Environmental Impact Assessment Report

(IRC-104-1988)

Safeguard Policies for Environment

With

Environmental Checklist, Management and Monitoring Plan

Solapur Environmental Assessment for NHAI – Solapur to Vijayapura of NH – 13 Roads, State of Maharashtra & Karnataka

NHAI: National Highway Authority of India,

Name: Er. Harish Kumar Gupta
Designation: Environmental Expert

January – 2020

TABLE OF CONTENTS

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
AC	Asphaltic Concrete
ADT	Average Daily Traffic
BBD	Benkelman Beam Deflection
BC	Bituminous Concrete
BM	Bituminous Macadam
BOQ	Bill of Quantities
BOT	Build Operate Transfer
BSNL	Bharat Sanchar Nigam Limited
BT	Bituminous Track
CBR	California Bearing Ratio
CD	Cross Drainage
CGWB	Central Ground Water Board
CMSA	Cumulative Million Standard Axles
COI	Corridorof Impact
CRRI	Central Road Research Institute (India)
CVPD	Commercial Vehicle Per Day
DBFOT	Design, Build, Finance, Operate & Transfer
DBM	Dense Bituminous Macadam
DLC	Dry Lean Concrete
DTM	Digital Terrain Model
EA	Environmental Assessment
EASL	Equivalent Standard Axle Load
EIA	Environment Impact Assessment
EIRR	Economic Internal Rate of Return
FFR	Final Feasibility Report
FIRR	Financial Internal Rateof Return
GAD	General Arrangement Drawing
GDP	Gross Domestic Product
GOI	Government of India
GPS	Global Positioning System
GSB	Granular Sub – Base
GTS	Geodetic Triangulation Survey
Ha	Hectare
HDM – 4	Highway Design & Maintenance Model (Series – 4)
HDMQ	Highway Design and Maintenance Model with Congestion Analysis
HFL	High Flood Level
IRC	Indian Road Congress
IRR	Internal Rate of Return
Km	Kilometre
KMPH	Kilometre Per Hour
LA	Land Acquisition
LT/ HT	Low Tension/ High Tension Electric Lines
m	Meters
MDR	Major District Road
mm	Millimetre
Dia.	Diameters
EPC	Engineering, Procurement, and Construction
PPR	Peste – des Petits Ruminants
LMI	Labour Market Information
SARA	Saturates, Aromatics, Resins and Asphaltenes
PET	Poly – Ethylene Tere – phthalate
FRC	Fibre Reinforced Concrete
PCM	Public Consultation Meeting
UTC	Universal Time Coordinated
DEM	Digital Elevation Model
FCW	Flush Cause Way
CVPD	Commercial Vehicles Per Day
CCCT	Centre for Computers and Communication
NWL	Normal Water Level
CCP	CIVIL CONSTRUCTION PRACTICES
GSD	Ground Sample Distance
NRSC	National Remote Sensing Centre
DEM	Digital Elevation Model
NHAI	**National Highway Authority of India**

MOEF	Ministry of Environment and Forests
MORT & H	Ministry of Road Transport & Highways
BRO	Border Road Organisation
MSA	Million Standard Axles
MSL	Mean Sea Level
NH	National Highway
NMT	Non – Motorized Traffic
NPV	Net Present Value
NSDP	Net State Domestic Product
NTPC	National Thermal Power Corporation
O&M	Operation & Maintenance
O – D	Origin Destination
OFC	Optical Fiber Cable
OMC	Optimum Moisture Content
PCC	Plain Cement Concrete
PCU	Passenger Car Unit
PIU	Project Implementation Unit
PPM	Parts Per Million
PPP	Public Private Partnership
PPR	Preliminary Project Report
PQ	Pre – Qualification
PQC	Pavement Quality Control
PWD	Public Works Department
QAP	Quality Assurance Plan
QC	Quality Control
R&R	Resettlement and Rehabilitation
RAP	Resettlement Action Plans
RCC	Reinforced Cement Concrete
RHS	Right Hand Side
RL	Reduced Level
ROB/ RUB	Road Over Bridge/ Road Under Bridge
ROW	Right of Way
Rs.	Rupees
SH	State Highway
SIA	Social Impact Assessment
Sq. Km.	Square Kilometers
TBM	Temporary Bench Mark
Temp	Temperature
TOR	Terms of Reference
TRL	Transportation Research Laboratory
UG	Under Ground
VDF	Vehicles Damage Factor
Veh.	Vehicles
VGF	Viability Gap Funding
WB	World Bank
WBM	Water Bound Macadam
WMM	Wet Mix Macadam
PPE	Personal Protective Equipment
GAD	General Administration Department
MSE	Mean Squared Error
ACZ	Agro – Climatic Zone
SEDP	Sustainable Environmental Development
PCM	Public Consultation Method
FGD	Focus Group Discussion
GPS	Global Positioning System
DTM	Digital Terrain Model
CRRI	Central Road Research Institute
ATTC	Advanced Technical Training Centre
CRPF	Central Reserve Police Force
TAR	Tibet Autonomous Region
NSSDA	National Standard for Spatial Data Accuracy
DGPS	Differential Global Positioning System
GIS	Geographical Information System
RL	Reduced Level
CPWD	Central Public Works Department

This is a Report on **Environmental Assessment Management Framework (EAMF)** for the proposed **Enhancing Land, Air, Water, Noise and Road Construction Resource Efficiency (ELAWNRCRE)** Project with financial assistance from the **NHAI/ BRO/ ITBP/ CPWD/ PWD/ MPRDC/ MSRDC/ ADB/ NDB OR World Bank** etc. This is hereby disclosed with a view to soliciting comments/ suggestions on or before **December 2019**. In this regard, please send your comments/ suggestions by email to harishgupta1008@yahoo.com or by WhatsApp Number 09329213257 to ***Dr. Harish Kumar Gupta, Environmental Expert, L. N. M. Infra Projects Pvt. Ltd., Bhopal (M.P.).***

CHAPTER – 1: SOLAPUR ENVIRONMENTAL ASSESSMENT AND EMP FOR MAHARASHTRA & KARNATAKA STATE

1. INTRODUCTION AND BACKGROUND OF THE PROJECT

"Solapur" (सोलापुर) is the 4th largest district in the Western Indian State of Maharashtra in its Southern Region. Solapur is a significant node and plays a critical role in the district as headquarter for district administration. Solapur houses all the administrative offices of the district level administration and has a strong industrial presence. Solapur historically is regarded as an industrial city prominently having the textile units. One of the key events triggering the industrial growth was starting up the railway in Solapur in the year 1880. Solapur is located in major road and rail routes between Mumbai and Hyderabad, with a branch line to Bijapur and Gadag cities in South Indian State of Karnataka.

India's urban population is expected to increase from 377 Million in 2011 to 534 Million in 2026. The share of urban economy in country's overall economy is increasing over the years. Hence, our country has to improve its urban infrastructure to achieve the objectives of economic development. Urban transport is one of the major problems, affecting the mobility of people and economic growth of the urban areas. These problems are due to prevailing imbalance in modal split; inadequate transport infrastructure and its sub – optimal use, non – integration of land use and transport infrastructure; and lack of improvement or little improvement in city bus services. This has resulted in accelerated growth of personalized modes, which is unsustainable and needs to be corrected. This has resulted in the import of oil becoming the biggest component in the imports and increasing current account deficit. This in turn is severely affecting the country's economic growth.

The city lies centrally in the basin of River Bhima and the watershed of River Adila (a tributary of River Sina). It is located at 17°.10" and 18°.32" North – Latitude and 74°.42" and 76°.15" East **"Comprehensive Mobility Plan" (CMP)** for Solapur Draft ultimate Report Scope at Latitude and Longitude. It has an average elevation of 457 meters **"Above Mean Sea Level" (AMSL)**. The location of **"Solapur and Karnataka State"** is shown in the **Figures 1 (a) to 1 (b) and 4 (a) to 4 (c)**.

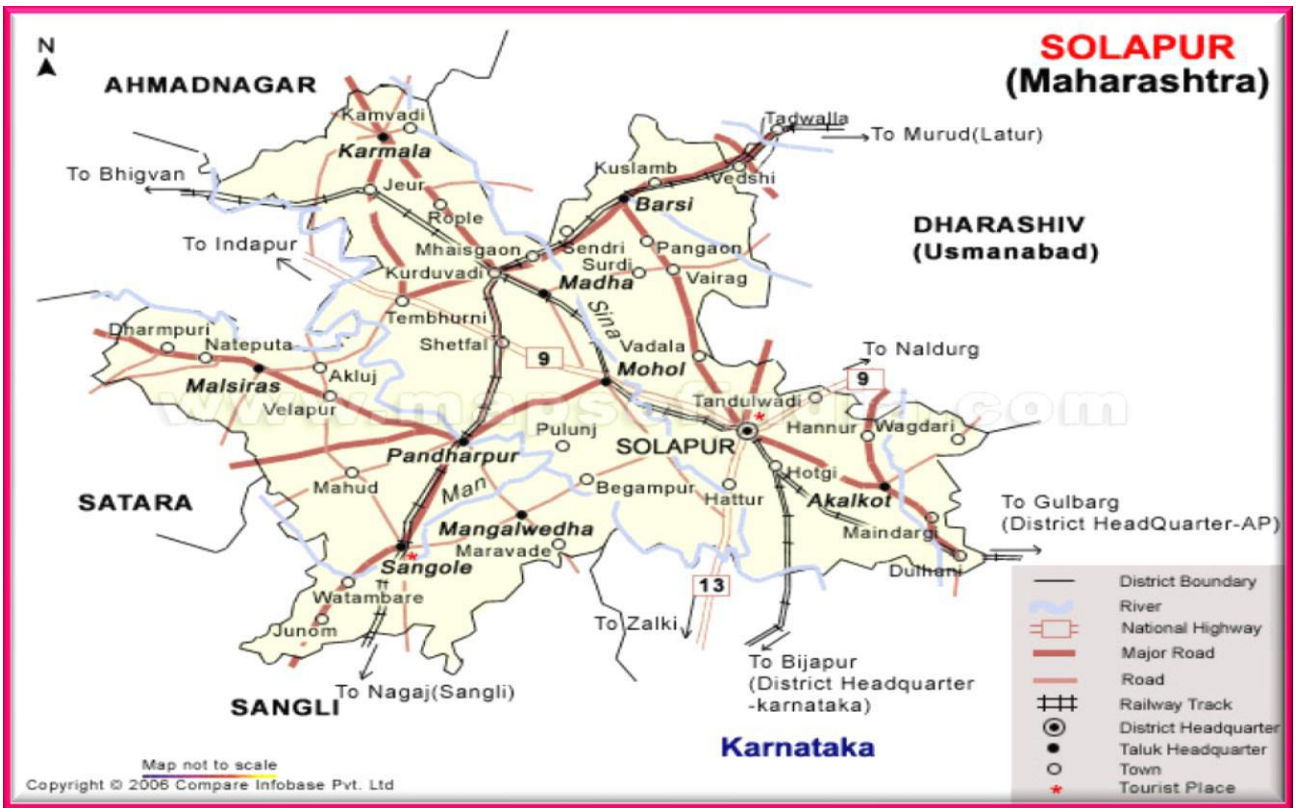


Figure 1 (a): Location Map of Solapur, Maharashtra State.

Karnataka Profile (कर्नाटक प्रोफाइल)

"Geographically Karnataka" (कर्नाटक) is situated on a tableland where the Western and Eastern Ghat ranges converge into the Nilgiri Hill Complex, the State of Karnataka is confined roughly within 11.5° North and 18.5° North latitudes and 74° East and 78.5° East longitude. The neighboring states bounded with Karnataka includes Maharashtra and Goa in the North and North – West; by the Arabian Sea in the West; by Kerala and Tamilnadu in the South and Andhra Pradesh in the East. The State extends to about 750 Km from North to South and about 400 Km from East to West and covers an area of about 1,91,796 Square Kilometers being the 8th largest state holding 5.83% of the total geographical area of India.

Karnataka comprises of varied topographical structures that includes high mountains, plateaus, residual hills and coastal plains. The State is enclosed by chains of mountains to its West, East and South. It consists mainly of plateau which has higher elevation of 600 to 900 Metres above **"Mean Sea Level" (MSL)**. The entire landscape is undulating, broken up by mountains and deep ravines. Plain land of elevation less than 300 Metres above **"Mean Sea Level" (MSL)** is found only in the narrow coastal belt, facing the Arabian Sea. There are quite a few high peaks both in Western and Eastern Ghat systems with altitudes more than 1,500 Metres. A series of cross – sections drawn from West to East across the Western Ghat generally exhibit, a narrow coastal plain followed to the East by small and short plateaus at different altitudes, then suddenly rising upto great heights. Then follows the gentle East and East – North – West sloping plateau and among the tallest peaks of Karnataka are the Mullayyana Giri (1,925 Meters), Bababudangiri (Chandradrona Parvata 1,894 Meters) and the Kudremukh (1,895 Meters) from the Chikmagalur District and the Pushpagiri (1,908 Meters) in Kodagu District.

