capacity developed the above EIA Report,





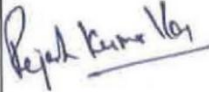
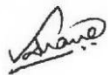
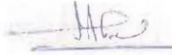

Signature:




Name of EIA Coordinator : Mohammad Akhtar
 Date : 18.01.2022
 Period of Involvement : March, 2019 to till date
 Contact Information : Mohammad Akhtar
 Head (Environment & Social
 Louis Berger Consultant Pvt. Ltd
 5th Floor Jakhar Bhavan (IFFCO)
 Plot No.3| Sector 32| Gurgaon|
 Haryana|122001|India.

Functional Area Expert:

| S. No | Functional Areas | Name of the experts with duration of Employment with organization. | Task | Signatures |
|-------|--|--|--|---|
| 1. | Air Pollution Monitoring, Prevention and Control-AP | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none"> Review of EIA Report Review of Air Monitoring data Impact Examination and Mitigation Measures. Report Preparation |  |
| 2. | Water Pollution, Monitoring, Prevention and Control-WP | Sridhar Janaswamy (Mar 2018 to till date) | <ul style="list-style-type: none"> Preparation of Scope for baseline study Review of water monitoring data Impact assessment for water quality Mitigation measures for water pollution |  |

| | | | | |
|----|---|---|--|--|
| 3. | Meteorology, Air Quality and Modeling and Prediction-AQ | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none"> • Study of wind pattern and weather conditions. • Preparation of Meteorology Report • Air quality Modelling • Impact identification and mitigation measures • Report Preparation |  |
| 4. | Ecology and Biodiversity -EB | Mohammad Shabbir Ali (August 2019 to till date)/ Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none"> • Ecology & biodiversity survey of the study area • Consultation with Forest officials and local people. • Joint survey of forest and trees with forest department and revenue department • Examine Impact and mitigation measures • Preparation of Ecological Report. |   |
| 5. | Land Use-LU | K.Mohan (March 2011 to till date) | <ul style="list-style-type: none"> • Preparation Land Use Maps • Examine impact of land use • Mitigation Measures. |  |
| 6. | Socio-Economic-SE | PDV Ramana Kumar (April 2018 to till date)/ Rajesh Kumar Verma (November 2019 to till date) | <ul style="list-style-type: none"> • Socio-economic and Census survey of the area • Impact of PAP • Review of R&R Framework • RAP and SIA Preparation |  |
| 7. | Soil Conservation-SC | D.M. Godbole (November 2003 to till date)/ Vivek Anand (March 2017 to till date) | <ul style="list-style-type: none"> • Preparation of Scope for baseline study • Review of soil monitoring data • Impact assessment for soil quality • Mitigation measures for soil conservation • Report Preparation. |  |
| 8. | Noise and Vibration-NV | Imtiyaz Mallick (April 2018 to till date) | <ul style="list-style-type: none"> • Noise monitoring scoping • Noise impact analysis • Preparation of Management plan |  |
| 9. | Hydrology, Ground Water and Water Conservation-HG | Dr. Navin Kumar Singh (Aug 2016 to till date) | <ul style="list-style-type: none"> • Review of Hydro-geological pattern of the area • Assessment of impact |  |

| | | | | |
|-----|-------------------------------|---|--|---|
| | | | <ul style="list-style-type: none">• Mitigation Measures• Report Preparation | |
| 10. | Risk and Hazard Management-RH | Manjunath K.B (Apr 2018 to till date) | <ul style="list-style-type: none">• Assessment of Construction related risks and hazards.• Report Preparation |  |
| 11. | Municipal Solid Waste-MSW | Imtiyaz Mallick (Apr 2018 to till date) | <ul style="list-style-type: none">• Quantitative assessment of municipal waste likely to be generated• Development of waste management plan |  |
| 12. | Solid and Hazardous Waste-SHW | Sridhar Janaswamy (March 2018 to till date) | <ul style="list-style-type: none">• Impact assessment for SHW• Mitigation measures for water SHW• Preparation of SHW Report |  |
| 13. | EIA Expert & Report Reviewer | Mohammad Akhtar (March 2019 to till date) | <ul style="list-style-type: none">• Project Management• Report Review |  |

Declaration by the Head of the Accredited Consultant Organization/ Authority

I, Kshitish V Nadgauda, hereby, confirm that the above-mentioned experts prepared the EIA for Development of Satellite Town Ring Road (STRR) Phase-I newly declared National Highway NH-948A from Dabaspeta (km 0.000) to Ramanagara (km 82.200) in Bangalore Rural and Ramanagara Districts in Karnataka under Bharatmala Pariyojana. I also confirm that I shall be fully accountable for any mis-leading information mentioned in this statement.



Name: Sh. Kshitish V Nadgauda

Designation: SVP & MD (Asia)

Name of the EIA Consultant Organization: Louis Berger Consultant Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/EIA/2023/IA0064 (Rev. 01) dated July 28, 2021.

The NABET accreditation is given as **Annexure-8**.