Physiograpically, Karnataka State forms part of two well – defined macro regions of Indian Union; the Deccan Plateau and the Coastal plains and Islands. The State has four physiographic regions namely Northern Karnataka Plateau, Central Karnataka Plateau, Southern Karnataka Plateau and Karnataka Coastal Region.

More information on 2001 Census data with the 30 Districts of Karnataka are as follows **(Table 1)**:

Table 1: Census Data of 30 Districts in Karnataka State.

Sr. No.	Districts				
1.	**:**	*Bagalkot*	**16.**	**:**	*Gulbarga*
2.	**:**	*Bangalore Rural*	**17.**	**:**	*Hassan*
3.	**:**	*Bangalore Urban*	**18.**	**:**	*Haveri*
4.	**:**	*Belgaum*	**19.**	**:**	*Karwar*
5.	**:**	*Bellary*	**20.**	**:**	*Kodagu*
6.	**:**	*Bidar*	**21.**	**:**	*Kolar*
7.	**:**	*Bijapur*	**22.**	**:**	*Koppal*
8.	**:**	*Chamrajanagar*	**23.**	**:**	*Mandya*
9.	**:**	*Chikkaballapur*	**24.**	**:**	*Mysore*
10.	**:**	*Chikkamagalur*	**25.**	**:**	*Raichur*
11.	**:**	*Chitradurga*	**26.**	**:**	*Ramanagara*
12.	**:**	*Dakshina Kannada*	**27.**	**:**	*Shimoga*
13.	**:**	*Davanagere*	**28.**	**:**	*Tumkur*
14.	**:**	*Dharwad*	**29.**	**:**	*Udupi*
15.	**:**	*Gadag*	**30.**	**:**	*Yadgir*

Geography

The state has three principal geographical zones:

(i) *The coastal region of* ***"Karavali"****;*
(ii) *The hilly* ***"Malenadu"*** *region comprising the* ***"Western Ghats"****;*

(iii) *The* ***"Bayaluseeme"*** *region comprising the plains of the* ***"Deccan Plateau"****;*

The bulk of the state is in the Bayaluseeme region, the Northern part of which is the second – largest arid region in India. The highest point in Karnataka is the Mullayanagiri hills in Chikmagalur district which has an altitude of 1,925 Metres (6,316 Feet). Some of the important rivers in Karnataka are Kaveri, Tungabhadra, Krishna, Malaprabha and the Sharavathi. A large number of dams and reservoirs are constructed across these rivers which richly add to the irrigation and hydel power generation capacities of the state. Karnataka consists of four main types of geological formations the Archean complex made up of Dharwad schists and granitic gneisses, the Proterozoic non – fossiliferous sedimentary formations of the **"Kaladgi"** and **"Bhima Series",** the Deccan trappean and intertrappean deposits and the tertiary and recent laterites and alluvial deposits. Significantly, about 60% of the state is composed of the Archean complex, which consists of gneisses, granites and charnockite rocks. Laterite cappings that are found in many districts over the Deccan Traps were formed after the cessation of volcanic activity in the early tertiary period. Eleven groups of soil orders are found in Karnataka, viz. Entisols, Inceptisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, Aridisols, Vertisols, Andisols and Hist osols. Depending on the agricultural capability of the soil, the soil types are divided into six types, viz. red, lateritic, black, alluvio – colluvial, forest and coastal soils.

Karnataka experiences four seasons. The winter in January and February is followed by summer between March and May, the monsoon season between June and September and the post – monsoon season from October till December. Meteorologically, Karnataka is divided into three zones – coastal, North interior and South interior. Of these, the coastal zone receives the heaviest rainfall with an average rainfall of about 3,638.5 mm (143 in) per annum, far in excess of the state average of 1,139 mm (45 in). Amagaon in Khanapur received 10,068 mm (396 in) of rainfall in the year 2010. In the year 2014, Kokalli in Sirsi taluk received 8,746 mm (344 in) of rainfall. Agumbe and Hulikal were considered the rainiest cities in Karnataka, being one of the wettest regions in the world. The highest recorded temperature was 45.6°C (114°F) at Raichur and the lowest recorded temperature was 2.8°C (37°F) at Bidar.

The following **(Table 2)** shows the places with recorded coldest temperature in Karnataka [Year: 2019] Source: KSNDMC.

Table 2: Coldest Temperature Recorded in Karnataka [Year: 2019].

Rank	District	Taluk	Hobli/ Village	Temperature (°C)
1.	**Bidar District**	*Bhalki*	**Nittur Buzurg**	*4.0*
2.	**Dharwad District**	*Dharwad*	**Garag**	*4.1*
3.	**Bijapur District**	*Singi*	**Almel**	*4.1*
4.	**Belgaum District**	*Hukeri*	**Hukkeri**	*4.1*
5.	**Tumakuru District**	*Tumkur*	**Hebbur**	*4.1*
6.	**Bidar District**	*Aurad*	**Kamalnagar**	*4.3*
7.	**Hassan District**	*Sakleshpur*	**Belagodu**	*4.3*
8.	**Bidar District**	*Bhalki*	**Halbarga**	*4.7*
9.	**Chikmagalur District**	*Mudigere*	**Bankal**	*4.9*
10.	**Uttara Kannada**	*Sirsi*	**Sampakhanda**	*5.0*

About 38,724 Km² (14,951 Sq. Mi.) of Karnataka (*i.e.,* 20% of the state's geographic area) is covered by forests. The forests are classified as reserved, protected, unclosed, village and private forests. The percentage of forested area is slightly less than the all – India average of about 23%, and significantly less than the 33% prescribed in the **"National Forest Policy" (NFP)**.

Rainfall in Karnataka (कर्नाटक में बर्षा)

Agumbe and Hulikal in Shivamogga District of Western Ghat region is considered as **"Cherrapunji of South India" (Cherrapunji being the Rainiest known Place)** but some places in Western Ghats region had more rainfall than these two villages. Amagaon in Belgaum District recorded number of 10,068 mm in 2010; Mundrote in Kodagu District recorded 9,974 mm in 2011 **(Tables 3 to 5)** respectively.

Table 3: District/ Region/ Village Rainfall Recorded in Karnataka [Year: 2006 to 2017].

Year	Hulikal Rainfall (mm)	Agumbe Rainfall (mm)	Amagaon Rainfall (mm)	Talacauvery Rainfall (mm)	Kokalli Rainfall (mm)	Nilkund Rainfall (mm)	Castle Rock Rainfall (mm)	Mundrote Rainfall (mm)	Kollur Rainfall (mm)
2017	5,700	6,311	4,733	5,859	3,130	4,981	5,560	1,002	5,203
2016	5,721	6,449	4,705	5,430	2,682	4,655	4,968	1,458	3,496
2015	6,035	5,518	4,013	5,319	2,730	4,367	3,667	3,143	4,254
2014	7,907	7,917	5,580	7,844	8,746	6,710	5,956	5,566	3,308
2013	9,383	8,770	8,440	8,628	4,464	7,082	3,667	7,199	6,614
2012	8,409	6,933	5,987	5,722	5,036	5,398	6,165	3,727	6,715
2011	8,523	7,921	9,368	6,855	4,437	6,593	7,083	9,974	7,083
2010	7,717	6,929	10,068	6,794	4,002	-------	-------	5,042	7,685
2009	8,357	7,982	-------	-------	-------	-------	-------	-------	-------
2008	7,115	7,199	-------	-------	-------	-------	-------	-------	-------
2007	9,038	8,255	-------	-------	-------	-------	-------	-------	-------
2006	8,656	8,457	-------	-------	-------	-------	-------	-------	-------

Table 4: Top 5 Places Highest Rainfall Record in Statistics [Year: 2010 to 2017].

Rank	Hobli/ Village	District	Taluk	Year	Rainfall (mm)	Elevation (Metres)
1.	Amagaon	Belgaum District	Khanapur	2010	10,068	785
2.	Mundrote	Kodagu District/ Coorg District	Madikeri	2011	9,974	585
3.	Hulikal	Shimoga District	Hosanagara	2013	9,383	614
4.	Agumbe	Shimoga District	Thirthahalli	2013	8,770	643
5.	Kokalli/ Kakalli	Uttara Kannada	Sirsi	2014	8,746	780

Table 5: Top 8 Places Recorded Highest Rainfall, Each Year [2010 to 2017].

Year	Place	Taluk	District	Rainfall (mm)	Elevation (Height or Altitud)
2017	Agumbe	Thirthahalli	Shimoga District	6,311	643
2016	Agumbe	Thirthahalli	Shimoga District	6,449	643
2015	Hulikal	Hosanagara	Shimoga District	6,035	614
2014	Kokalli	Sirsi	Uttara Kannada	8,746	780
2013	Hulikal	Hosanagara	Shimoga District	9,383	614
2012	Hulikal	Hosanagara	Shimoga District	8,409	614
2011	Mundrote	Madikeri	Kodagu District	9,974	585
2010	Amagaon	Khanapur	Belgaum District	10,068	785

Cities

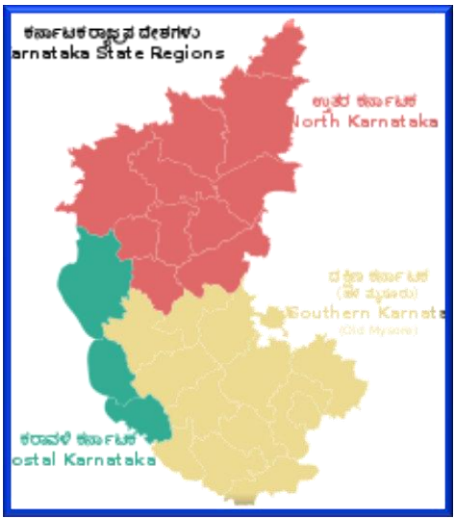


Figure 1 (b): Map of Karnataka State Regions.

Regions of Karnataka (कर्नाटक के क्षेत्र)

At the 2011 census, Karnataka's ten largest cities, sorted in order of decreasing population, were Bangalore, Hubli,Dharwad, Mysuru, Gulbarga,Belgaum, Mangalore, Davangere, Bellary, Vijayapur and Shimoga **(Table 6)**.

Table 6: Karnataka's Ten Largest Cities [Census: 2011].

Rank	City	District	Population (2011)
1.	**Bangalore**	*Bangalore Urban*	**8,728,906**
2.	**Hubli – Dharwad (Hubballi – Dharwad)**	*Dharwad District*	**943,857**
3.	**Mysore (Mysuru)**	*Mysore District*	**887,446**
4.	**Gulbarga (Kalaburagi)**	*Gulbarga District*	**532,031**
5.	**Belgaum (Belagavi)**	*Belgaum District*	**488,292**
6.	**Mangalore (Mangaluru)**	*Dakshina Kannada District*	**484,785**
7.	**Davanagere (Davangere)**	*Davanagere District*	**435,128**
8.	**Bellary (Ballari)**	*Bellary District*	**409,444**
9.	**Vijayapur (Bijapur)**	*Vijayapur District*	**327,427**
10.	**Shimoga (Shivamogga)**	*Shimoga District*	**322,428**

Demographics

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 1,000 males for every 973 females. This represents a 15.60% increase over the population in 2001. The population density was 319 per Km^2 and 38.67% of the people lived in urban areas. The literacy rate was 75.36% with 82.47% of males and 68.08% of females being literate. Around 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 and 0.02% were belonging to other religions and 0.27% of the population did not state their religion. In 2007 the state had a birth rate of 2.2%, a death rate of 0.7%, and an infant mortality rate of 5.5% and a maternal mortality rate of 0.2% and the total fertility rate were 2.2.

In the field of speciality health care, Karnataka's private sector competes with the best in the world. Karnataka has also established a **"Modicum of Public Health Services" (MPHS)** having a better

record of health care and child care than most other states of India. In spite of these advances, some parts of the state still leave much to be desired when it comes to primary health care.

Government and Administration

Figure 2: Vidhana Soudha in Bangalore, Legislative Assembly of Karnataka.

Karnataka has a parliamentary system of government with two democratically elected houses, the Legislative Assembly and the Legislative Council. The Legislative Assembly consists of 224 members who are elected for five – year terms. The Legislative Council is a permanent body of 75 members with one – third (25 members) retiring every two years **(Figure 2)**.

Culture, Religion and Tourism Ethics or Principles

The diverse linguistic and religious ethnicities that are native to Karnataka, combined with their long histories, have contributed immensely to the varied **"Cultural Heritage"** of the State. Apart from Kannadigas, Karnataka is home to Tuluvas, Kodavas and Konkanis. Minor populations of Tibetan Buddhists and tribes like the Soligas, Yeravas, Todas and Siddhis also live in Karnataka. The traditional folk arts cover the entire gamut of music, dance, drama, storytelling by itinerant troupes, etc. Yakshagana of Malnad and coastal Karnataka, a classical dance drama, is one of the major theatrical forms of Karnataka. Contemporary theatre culture in Karnataka remains vibrant with organisations like Ninasam, Ranga Shankara, Rangayana and Prabhat Kalavidaru continuing to build on the foundations laid by Gubbi Veeranna, T. P. Kailasam, B. V. Karanth, K. V. Subbanna, Prasanna and others.

Veeragase, Kamsale, Kolata and Dollu Kunitha are popular dance forms. The Mysore style of Bharatanatya, nurtured and popularised by the likes of the legendary Jatti Tayamma, continues to hold sway in Karnataka, and Bangalore also enjoys an eminent place as one of the foremost centres of Bharatanatya. Saree is the traditional dress of women in Karnataka. Women in Kodagu have a distinct style of wearing the saree, different from the rest of Karnataka. Dhoti, known as Panche in Karnataka, is the traditional attire of men. Shirt, Trousers and Salwar kameez are widely worn in urban areas. Mysore Peta is the traditional headgear of southern Karnataka, while the **"Pagadi or Pataga" (similar to the Rajasthani Turban)** is preferred in the northern areas of the state. Rice and Ragi form the staple food in South Karnataka, whereas Jolada rotti, Sorghum is staple to North Karnataka. Bisi bele bath, Jolada Rotti, Ragi Mudde, Uppittu, Benne Dose, Masala Dose and Maddur Vade are some of the popular food items in Karnataka. Among Sweets, Mysore Pak, Karadantu of Gokak and Amingad, Belgaavi Kunda and Dharwad Pedha are popular. Apart from this, coastal Karnataka and Kodagu have distinctive cuisines of their own. Udupi cuisine of coastal Karnataka is popular all over India.

Adi Shankaracharya (788 – 820) chose Sringeri in Karnataka to establish the first of his four Mathas (Monastery). Madhvacharya (1238 – 1317) was the chief proponent of **"Tattvavada" (Philosophy of Reality),** popularly known as Dvaita or Dualistic school of Hindu philosophy — one of the three most influential Vedanta philosophies. Madhvacharya was one of the important philosophers during the Bhakti movement. He was a pioneer in many ways, going against standard conventions and norms. According to tradition, Madhvacharya is believed to be the third incarnation of Vayu (Mukhyaprana), after Hanuman and Bhima. The Haridasa devotional movement is considered as one of the turning points in the cultural history of India. Over a span of nearly six centuries,

several saints and mystics helped shape the culture, philosophy, and art of South India and Karnataka in particular by exerting considerable spiritual influence over the masses and kingdoms that ruled South India.

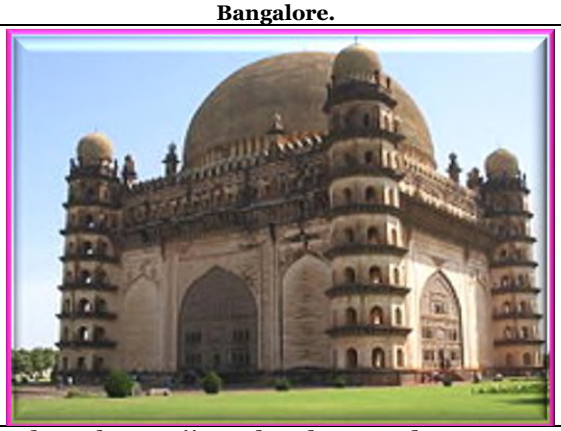
A Yakshagana Artist.

Vishnu Image Inside the Badami Cave Temple Complex Number 3. The Complex is An Example of Indian Rock – Cut – Architecture.

The State Bird, Indian Roller.

Bengal Tigers at Bannerghatta National Park near Bangalore.

Chennakesava Temple is a Model Example of the Hoysala Architecture Later Repaired in the 16th Century with Financial Support and Grants by the Vijayanagara Emperors.



Gol Gumbaz at Bijapur has the Second Largest Pre – Modern Dome in the World after the Byzantine Hagia Sophia.

By virtue of its varied geography and long history, Karnataka hosts numerous spots of interest for tourists. There is an array of ancient sculptured temples, modern cities, scenic hill ranges, forests and beaches. Karnataka has been ranked as the fourth most popular destination for tourism among the states of India. Karnataka has the second highest number of nationally protected monuments in India, second only to Uttar Pradesh, in addition to 752 monuments protected by the **"State Directorate of Archaeology and Museums" (SDAM)**. Another 25,000 monuments are yet to receive protection.

The districts of the Western Ghats and the Southern Districts of the state have popular eco – tourism locations including Kudremukh, Madikeri and Agumbe. Karnataka has 25 wildlife sanctuaries and five national parks. Popular among them are **"Bandipur National Park" (BNP), "Bannerghatta National Park" (BNP) and "Nagarhole National Park" (NNP)**. The ruins of the Vijayanagara Empire at Hampi and the monuments of Pattadakal are on the list of **UNESCO's "World Heritage Sites"**. The cave temples at Badami and the rock – cut temples at Aihole representing the Badami Chalukyan style of architecture are also popular tourist destinations. The Hoysala temples at Belur and Halebidu which were built with **"Chloritic Schist" (Soap Stone)** are proposed **"UNESCO World Heritage Sites"**. The Gol Gumbaz and Ibrahim Rauza are famous examples of the Deccan Sultanate style of architecture. The monolith of Gomateshwara Bahubali at Shravanabelagola is the tallest sculpted monolith in the world, attracting tens of thousands of pilgrims during the **"Mahamastakabhisheka Festival"**.

The waterfalls of Karnataka and Kudremukh are considered by some to be among the **"1001 Natural Wonders of the World"**. Jog Falls is India's tallest single – tiered waterfall with Gokak Falls, Unchalli Falls, Magod Falls, Abbey Falls and **"Shivanasamudra Falls"** among other popular waterfalls.

Several popular beaches dot the coastline, including Murudeshwara, Gokarna, Malpe and Karwar. In addition, Karnataka is home to several places of **"Religious and Cultural Heritage"** importance. Several Hindu temples including the famous Udupi Sri Krishna Matha, the Marikamba Temple at Sirsi, the Kollur Mookambika Temple, the Sri Manjunatha Temple at Dharmasthala, Kukke Subramanya Temple, Janardhana and Mahakali Temple at Ambalpadi, Sharadamba Temple at Shringeri attract pilgrims from all over India. Most of the holy sites of Lingayatism, like Kudalasangama and Basavana Bagewadi, are found in Northern parts of the state. Shravanabelagola, Mudabidri and Karkala are famous for Jain history and monuments. Jainism had a stronghold in Karnataka in the early medieval period with Shravanabelagola as its most important centre. The Shettihalli Rosary Church near Shettihalli, an example of **"French"** colonial **"Gothic Architecture",** is a rare example of a Christian ruin, is a popular **"Tourist Legacy"** site.

Mysore Palace, Historical Palace and Royal Residence at Mysore in the Indian State of Karnataka.

An incredibly breathtaking example of **"Indo – Saracenic Style"** of architecture, the **"Mysore Palace"** is a magnificent edifice located in Mysore in the State of Karnataka. Also known as the **"Amba**

Vilas Palace", it is the former palace of the royal family of Mysore and is still their official residence. Recently Karnataka has emerged as a center of health care tourism and Karnataka has the highest number of approved health systems and alternative therapies in India. Along with some ISO certified government – owned hospitals, private institutions which provide international – quality services have caused the health care industry to grow by 30% during 2004 – 05. A hospital in Karnataka treats around 8,000 health tourists every year.

Festivals

Mysore Dasara is celebrated as the **"Nada Habba" (State Festival)** and this is marked by major festivities at Mysore. Bangalore Karaga, celebrated in the heart of Bangalore, is the second most important festival celebrated in Karnataka. **"Ugadi" (Kannada New Year), "Makara Sankranti" (the Harvest Festival),** Ganesh Chaturthi, Gowri Habba, Ram Navami, Nagapanchami, Basava Jayanthi, Deepavali, and Ramzan are the other major festivals of Karnataka.

Flora and Fauna

"Karnataka" (कर्नाटक) has a rich diversity of flora and fauna. It has a recorded forest area of 38,720 Km^2 (14,950 Sq. Mi.) which constitutes 20.19% of the total geographical area of the State. These forests support 25% of the elephant and 10% of the tiger population of India. Many regions of Karnataka are as yet unexplored, so new species of flora and fauna are found periodically. The Western Ghats, a biodiversity hotspot, includes the Western region of Karnataka. Two sub – clusters in the Western Ghats, viz. Talacauvery and Kudremukh, both in Karnataka, are on the tentative list of **"World Heritage Sites of UNESCO"**. The Bandipur and **"Nagarahole National Parks" (NNP),** which fall outside these subclusters, were included in the **"Nilgiri Biosphere Reserve" (NBR**) in 1986, a UNESCO designation. The Indian roller and the Indian elephant are recognised as the state bird and animal while sandalwood and the lotus are recognised as the state tree and flower respectively. Karnataka has **"Five National Parks": "Anshi, Bandipur, Bannerghatta, Kudremukh and Nagarhole"**. It also has 27 wildlife sanctuaries of which seven are bird sanctuaries and the wild animals that are found in Karnataka include the elephant, the tiger, the leopard, the gaur, the sambar deer, the chital or spotted deer, the muntjac, the bonnet macaque, the slender loris, the common palm civet, the small Indian civet, the sloth bear, the dhole, the striped hyena and the golden jackal.

Some of the birds found here are the great hornbill, the Malabar pied hornbill, the Ceylon frogmouth, herons, ducks, kites, eagles, falcons, quails, partridges, lapwings, sandpipers, pigeons, doves, parakeets, cuckoos, owls, nightjars, swifts, kingfishers, bee – eaters and munias. Some species of trees found in Karnataka are Callophyllum *tomentosa*, Callophyllum *wightianum*, Garcina *cambogia*, Garcina *morealla*, Alstonia *scholaris*, Flacourtia *montana*, Artocarpus *hirsutus*, Artocarpus *lacoocha*, Cinnamomum *zeylanicum*, Grewia *tilaefolia*, Santalum *album*, Shorea *talura*, Emblica *officinalis*, Vitex *altissima* and Wrig htia *tinctoria*. ***"Wildlife and Flora and Fauna in Karnataka is threatened by poaching, habitat destruction, human – wildlife conflict like Land, Noise, Water, Soil and Air Pollution" as per record along the projected sites (Figure 3)***.

Figure 3: Location Map of Karnataka State.

Solapur to Vijayapura Trek – Takli Village:
1) At Package 2/ 3 Camp;
2) IJM Camp Karnataka/ Package 4 Camp.

Figure 4 (a): Environmental Visit, Solapur to Vijayapura from 00.000 Km to 110.542 Km, Maharashtra and Karnataka State.

Solapur to Vijayapura Trek – Takli Village:
1) At Package 2/ 3 Camp;
2) IJM Camp Karnataka/ Package 4 Camp.

Figure 4 (b): Environmental Visit, Collaboration with IJM (India) Infrastructure Limited (IJMIL) at Solapur to Vijayapura from 00.000 Km to 110.542 Km, Maharashtra and Karnataka State.

Solapur to Vijayapura Trek – Takli Village:
1) At Package 2/ 3 Camp;
2) IJM Camp Karnataka/ Package 4 Camp.

Figure 4 (c): Environmental Visit, Joint Effort with DRN/ IJM (India) Infrastructure Limited (IJMIL) at Solapur to Vijayapura from 00.000 Km to 110.542 Km, Maharashtra and Karnataka State.

Takli is a Village in Pandharpur Taluka in Solapur District of Maharashtra State, India **{Figures 4 (a) to 4 (c)}**. It belongs to Desh or Paschim Maharashtra Region and also it belong to Pune Division. It is located 76 Km towards West from District head quarters Solapur and 7 Km from Pandharewadi. The consultancy services for carrying out preparation of **"Initial Environmental Examination" (IEE)**/ Detailed Project Report (DPR) and bid documents. In order to fulfil the traffic needs and road safety requirement, **"National Highway Authority of India" (NHAI)** has appointed the **M/s L. N. Malviya Infra Projects Pvt. Ltd. Bhopal (MP),** for Survey, Investigation and Preparation of Detailed Project Report for improvement of Road and Bridges etc. for construction of High Altitude Hill Roads to **"National Highway Authority of India"** in the state of Maharashtra using **"Satellite Imagery"** and **"Geographical Information System" (GIS)**. The report brings out the project background, mobilization

and staffing, approach and methodology relating to surveys/ investigations and detailed design. A Broad conceptualization of the project essentially based on study of available data/ reports and a detailed reconnaissance survey has been provided. ***"Solapur Maharashtra NHAI, has been entrusted preparation of "Initial Environmental Examination" (IEE) of "Solapur to Vijayapura" from 00.000 Km to 110.542 Km in the State of Maharashtra and Karnataka".***

The report covers the following major aspects and prospects are as discussed below one by one:

(i) *Project Background;*
(ii) *Mobilization and Progress;*
(iii) *Project Appreciation and Conceptualization;*
(iv) *Proposed Approach and Methodology;*

Alignment Deciding Criteria andSignificant Factors

(v) *Stable Side of Hilly Areas;*
(vi) *Avoiding of S – Bends to the Extent Possible;*
(vii) *Gradient Limits;*
(viii) *Availability of Road Construction Materials;*
(ix) *Minimum Number of Cross Drainage Structures;*
(x) *Connectivity to Intermediate Village, If Any;*
(xi) *Avoiding Acquisition of Private Land;*
(xii) *Keeping the Alignment 25 – 30 m above "Normal Water Level" (NWL) of River, If Any;*

The consultancy services for the same have included design of best possible alignment and pavement composition, culverts and other structures in addition to analysis of costs, determining project feasibility and **"Initial Environmental Examination" (IEE)** Report for the Project **"Solapur to Vijayapura"** Road **"Starts"** from **"Solapur Road"** and **"Terminates"** at **"Vijayapura Road"** in the **"Maharashtra and Karnataka State"**.

It is situated at a distance of 410 Km (250 Miles) from the Maharashtra State Capital of Mumbai by road and train. Solapur is at a distance of 245 Km (152 Miles) from Pune and 305 Km (190 Miles) from Hyderabad. Solapur is situated on the Deccan plateau. Solapur Maharashtra India Weather Forecast shows moderate or heavy rain shower with a temperature of 27°C and a wind West – Nord – West speed of 26 Km/ H and the humidity will be 75% and there will be 8.7 mm of precipitation. It lies between **"Latitude 17° 39' 35.7120" N and Longitude 75° 54' 22.9932" E"**. The design length of proposed alignment is **"109.08 Km"** and the route plan of **"Solapur to Vijayapura Road"** is given in **Table 7**.

Table 7: The Route Plan of Solapur to Vijayapura Road.
Road Direction and Route Plan

Place Name		Distance	Approximate Time for Journey	Mode of Vehicle
From	To			
Solapur	**Vijayapura**	*110.542 Km.*	*02.15 Hrs*	**By Road with 4 Wheeler Drive**
	Total	**110.542 Km.**		

2. BACKGROUND – Scope and Study

Solapur is well connected by roadways and railways to all major cities in Maharashtra and neighboring states. The city is connected with Karnataka and Maharashtra by four National Highways as NH – 52 to Mangalore; NH – 65 to Pune and SH – 151 to Mangalvedha and the connectivity of Solapur city to major urban centers in Maharashtra state.

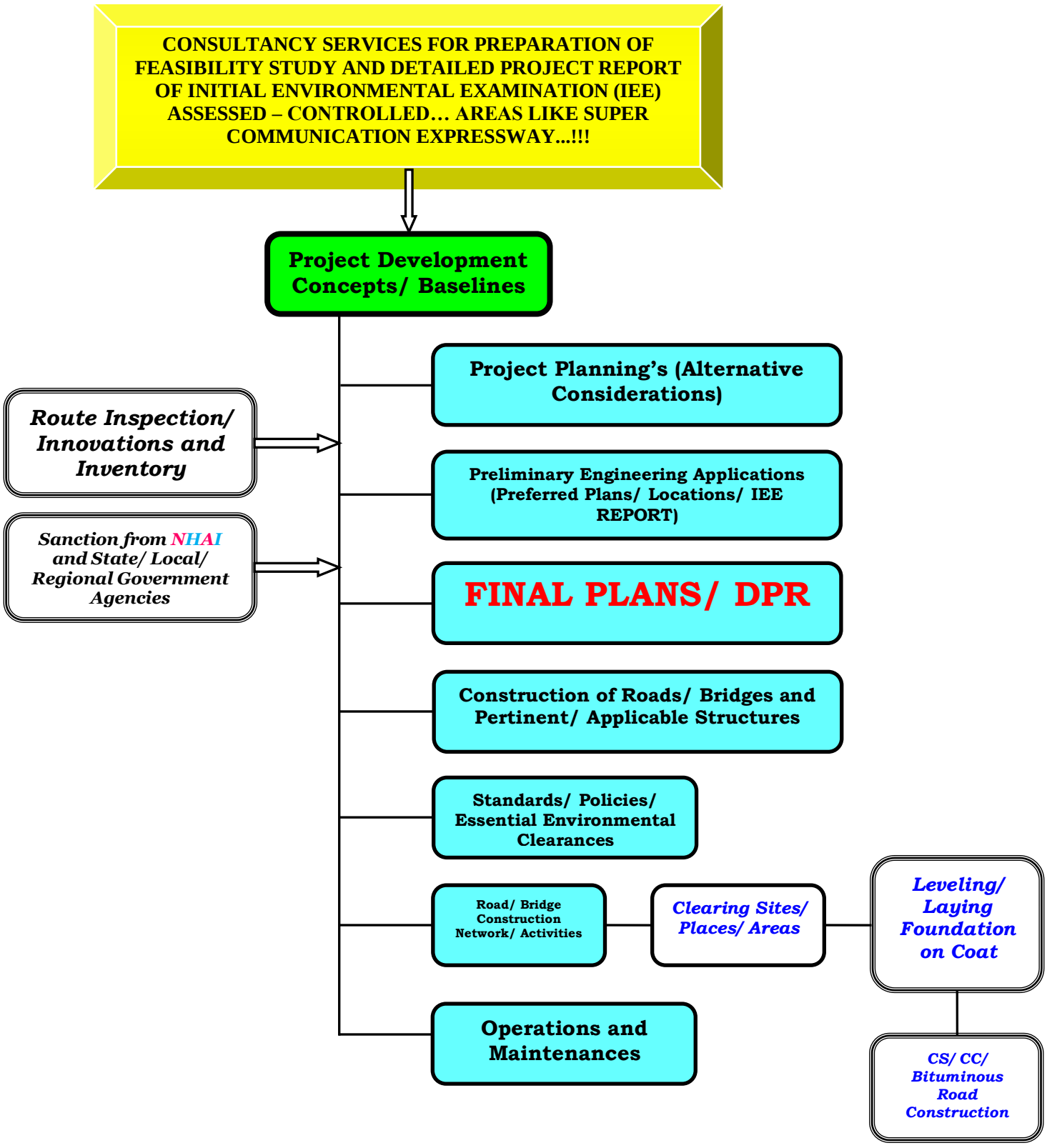
"Solapur Municipal Corporation" (SMC) is a designated nodal agency for overseeing city's infrastructure deficiencies. SMC has formed for the purpose of promoting and securing the planned development of Solapur Municipal Corporation. The Solapur Municipal Corporation is desirous of securing a **"Comprehensive Mobility Plan" (CMP)** for the urban limits of Solapur.

This project section is from Solapur to Vijayapura in the State of Maharashtra and the **"Total Length of Proposed Road is 110.542 Km".** The Coordinates of Project roads at **"Starting Point", "Solapur"** are **"Latitude of 17.6599° (North) and Longitude of 75.9064° (East)"**. Coordinates at the **"End Point, Vijayapura"** are **"Latitude of 21.1298° (North)" and "Longitude of 73.8110° (East)"**. ***"Length provide by NHAI for the road is 110.542 Km., whereas the designed length is 109.08 Km".***

The project study consists of preparation of the following as shown in **Figure 5**:

Stage 1 –: Inception Report and Quality Assurance Plan;
Stage 2 –: Reconnaissance/ Feasibility/ Strip Plan / Investigation/ Servey Report;
Stage 3 –: Land Acquisition and Clearances: Ist – Report;
Stage 4 –: Detailed Project Report (DPR);
Stage 5 –: Technical Schedules and Strategies (TSS);
Stage 6 –: Land Acquisition and Clearances: IInd – Report;
Stage 7 –: Final Detailed Project Report (FDPR);

Figure 5: Detailed Project Description Process (Schematic Diagram OR Flowchart Showing Project Layouts and Concluding Components).



Stakeholders Maharashtra and Karnataka State

Following is the list of stakeholders for consultation regarding the study:

- *"National Highway Authority of India" (NHAI);*
- *"IJM (India) Infrastructure Limited" (IJMIL), Solapur;*
- *Solapur Municipal Corporation (SMC);*
- *Maharashtra State Road Transport Corporation (MSRTC);*
- *Regional Transport Office, Solapur (RTO);*
- *Public Works Department, Solapur (PWD);*
- *Superintendent of Police (Traffic), Solapur;*
- *Maharashtra Pollution Control Board (MPCB);*

And

- *Karnataka State Highways Improvement III Project (KSHIP III);*
- *Karnataka Udyog Mitra;*
- *Bangalore Development Authority (BDA);*
- *Karnataka State Road Transportation Corporation (KSRTC);*
- *Bangalore Metropolitan Transport Corporation (BMTC);*
- *North East Karnataka Road Transport Corporation (NEKRTC);*
- *Directorate of Urban Land Transport (DULT);*
- *Northeast Karnataka Road Transport Corporation (NKRTC);*
- *Karnataka State Pollution Control Board (KSPCB);*
- *ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ;*

In November 2017, IJM secured the four – laning of the 109 Km Solapur – Bijapur section of the new National Highway 52 between the states of Maharashtra and Karnataka in India. The tollway will be the largest Indian project undertaken by IJM in value, building on track record of delivering 16 major road projects totalling 1,378 Km in India since 1998. **"IJM (India)" "Infrastructure Limited" (IJMIL)** is a Company established in 1998 and registered under the Companies Act 1956. Its Registered Office is located at 1 – 89/1, Plot No.42 & 43, 3rd and 4th Floor, Kavuri Hills, Phase – I, Madhapur, Hyderabad – 500 081.

IJMIL is a Malaysian Multinational, which is a subsidiary of IJM Corporation Bhd. (IJM), Malaysia. IJM, whose core competency is construction, is one of the Malaysia's largest and most diversified construction groups, with world – wide presence with specialization in the areas of construction, property development, manufacturing, quarrying, plantation and international ventures. Its current operations are spread over Malaysia, India, Australia, Argentina, Chile, China, Myanmar, Singapore and Vietnam. IJM is a highly quality conscious company with the motto of **"Excellence Through Quality"**.

IJMIL has been actively participating in the high growth opportu Vijayapuraes offered by Indian Infrastructure Industry, more specifically in the construction sector. IJMIL's main thrust is in construction and upgrading of highways and property development including world class townships and commercial buildings using modern technology and equipment. **"IJM (India) Infrastructure Limited"** is firmly committed to its quality motto of **"We Deliver"** On Time within Budget with Commitment.

Extra Widening/ Improvement Index

- The Project road is proposed as single lane with shoulder, drain, and extra widening (3.75 m + 2 × 1.25 m + 0.6 m + 0.6 m) as shown in the **Table 8**.

Table 8: Extra Widening/ Improvement and Land Acquisition Index.

Sr. No.	Feature	Description
1.	*Extra Widening/ Land Acquisition (3.75 m + 2 × 1.25 m + 0.6 m + 0.6 m)*	**60 to 50 m Extra Widening (ROW) Strip of Land is Required**

The aim of reconnaissance survey was to assess the scope of land acquisition and resettlement study and accordingly the detailed plan of action was prepared for the preparation of land acquisition planning and resettlement plan. The transparent process for land acquisition for industrialization, development of essential infrastructural facilities and urbanization with the least disturbance to the owners of the land and other affected families and provide just fair compensation to the affected families whose land has been acquired or proposed to be acquired or are affected by such acquisition and make adequate provisions for such affected persons for their rehabilitation and resettlement and for ensuring that the cumulative outcome of compulsory acquisition should be that affected persons become partners in development leading to an improvement in their post acquisition social and economic status and for matters connected therewith or incidental thereto.

Methodology for Social Impact Assessment

Project Road if traverses through rolling and steep as well as plain terrain. The proposed alignment improvement design is based on various parameters. The design principles for alignment selection have been evolved based on discussions with the expertise in Highway Engineers, Bridge Design Specialists, Environmentalist, Transport and other key personnel. The selection of the alignment is broadly based on the following criteria:

- *Technical soundness and economic viability;*
- *Least social and environmental adverse impact;*
- *Least displacements and loss of public property;*
- *Avoiding adverse impact to water bodies and other environmental features;*
- *Locations of required causeways;*

3. PROJECT DESCRIPTION AND ALIGNMENT

Projected Road Description: The Project Section of **"Solapur to Vijayapura, Road"** is located in the District of **"Solapur/ Vijayapura",** which in turn is located in the State of Maharashtra length as per topography survey is 110.542 Km and as per design is 109.08 Km. The alignment of the project road is connecting Solapur and Vijayapura. The project road Solapur to Vijayapura having length of ***110.542 Km*** and the project ***Stretch*** is traversing in plain and flat level terrain from ***Solapur at (17.6599° N Latitude and 75.9064° E Longitudes)*** and ***Ends*** at ***Vijayapura Village (21.1298° N Latitude and 73.8110° E Longitudes)*** in the State of Maharashtra. The RL difference between two locations is 500 m. The Proposed designed alignment/ corridor between these stations comes out to be from ***00+000 Km to 109+08 Km*** (as shown above in yellow colour). ***"Length provide by NHAI for the road is 110.542 Km, whereas the designed length is 109.08 Km".***

- *The Existing Alignment of **"Solapur to Vijayapura, Road"** is Newly Declared as NH/ SH; is connecting to Newly Declare Road. The Total Existing Length of the Projected Road is approximately **"110.542 Km".***
- *The Actual Design Length of the Project Road is around **"109.08 Km".***
- *The project road section between **"Solapur to Vijayapura, Road"** has been divided into following homogeneous section in the **Table 3**:*

Report Purpose

- ✓ *To Identify Existing Traffic Data in the Region/ State;*
- ✓ *To Describe New Data Collection Requirements;*
- ✓ *To Presents the Findings of Data Collection Undertaken;*
- ✓ *To Determine if the Data Collection is Fit for Use;*

Table 9: The Inventory of Solapur to Vijayapura Projected Road.

ROAD INVENTORY																		
Road Name: Solapur to Vijayapura																		
Section : From Km 00+000 To 110+542 Km.													District: North Maharashtra					
Chainage		Type of Terrain	Land Use Pattern	Name of Village/ Town	Right of Way (m)	Roadway Width (m)	Carriageway			Shoulders		Average Height of Embankment or Depth of Cutting (m)	Road Side Drainage		Service Road, If Any	Details of Cross Roads			Remarks
Km	Km						Type	Width (m)	Condition	Type	Width (m)		Exists (F/ NF)	Does not Exist		Location	Destination	C/W (m)	
00+000	110+542	Generally Plain and Relatively Flat Land Area	Agricultural Field Area and No Use of Forest Land	Total Number of 16 Towns and Villages in the Region (Including Solapur to Vijayapura)	Varies from 13.3 m to 60 m	Varies from 7.0 m to 10.0 m	2 – Lane Road Network (Flexible/ Strechy/ Elastic)	Varies from 7.0 m to 10.0 m (Flexible/ Strechy/ Elastic)	Good – 80.78%; Fair – 13.04%; Poor – 6.18% (New Expansion)	Earthen and Paved Type Sholders	Earthen (1.0 m to 2.5 m); Paved Shoulders (1.0 m to 1.5 m) (2 m)	Varies Between Level 1 m to 2.5 m	Final (Including Solapur to Vijayapura)	Does not Exist	12 to 18 m (Solapur to Vijayapura)	Major Junction – 8 No's Minor Junction – 26 No's (For details please refer Appendix A – VI (b) and Appendix A – VI (c) of Concession Agreement)	(For details please refer Appendix A – VI (b) and Appendix A – VI (c) of Concession Agreement	(For details please refer Appendix A – VI (b) and Appendix A – VI (c) of Concession Agreement	Highway Road Pathway/ Corridor

- *The Existing road **Starts** from **00+000 Km Solapur Village** of Latitude and Longitude **(17.6599° N Latitude and 75.9064° E Longitudes)** and the road **Terminates** at **110.542 Km.** of **Vijayapura Village** with Latitude and Longitude **(21.1298° N Latitude and 73.8110° E Longitudes)**. The Project Road **Solapur to Vijayapura** is situated in **Maharashtra and Karnataka State**.*
- *The consultancy services for the same is to include design of best possible alignment and* pavement *composition, design of bridges, culverts and other structures in addition to analysis of costs, determining project feasibility, preparation of **"Land – Acquisition – Plan" (LAP),** if applicable in any area, and obtaining of all requisite clearances as per need or suitability in the projected areas.*
- *The index map illustrates the **"Approved Project Alignment of Solapur to Vijayapura Road Projected"** are presented in the **Table 10** below:*

Table 10: Details of Road Crossing NH – 13 at Projected Solapur to Vijayapura Road.

Sr. No.	Chainage of NH – 13 (Crossing Chainage)	Road Connecting Villages		Category of Road (VR, ODR, MDR, NH, SH)	Type of Road (Mud, Metal, Black Top)
		Village Name on LHS	Village Name on RHS		
	Start Point at Solapur Village Chainage = 01+070 Km.				
1.	01+070	*Deshmukh Vaste*	**Shivaji Nagar**	*Village Road*	**Metal**
2.	02+176	*Deshmukh Vaste*	**Connecting to NH – 9**	*State Highway*	**Black Top**
3.	04+820	*Connected to NH – 166*	**Dall Mill Road**	*Village Road*	**Mud**
4.	05+334	*Solapur*	**Mangalveda**	*National Highway*	**Black Top**
5.	06+890	*Belati*	**Connected to NH – 166**	*Village Road*	**Black Top**
6.	07+720	*Belati*	**Belati Thanda**	*Village Road*	**Black Top**
7.	08+120	*Belati*	**Pathri**	*ODR*	**Black Top**
8.	09+350	*Belati*	**Donegao**	*State Highway*	**Black Top**
9.	09+920	*Kawathe*	**Donegao**	*State Highway*	**Black Top**
10.	11+105	*Kawathe*	**Donegao**	*Village Road*	**Black Top**
11.	12+176	*Solapur*	**Donegao**	*State Highway*	**Black Top**
12.	12+720	*Soregao*	**Donegao**	*State Highway*	**Black Top**

13.	**15+960**	*Soregao*	**Nandur**	*Village Road*	**Black Top**
14.	**18+176**	*Solapur*	**Shamshapur**	*Village Road*	**Black Top**
15.	**22+820**	-------	**Dondgango**	*Village Road*	**BT Road**
16.	**22+700**	*Hatur*	-------	*Village Road*	**BT Road**
17.	**24+680**	-------	**Yangi**	*Village Road*	**BT Road**
18.	**26+620**	*Honmurgi*	-------	*Village Road*	**BT Road**
19.	**29+275**	-------	**Mundroop**	*State Highwa*	**BT Road**
20.	**29+260**	*Aurad*	-------	*Village Road*	**BT Road**
21.	**33+815**	-------	**Mundroop**	*Village Road*	**BT Road**
22.	**33+815**	*Bandalgi*	-------	*Village Road*	**MUD**
23.	**37+520**	-------	**Kurghot**	*Village Road*	**BT Road**
24.	**37+520**	*Barur*	-------	*Village Road*	**BT Road**
25.	**38+520**	*Takali*	-------	*Village Road*	**MUD**
26.	**39+440**	-------	**SIRNAL**	*VILLAGE ROAD*	**METAL ROAD**
27.	**40+200**	*DHULKED*	-------	*AGRICULTURE FIELDS*	**METAL ROAD**
28.	**40+600**	*CHINTAPUR*	-------	*VILLAGE ROAD*	**METAL ROAD**
29.	**40+600**	-------	**MARGUR**	*AGRICULTURE FIELDS*	**BLACK TOP**
30.	**41+100**	-------	**CHINAGAV**	*VILLAGE ROAD*	**BLACK TOP**
31.	**41+310**	-------	**MARGUR**	*VILLAGE ROAD*	**BLACK TOP**
32.	**41+400**	-------	**DHULKED**	*VILLAGE ROAD*	**CC ROAD**
33.	**41+510**	-------	**DHULKED**	*VILLAGE ROAD*	**CC ROAD**
34.	**41+570**	-------	**DHULKED**	*VILLAGE ROAD*	**CC ROAD**
35.	**41+720**	-------	**DHULKED**	*VILLAGE ROAD*	**CC ROAD**
36.	**42+820**	*DHULKED*	-------	*AGRICULTURE FIELDS*	**METAL ROAD**
37.	**43+140**	-------	**MARGUR SUGAR FACTORY**	*VILLAGE ROAD*	**BLACK TOP**
38.	**45+700**	*ANCHI*	-------	*VILLAGE ROAD*	**BLACK TOP**
39.	**46+200**	*INDI*	-------	*MDR*	**BLACK TOP**
40.	**49+420**	*ALIGI*	**MANNEKHELLI**	*VILLAGE ROAD*	**BLACK TOP**
41.	**52+340**	-------	-------	*AGRICULTURE FIELDS*	**MUD**
42.	**53+590**	*AJANALE*	**GOTYAL**	*VILLAGE ROAD*	**BLACK TOP**
43.	**54+410**	*AJANALE*	-------	*VILLAGE ROAD*	**MUD**
44.	**57+510**	*INDI*	**CHADCHAN**	*MDR*	**BLACK TOP**
45.	**58+080**	-------	**INTERNAL ROAD**	*AGRICULTURE FIELDS*	**MUD**
46.	**59+650**	-------	**BALLOLI**	*VILLAGE AND MARKET*	**CC ROAD**
47.	**61+660**	-------	-------	*AGRICULTURE FIELDS*	**MUD**
48.	**62+120**	*GUNDAWANA*	-------	*VILLADGE ROAD*	**CC ROAD**
49.	**62+200**	-------	**SIGANNAPUR**	*VILLAGE ROAD*	**METAL ROAD**
50.	**62+510**	-------	**NANDRAGI CROSS**	*VILLAGE ROD*	**BLACK TOP**
51.	**64+870**	-------	**NANDRAGI CROSS**	*VILLAGE ROD*	**BLACK TOP**

52.	**65+200**	-------	**KAPNIMBARGI**	*VILLAGE ROD*	**BLACK TOP**
53.	**66+700**	-------	**-------**	*AGRICULTURE FIELDS*	**MUD**
54.	**67+230**	-------	**-------**	*AGRICULTURE FIELDS*	**MUD**
55.	**69+270**	-------	**Halagunaki**	*VR*	**BT**
56.	**69+310**	*Indi*	**-------**	*MDR*	**BT**
57.	**72+660**	-------	**Sonagana Halli**	*VR*	**BT**
58.	**72+995**	*Nimbal*	**-------**	*MDR*	**BT**
59.	**72+995**	-------	**Inchageri**	*MDR*	**BT**
60.	**73+260**	-------	**Koluragi**	*VR*	**CC Road**
61.	**75+770**	*Dhenkanal*	**-------**	*VR*	**BT**
62.	**75+770**	-------	**Koluragi**	*VR*	**BT**
63.	**76+080**	*Horti Thanda*	**-------**	*VR*	**Metal**
64.	**77+740**	-------	**Horti LT – 1**	*VR*	**BT**
65.	**80+880**	*Basnal*	**-------**	*VR*	**BT**
66.	**81+280**	-------	**Koluragi**	*VR*	**BT**
67.	**82+400**	*Kotnal*	**-------**	*VR*	**BT**
68.	**82+410**	-------	**Domnal**	*VR*	**BT**
69.	**85+315**	-------	**Domnal**	*VR*	**BT**
70.	**86+970**	-------	**Kannur**	*VR*	**BT**
71.	**87+345**	-------	**Makhanapur**	*VR*	**BT**
72.	**87+530**	*Gunaki*	**-------**	*VR*	**BT**
73.	**91+640**	-------	**Makhanapur**	*VR*	**Mud**
74.	**91+680**	*Kannal Tanda*	**-------**	*VR*	**Mud**
75.	**93+763**	*Kannal*	**-------**	*VR*	**BT**
76.	**94+670**	*Shantinagar LT*	**-------**	*VR*	**BT**
77.	**95+110**	*Bharatgi LT*	**-------**	*VR*	**CC Road**
78.	**95+205**	*Bharatgi LT*	**-------**	*VR*	**Mud**
79.	**95+702**	-------	**Naik Camp LT – 4**	*VR*	**BT**
80.	**96+535**	*Bharatgi LT – 2*	**-------**	*VR*	**BT**
81.	**96+538**	-------	**Arkeri Police Quarters**	*VR*	**BT**
82.	**98+059**	-------	**Bhutnal LT**	*VR*	**Mud**
83.	**98+390**	-------	**Bhutnal**	*VR*	**BT**
84.	**101+258**	-------	**Arkeri – Umdi – Pandharpur**	*SH*	**BT**
85.	**101+560**	*Bharatgi*	**-------**	*VR*	**BT**
86.	**101+560**	-------	**Bijapur City Road**	*MDR*	**BT**
87.	**102+033**	*Hanchnal*	**-------**	*VR*	**BT**
88.	**102+725**	-------	**Sanskriti Colony Road**	-------	**BT**
89.	**102+725**	*Hanchnal LT*	**-------**	*VR*	**Mud**
90.	**103+120**	*Uday Nagar Colony*	**-------**	-------	**BT**
91.	**104+632**	*Indi*	**-------**	*SH*	**BT**

92.	**104+632**	-------	**Bijapur APMC Road**	*MDR*	**BT**
93.	**105+880**	-------	**Bijapur Station Road**	-------	**BT**
94.	**106+450**	*Honnapur*	-------	*VR*	**BT**
95.	**107+260**	*Ainapur*	-------	*VR*	**BT**
96.	**107+855**	-------	**Bijapur City Road**	*MDR*	**CC Road**
97.	**107+855**	*Shindagi*		*NH 218 E*	**BT**
98.	**108+780**	-------	**Bijapur City Road**	-------	**BT**
99.	**108+795**	*Rambhapur*	-------	*VR*	**BT**
100.	**109+630**	-------	-------	-------	**BT**
	End Point at Vijayapura Village Chainage = 109+630 Km.				

Meticulous/ Particular TOR for Satellite Imagery

The coordinates of the origin and destination points of the proposed roads provided in the TOR were tentative. These have been checked on ground by us in concurrence of NHAI posts at the particular stations by GPS to ensure the accuracy of the coordinates.

4. OBJECTIVE OF CONSULTANCY SERVICES

The objective of current study is to prepare a comprehensive mobility plan by **"National Highway Authority of India" (NHAI) and "IJM (India) Infrastructure Limited" (IJMIL)** for Solapur Municipal Corporation area for the period 2015 – 2035 in line with National Urban Transport Policy, 2014, which focuses on the mobility of people and not vehicles and on the need for promoting safe pedestrian movement, bicycle movement and public transport, integration of land use and transport planning. Sustainable Mobility can only be ensured if the solutions are environmentally, socially, and economically sustainable as presented below.

Objective of Consultancy Services: The main objectives of the consultancy services are to prepare **"Initial Environmental Examination" (IEE)**/ DPR Report and bid documents for the length of **"110.542 Km of Solapur to Vijayapura Road"** and to establish the techno, economical, viability of the project and prepare detailed project reports for design of roads and bridges. An important requirement with regard to improving the Project Road is that the development of work shall be within the **"Right of Way" (ROW)** of **"60 to 50 Meters"** and avoiding additional land acquisition as far as possible. All these means that the development schemes for the Project Road should be as economical as possible consistent with the functional requirements and that it should amenable for quick implementation without delays.

To serve the environmental aspects and adopt good **"Road Construction Practices" (Sustainable Environmental Development Practices)** under this project are being considered. The present research methodology aims to use the waste of some industries like polypropylene, polyester (as waste of backing and carpet industries respectively) in the preparation of a special type of asphalt to be used in the production of **"Hot Mix Asphalt" (HMA)** for roads, bridges, structures and dams construction during the civil work. The solid materials in paving mix were low quality aggregates of high absorptive type and waste marble filler with the final objective to provide added value, to reduce the production costs and keep the virgin solid materials especially aggregates for a longer period of time. The produced mixes are of similar or of better performance compared to the conventional asphalt mixtures. And there is an urgent need to address the great challenges of our times: climate change, resource depletion, pollution, and peak oil. These issues are all accelerating rapidly, and all have strong links with the road as well as building industry as shown below in **Project Execution Objectives and Decision Making Work – Life Cycle (Figure 6)**.

- *Ground Control Point Survey by using "Differential Global Positioning System" (DGPS);*
- *Procurement of 0.5 m Resolution of Satellite Imagery from "National Remote Sensing Centre" (NRSC), Hyderabad, India;*
- *Development of "Geographical Information System" (GIS) Layers and "Digital Elevation Model" (DEM) of Finalized Alignment of Border Roads;*
- *Contours Creation at 2.5 m Interval;*

- *Ortho – photo Generation at 0.5 m "Ground Sample Distance" (GSD);*

Major Tasks and Scope of Consultancy Services

1) Engineering Surveys and Investigations

- *Topographic Surveys;*
- *Hydraulic and Hydrological Investigations;*
- *Traffic Surveys;*
- *Material Investigations;*

2) Engineering Designs

- *Geometric Designs;*
- *Pavement and Road Designs;*
- *Design of Bridge and Structures;*
- *Drainage Designs;*

3) Project Cost Estimations

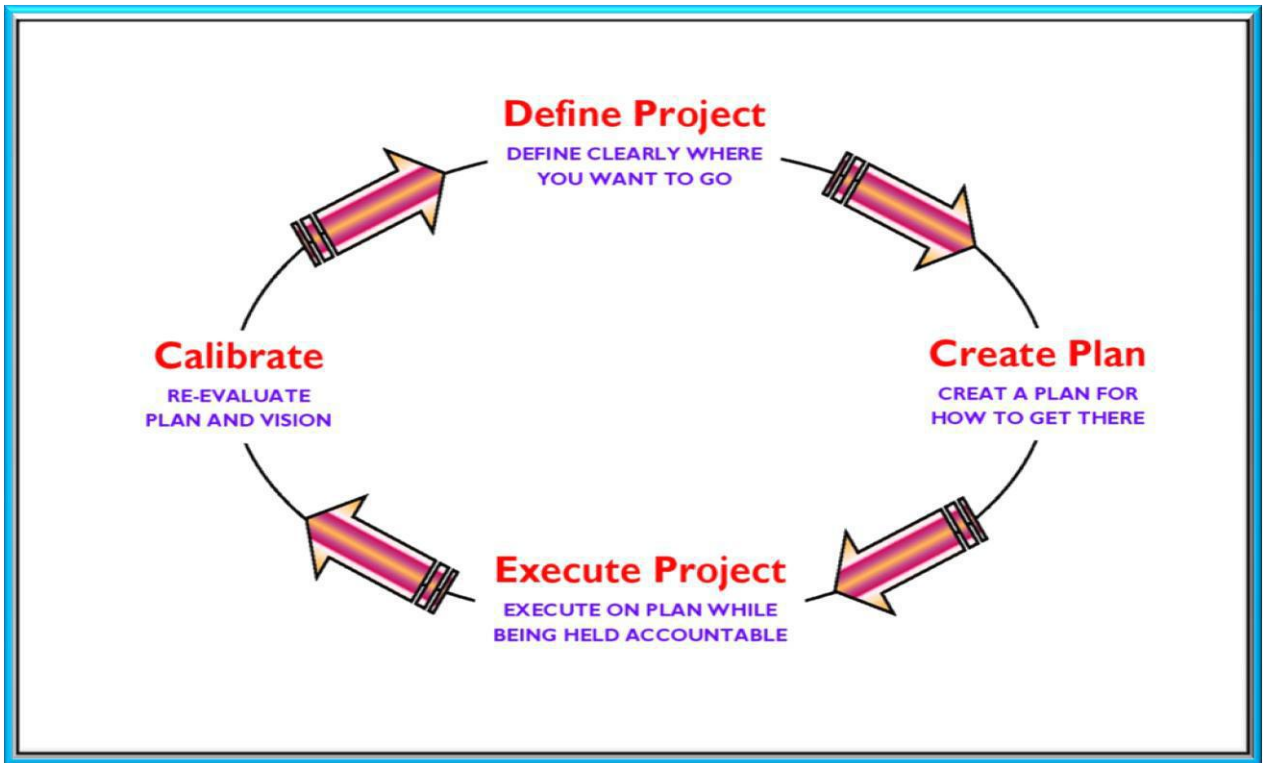
4) Detailed Project Report; "Initial Environmental Examination" and Bid Documents

5) General Topographical Features of the Area/ Region/ State

6) Proposed Drainage Facilities/ Structures of the Area/ Region/ State

- **Establishing the Most Suitable Alignment of the Projected Road;**
- **Minimal Adverse/ Unfavourable/ Unpleasant Impact on the Surrounding Environment.**

HAMARA SANDESH...!!! HARA BHARA "MAHARASHTRA AND KARNATAKA" PRADESH...!!!



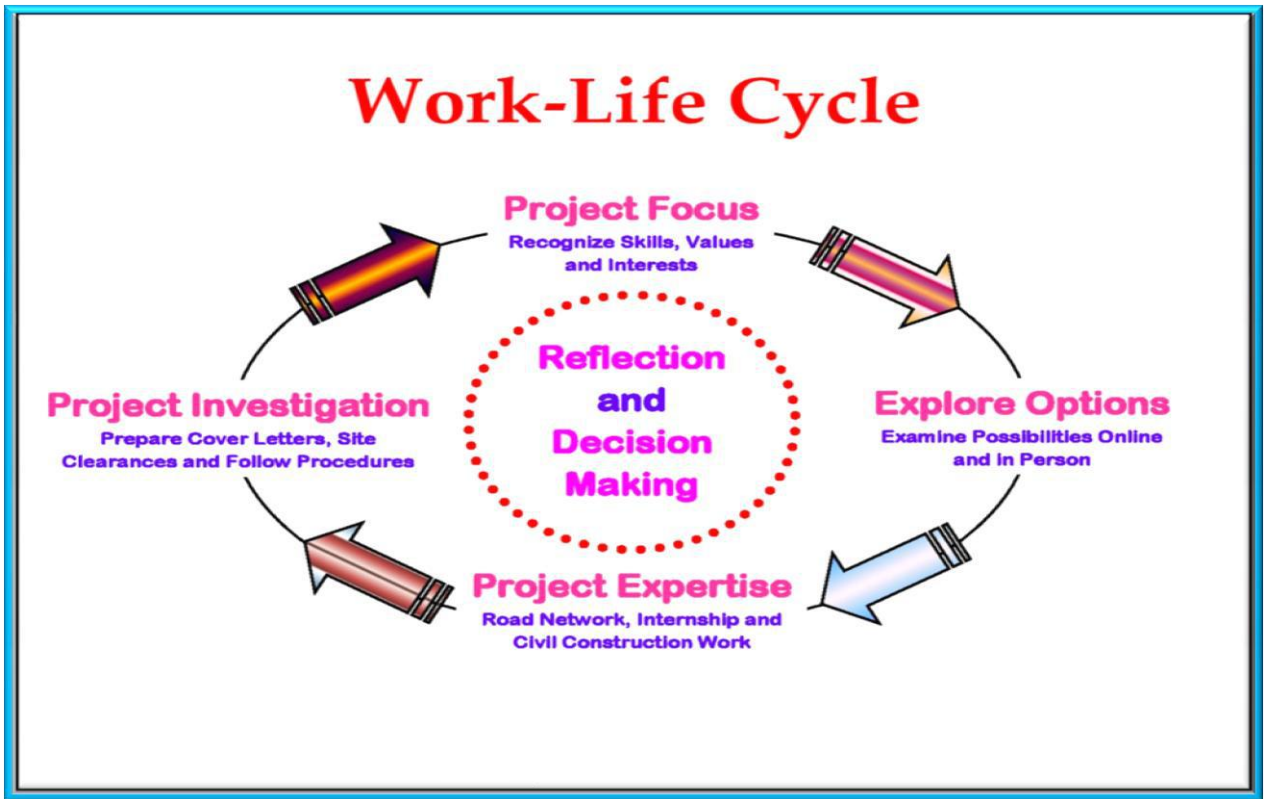


Figure 6: Project Execution Objectives and Decision Making Work – Life Cycle.

There is a growing consensus from scientists and the industry that, we are going to reach peak for construction in the next twenty years, and that we might have reached this point already. Global demand is soaring, whilst global production is declining, and oil is set to become increasingly expensive and scarce. The road and building industry is hugely dependent on cheap resources from the manufacture and transportation of its materials, to the machinery and tools used in demolition and construction. Not only in India, but also in other countries, they use vast quantities of fossil fuels, accounting for over half of total carbon emissions that lead to increase in temperature, global warming and climate change. The built environment is also responsible for significant amounts of air, soil and water pollution, and millions of tones of landfill waste and this is a situation that clearly needs to change. Strategic value of these always occur, because our roads, belongs to some very important and informative objectives, which makes our country strong against another country as whole around the **"World OR Globe OR Precious Earth Sphere"**.

5. PROPOSED APPROACH AND METHODOLOGY: Eco – Friendly OR Environmental Friendly Road Construction Methods and Materials

General Approach: The general approach of the Consultants would be to comprehensively address the various issues involved in the project, to carry out all the field and design office activities as set out in the Scope of Services of the ***"Term of Reference" (TOR)*** and finally to develop improvement proposals satisfying the objectives of the project.

Methodology: The project involves a series of inter – related activities, both in the field and in the design office. Methodology for carrying out these activities is described in the following paragraphs.

Topographical Surveys: The topographical surveys by means of ***"Global Positioning System (GPS)",*** for fixing of ground control points for the entire length of the corridor. Further, the survey has been completed with the 0.5 m high resolution satellite imagery.

Soil and Material Investigations: Prospective sources of construction materials have been located by the Consultants to add in list of sources of materials. To estimate the quantities of available suitable materials; the Consultants have prepared quarry/ material source charts including lead distances etc. This

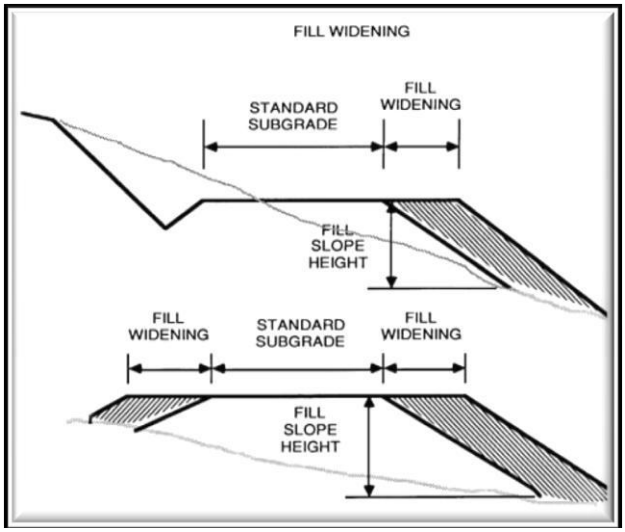
shall form an input in Rate Analysis of borrow/ quarry materials, following which recommendations for the use of the materials from different sources can be made. Material investigation done for engineering properties reveals that the material available at site is fit for use in protection, drainage and surfacing works aggregate and no quarry outside the site is required. The material can be used for crust layer execution by processing the available material by stone crusher and rotary screen. Only local transportation is the need for transporting the aggregates for preparation of bituminous mix preparation and laying at respective chainages.

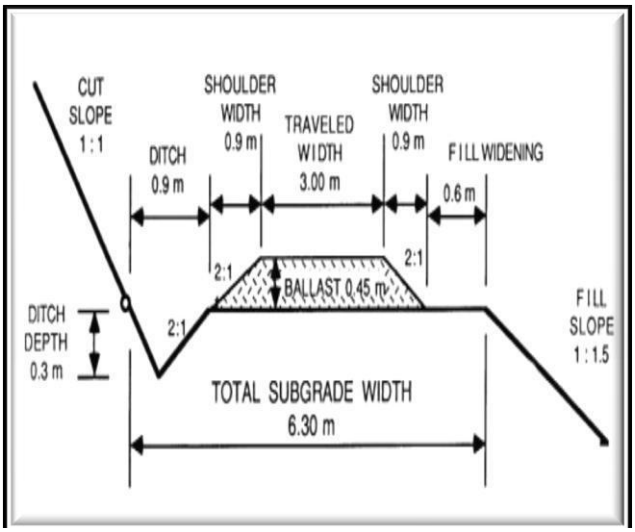
For the completion of this environmental report the data was collected from different sources including government department and our DPR as well as **"Initial Environmental Examination" (IEE) "Report, Expert/ Specialist Team"**. The main aim of this report is to produce a smart; innovative/ informative/ adaptive/ applicable guideline for good construction practices. Eco – friendly design methodologies and technologies can further reduce energy consumption by minimizing energy inputs for heating, cooling and light, and incorporating energy efficient appliances and applications. Saving energy for the occupant also saves money – an issue that will become increasingly important as the cost of fossil fuels and materials for road, bridges, and structure are used inevitably rises in the near future. High absorptive aggregate and waste polymer must play a very important role in road paving to decrease the cost of construction and maintenance. With the inevitability of declining fossil fuels, and the threat of global climate change, reducing our energy consumption is an essential survival strategy. ***"Choosing to Build – Green...!!! And Go – Green...!!! To Save Energy Consumptions and its Valuable Resources to Achieve Significant Prospective Goals in the Projected Area Study"***. The low embodied energy of green products ensures that very little energy went into their manufacture and production, with a direct reduction in carbon emissions. The best modifier of asphalt must contain high percentages of Iso and Cyclo – Paraffins and lower percentage of asphaltenes similar to asphalt composition itself and the waste polymer from other industries can be used in future work.

The report mainly contains environmental points regarding different stages of the Designing; Construction and Operational Phases like three as depicted below for **"Solapur to Vijayapura Road"**, which is situated in the Sourthern part of **"Maharashtra and Karnataka State"** to achieve projected goals and mainly these are in:

- *Designing Phase;*
- *Construction Phase;*
- *Operational Phase.*

Bitumen, as a residue from crude oil distillation, is the complex mixture of four main families of compounds, referred to as **"SARA" Fractions (Saturates, Aromatics, Resins and Asphaltenes)**. The behaviour of bitumen depended on the relative concentration and the chemical features of asphaltenes and maltenes; thus, variation in its composition strongly affects its mechanical properties. Methodological Perspective Over – View of Road Date Base Construction Photographs is given in **Figure 7**.





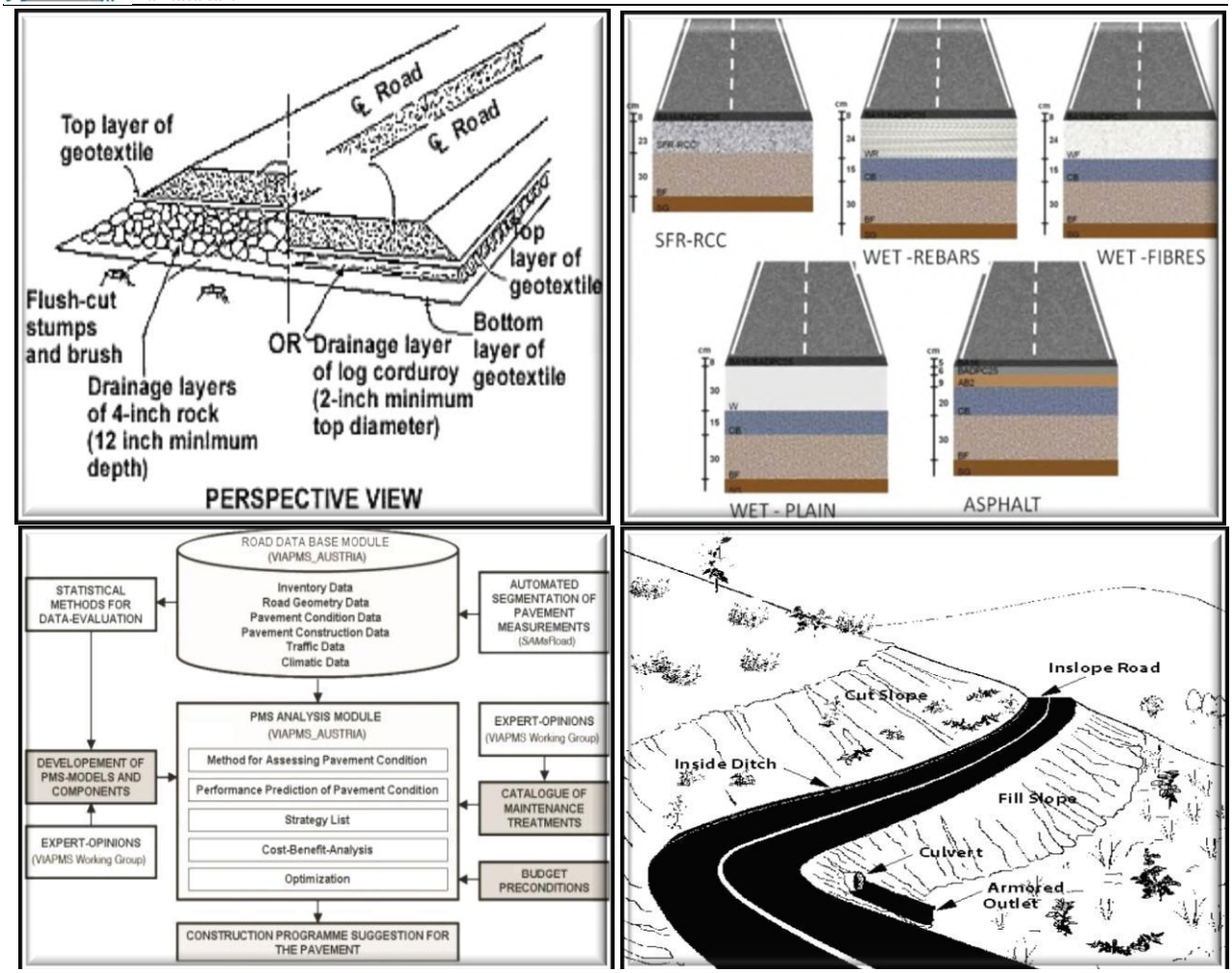


Figure 7: Methodological Perspective Over – View of Road Date Base Construction Photographs.

It presents a large set of interesting potential properties: impermeability, ductility, adhesivity and resistance to the effect of weathering and chemicals, etc. In the last 20 years, a wide spectrum of modifying polymeric materials has been tested with bitumens for their use in road construction. For a polymer to be effective it must blend with bitumen and improve its resistance at high temperatures without making the bitumen too viscous at mixing temperatures or too brittle at low temperatures. It should be capable of being processed by conventional equipment, available, not expensive and physically and chemically stable during storage, application and service. In actual modified bitumens, thermoplastic rubbers, as well as some thermoplastic polymers, were mainly used. The use of secondary (recycled) aggregates, instead of primary (virgin) materials helped in easing landfill pressures, reducing the need for extraction, protecting environment and minimizing the consumption of original resources. Polyester polymer, thermoplastic **"Poly – Ethylene Tere – phthalate" (PET)** and mineral fibres are the additives, which are mostly used to produce strong and durable reinforcement bitumen. Also, different industrial wastes such as waste polymers, spent toner, marble quarry waste and fibres ...etc. can be used as asphalt modifiers for civil construction work. Carpet waste fibres were used recently in asphalt mixtures and in **"Fibre Reinforced Concrete" (FRC)**. Such reinforcement improved effectively the shatter resistance, toughness, and ductility of concrete. One of the major waste generating industries is the construction and marble production, and, it was reported that the potentials to use this type of waste in low to medium traffic urban as well as rural areas roads and as binder courses were very beneficial. There are some literatures that discussed the use of fillers such as limestone powders, rubber silica and carbon black as modifiers for asphalt mixture. In Egypt, the use of waste materials in HMA is not applied yet, in addition to the presence of a large amount of low quality aggregate not suitable for use in paving or other purposes.

Preparation of Hot Mix Asphalt and Properties

Hot mix asphalt samples were prepared using virgin asphalt and modified binders and were evaluated using the **"Marshall Test Method" (ASTM: D – 6927)**. The mixes were designed according to the standard limits of surface (wearing) course. The job mix was formulated (% Wt.) using coarse and fine aggregates, sand and filler as 33, 30, 32 and 5 Wt. %, respectively. The mixes were tested for maximum load and flow along with density and air voids in mixes and solid materials were determined.

- *HMA are hot mixes asphalt consisted of normal absorptive aggregate type, primary (virgin) asphalt samples and limestone filler;*
- *HMA are hot mixes asphalt consisted of high absorptive aggregate type, virgin (primary) asphalt samples and limestone filler;*
- *HMA are hot mixes asphalt consisted of high absorptive aggregate type, marble dust, modified asphalt through using 5% of waste polypropylene and waste polyester respectively.*

Conclusion and Recommendation

This research aimed to prepare and use special types of HMA consisting of unordinary materials with the final objective of decreasing the cost of paving and maintenance, keeping the premium aggregate for the longest period of time and decreasing the land space needed for land filling of un – degradable pollutants. To achieve this aim, 5 to 15% of each of waste polypropylene and polyester were used in asphalt modifying. High absorptive aggregate and marble fillers were used in mixes preparation instead of ordering materials such as normal absorptive aggregate and limestone filler. The obtained results showed that all the types of waste polymers and solid materials used in the study are suitable in road paving and construction activities. The mixes comply with the standards and have reduced temperature susceptibility. The best modifier was polypropylene waste and the polyester waste was found to be very tough. The mix can be used as base course or other purpose in any type of construction and civil work.

6. ENVIRONMENTAL INDEX OR FEATURES OF THE PROJECT

"Policies, Environment and Economy Status of Maharashtra"

These share policies, principles, and strategies intended to preserve and even enhance valued natural and cultural resources and facilitate **"Healthy",** sustainable communities and neighborhoods. These approaches also tend to foster a balance of mixed uses (including housing, educational, employment, recreational, retail, and service opportunities) which recognize the importance of spatial or geographic proximity, layout, and design of those uses. In addition, the consideration of long term and Broader (even global) impacts of land use decisions on our natural and human – made environment, including transportation systems and facilities, is critical to these concepts, as well. Integrating land – use and transport planning are essential for environmentally, socially and economically sustainable urban development. Design of urban settlements and choice of locations aim at Maharashtra & Karnataka Region:

- *The creation of new planning tools should aim to increase public involvement in the development of transportation and land use policies;*
- ***Reducing the rate of growth of car trips;***
- *Promoting public transportation;*
- ***Enhancing the healthy conditions for living;***
- *Improving air quality through reducing fuel use and vehicle emissions;*
- ***More accessible land use patterns to reduce travel distances;***
- *Respond to the changing needs of the population;*
- ***Providing high level of accessibility;***
- *Encourage mixed use development;*

- ***Use of "Water Sensors", to reduce reservoirs, tanks' water overflow/ stream/ watercourse wastage on road construction sites or localities, building construction sites and locations, farming fields, agricultural processing industries, pharmaceutical industries, manufacturing sectors like textiles including food processing units, government and non – government organization, institutes, schools, colleges and other private sectors etc.***

Transportation's purpose is moving people and goods from one place to another, but transportation systems also affect community character, the natural and human environment, and economic development patterns. A transportation system can improve the economy, shape development patterns, and influence quality of life and the natural environment.

With greenhouse gas emissions from transport representing 13% of total India's domestic emissions, decarbonizing transport must be part of the solution. This will be a major change, but moving to a low carbon economy and transport system also presents huge opportunities; not just for climate change but for our prosperity, health, and the wider natural environment. Working towards a form of mobility that is sustainable, energy efficient and respectful of the environment is not only to improve citizens' quality of life...!!! but also to be sought and strengthen the economy by promoting sustainable urban mobility and increased use of clean and green energy efficient vehicles on road network of **Solapur (सोलापुर) to Vijayapura (बीजापुर)** in the State of Maharashtra & Karnataka.

Homogeneous Section

The entire Projected Road is considering as one homogeneous section based on **"Traffic Volume"** and its characteristics in the below **{Table 11 on Page No. 34}**. And **Table 12** shows the **"Existing – Proposed Chainage Wise Villages".**

Table 11: Homogeneous Section based on Traffic Volume Tehsil/ District Wise Villages.

Sr. No.	Homogenous Section	Design Section Chainage		Existing Section Length (Km)	Design Length (Km)	Lane Widening
		From (Km)	To (Km)			
1.	Solapur to Vijayapura Road	*00.000*	**109.08**	*00.000 to 110.542*	**00.000 to 109.08**	*Bothways*
		110+542			**109.08**	

Table 12: Existing – Proposed Chainage Wise Villages.

Sr. No.	Homogenous Section	Existing Chainage Section		Proposed Chainage Section	
		From (Km)	To (Km)	From (Km)	To (Km)
1.	Solapur to Vijayapura Village	*00+000*	**110+542**	*00+000*	**110+542**

7. DEMOGRAPHIC INFRASTRUCTURE INDEX OF THE PROJECT DISTRICT/ STATE

"SOLAPUR" (सोलापुर) is one of the important districts of Maharashtra State of India. It is located in the Southern part of Maharshtra. Solapur grew rapidly as an industrial town in 1970s. This is also reflected in the population growth during the same period. The decadal growth was very high between 1971 and 1991, when the down turn of the textile industry begun. It is situated at a distance of 410 Km (250 Mile) from the Maharashtra State Capital of Mumbai by road and train. Solapur is at a distance of 245 Km (152 Mile) from Pune and 305 Km (190 Mile) from Hyderabad. Solapur is situated on the Deccan plateau. **"Solapur Fort" (Bhuikot Castle)** is an ancient Muslim fort situated in Solapur, one of the ancient historical and religious places in Maharashtra. This 14th century fort was built in memory of **"Hutatma Bagh"**. The fort also houses a temple, which attracts thousands of visitors and it was built by **"Bahamani Sultan"**.

Traffic and Transportation System Characteristics

- *Transport Connectivity;*
- *Road Connectivity;*

Solapur is well – connected by road with major cities of Maharashtra as well as the adjoining State Capitals of Andhra Pradesh & Karnataka and important cities in Andhra Pradesh & Karnataka by National Highways namely;

- ***NH – 9:*** *Highway connecting Pune with Vijayawada via Hyderabad;*
- ***NH – 13:*** *Connecting Solapur to Mangalore, Karnataka;*
- ***NH – 211:*** *Connecting Solapur to Dhule and;*
- ***NH – 204:*** *Connecting Ratnagiri – Solapur passes through city.*

"Policies, Environment and Economy Status of Karnataka"

"Vijayapura in Karnataka" (कर्नाटक में विजयपुरा) Vijayapura is now known as Bijapur and it is located in the Indian state Karnataka. It is a district headquarters of Bijapur taluka. Bijapur city is located near metropolitan cities like Mumbai, Bengaluru and Hyderabad. Bijapur is a beautiful city situated in Karnataka and serves as a memorable getaway from Bangalore. The city is dotted with historical and architectural splendors that date back to the 11th century. The city was established by the **"Chalukya Dynasty"** and named it as **"Vijayapura"**. Thus, the city houses descendants of both **"Dravidian and Aryan"**. Apart from architectural splendors, the festivals in the city also make it a worth visiting travel destination in Karnataka. So, it is highly populated and an important tourist location and it is well connected through railways and roads. Located in Karnataka state, South India, Vijayapura is a beautiful city known for its magnificent architecture, historic monuments and heritage buildings. Vijayapura has a long history and is replete with different tourist attractions. Bijapur district, officially known as Vijayapura district, is a district in the state of Karnataka in India. The city of Vijayapura is the headquarters of the district, and is located 530 Km North – West of Bangalore. Bijapur is well known for the great monuments of historical importance built during the **"Adil Shahi Dynasty"**. Here was enacted some of the capture of the momentous incidents of history. It was here that **"Aurangzeb",** after the capture of the city, commanded the unfortunate king, **"Sikandar Adil Shah"** to appear before him in silver chains. The building though roofless is a popular spot as it is set in large well landscaped public garden.

The **"85 – Foot" (26 Meter)** tall statue of **"Lord Shiva"** installed by the **"T. K. Patil Banakatti Charitable Trust in Vijayapura at Shivapur on Sindagi Road"** is gradually developing as a pilgrimage place. As per record 1, 500 tonnes statue considered as the second biggest statue of **"Lord Shiva"** in the country was prepared by sculptors from Shimoga for more than 13 months and the civilian design was provided by Bangalore-based architects. The statue weighs around 1,500 tonnes. A small idol of Shivalinga is installed beneath the big statue. **"Shiva Charite"** will also be inscribed in Kannada on the inner walls of the temple to help the devotees learn the mythological stories related to **"Lord Shiva"**.

Traffic and Transportation System Characteristics

"Vijayapura" (विजयपुरा) – "Solapur" (सोलापुर) highway in Karnataka would be four – laned soon. The tender process for the said works has been completed and the contract has been allocated to a private firm for converting the two – lane road into a four – lane highway connecting two districts in Karnataka and Maharashtra. Karnataka, a state in South India has a well – developed transport system. Its capital city, Bengaluru is well – connected by air to domestic and international destinations and the **"Kempegowda International Airport" (KIA)** in the city is one of the busiest airports in India. The minister performed bhoomi puja for widening work of National Highway – 218 and the proposed bridge at **"Bennehalla on Hubballi – Vijayapura"** Road. Of the ₹ 925 Crore sanctioned, ₹ 625 Crore has been

sanctioned towards the development of roads and bridges. The works include four – laning of NH – 63 in Hubballi City limits, four – laning of NH – 63 in Kaghtagi town limits, concretization of NH – 4 – A from **"Ramanagar to Karnataka Border"** and construction of a small bridge near **"Dastikoppa Village"** on NH – 63. The remaining ₹ 300 Crore will go towards development of **"Kittur Rani Channamma Circle and Jubilee Circle in Dharwad"** to ease or effortless traffic congestion.

8. ENVIRONMENTAL CHECKLIST

RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST
ROADS AND HIGHWAYS

INSTRUCTIONS

(i) The project team as **"Environmental Expert/ Specialist"** completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the **"Ministry of Environment and Forest and Climate Change" (MoEF & CC)** for concern nodal/ zones/ regional officer or expert/ specialist.

(ii) Answer the questions assuming the **"Without Mitigation"** case. The purpose is to identify potential impacts on its environment and surrounding areas. Use the **"Remarks"** section to discuss any anticipated mitigation measures and **"Rapid Environmental Assessment Checklist" (REAC)/ "Initial Environmental Examination" (IEE) Report** is shown in **Table 13**.

Table 13: Rapid Environmental Assessment Checklist.

Country/ Project Title	**India: Maharashtra & Karnataka State Sub – Project: Initial Environmental Examination Report for: Solapur to Vijayapura, Road**		
Sector Division/ Section	**Road and Transport Government of India (GOI)**		
Screening Questions	**Yes**	**No**	**Remarks**
A. Project Site			
Is the project area adjacent to or within any of the following environmentally sensitive zones/ sites/ areas?		**X**	No environmentally sensitive zone/ site is located within the projected road;
Cultural Heritage Site;		**X**	No archaeologically protected monument or cultural heritage site/ zones is located within the road;
Protected Area;		**X**	No protected areas are located/ placed close to roads and nearby zones/ areas;
Wetland Area;		**X**	No protected or classified wet land is located close to roads and nearby surrounding areas;
Mangrove Cover/ Area;		**X**	Project road is not located in Coastal Areas;
Estuarine Locality/ Area;		**X**	No Estuarine is located in the Project Area;
Buffer Zone of Protected Area;		**X**	No such area is located in the Project Vicinity;
Special Area for Protecting Biodiversity;		**X**	No such area is located in the Project Vicinity;
B. Potential Environmental Impacts			
Encroachment on historical/ cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?		**X**	The area is no mountainous throughout the proposed alignment and there is no human settelment nor any historical/ cultural places. So there no human encroachment;
Encroachment of precious ecology (*e.g.*, Sensitive or protected areas)?		**X**	Attempts have been made to minimizing the cutting of trees while finalizing the road widening options, but we didn't found any sensitive or procted area in the projected area;
Alteration of surface water hydrology of waterways crossed by roads, resultingin increased		**X**	The proposed alignment is crossing only small natural drains. All drainage courses will be maintained to avoid alteration in surface water hydrology so that water courses are not affected.

sediment in streams affected by increased soil erosion at construction site?			The temporary soil stockpiles will be designed so that runoff will not induce sedimentation of waterways. Silt fencing during construction will be provided. **To mitigate this problem the environmental management plan is already in corporated with their mitigation method;**
Deterioration of surface water quality due to silt runoff and sanitary wastes from worker – based camps and chemicals used in construction?		**X**	Adequate sanitary facilities including **"Soak Pits Treatment (SPT)",** facilities will be provided at construction camps, which will be set-up away from habitat and water bodies. No harmful ingredients are likely to be used in the construction activities. Surface water quality is not impacted due to construction. Measures like embankment slope stabilization, **"Reinforced Cement Concrete (RCC)",** retaining walls are proposed to prevent siltation of ponds located next to the road due to surface runoff;
Increased local/ regional areas air pollution due to rock crushing, cutting and filling works and chemicals from asphalt processing?	✓		Regional/ local/ on site **"Air Pollution Level (APL)",** will be high during construction period due to structure/ road construction work; vehicle movementsand asphalt processings etc. The **A**sphalt **M**ixing **P**lant **(AMP) OR H**ot **M**ix **P**lant **(HMP)** will be located away from habitat areas adequetly high stack for effective dispersion of likely Dust Emissions. Separation measures like spraying of water on unpaved vehicle movement areas are proposed to minimize the dust generation. To mitigate this problem the **E**nvironmental **M**anagement **P**lan**s (EMPs)**are already in corporated with their mitigation methods and measures;
Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological and radiological hazards during project construction and operation?	✓		Workers may get exposed to dust and noise during construction activities. However, the exposure levels are likely to be short and insignificant. Workers will be provided requisite **Personal Protective Equipments (PPEs)** to minimize such exposure and associated harmful occupational health effects. To mitigate this problem the **E**nvironmental **M**anagement **P**lan is already in corporated with their mitigation methods;
Noise and vibration activities due to blasting and other civil works on site construction of roads/ bridges and valuable residential and commercial structures establishments?		**X**	No blasting is involved. No significant noise generation is expected during construction activities except normal construction equipment operational noise. These noise levels will be impulsive in nature and its impact will be confined within few Meters of either side of the road. All stationary noise making sources equipment like DG set, compressors will be installed with acoustic enclosures/ mufflers/ silencers to reduce noise level on site if specified for the region or state.

9. STATUTORY CLEARANCES REQUIRED

The **"Environmental Impact Assessment/ Statement" (EIA/ S)** process adopted will follow regulations of "**Government of India" (GOI)** and "**Maharashtra and Karnataka Government"**. As per current policy since the project is more not more than 100 Km in length so the MOEF notification will not apply and need no **"Environmental Impact Assessment/ Statement" (EIA/ S)** Clearances. **Table 14** presents clearances required under the proposed project for roads network area.

Table 14: Required Statutory (EIA/ S) Clearances.

Sr. No.	Act / Rules	Purpose	Applicable Yes/ No	Authority
1.	*Environment Protection Act (EPA) – 1986.*	*To protect and improve overall environment.*	*No*	**MOEF; GOI; DOE; SPCB**
2.	*Environmental Impact Assessment Notification (EIAN) 14th September, 2006.*	*To provide environmental clearance to new development activities following environmental impact assessment.*	*No*	**MOEF; (EIAN)**
3.	*Notification for use of Fly Ash (NFA).*	*Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal.*	*Yes*	**NFA**
4.	*Coastal Regulation Zone (CRZ) Notification 1991*	*Protection of fragile coastal belt.*	*No*	**CRZN**

	(2002).			
5.	*National Environment Appellate Authority Act, (NEAA) 1997.*	*Address grievances regarding the process of Statutory Environmental Clearance (SEC).*	*No*	**NEAA; SEC**
6.	*The Land Acquisition Act (LAA) – NH – 1956.*	*Set out rule for acquisition of land by government.*	*Yes*	**Revenue Department; LAA**
7.	*MOEF Circular on Marginal Land Acquisition and Bypasses 1999.*	*Defining "Marginal Land" Acquisition relating to the 1997 Notification (MLAN).*	*No*	**MOEF; MLAN**
8.	*The Forest (Conservation) Act – 1927; The Forest (Conservation) Act – 1980; Forest (Conversion) Rules – 1981.*	*To check deforestation by restricting conversion of forested areas into non – forested areas.*	*Yes*	**Forest Department; Government of Haryana (GOH)**
9.	*Wild Life Protection Act – 1972.*	*To protect wildlife through certain of National Parks and Sanctuaries.*	*No*	**CCF; Department of Forest; (GOH)**
10.	*Air (Prevention and Control of Pollution) Act – 1981.*	*To control air pollution by and Transport Controlling Emission of Air Department (TCEPA). Pollutants as per the prescribed standards.*	*Yes*	**GO UP; SPCB; TCEPA**
11.	*Water Prevention and Control of Pollution) Act – 1974.*	*To control water pollution by controlling discharge of pollutants as per the prescribed standards.*	*Yes*	**(GOH); SPCB**
12.	*Noise Pollution (Regulation and Control Act) 1990.*	*The standards for noise for day and night have been promulgated by the MOEF for various land uses.*	*Yes*	**MOEF; (GOH); SPCB**
13.	*Ancient Monuments and Archaeological Sites and Remains Act – 1958.*	*Conservation of cultural and historical remains found in India.*	*No*	**ASI; GOI**
14.	*Public Liability and Insurance Act (PLIA) – 1991.*	*Protection form hazardous materials and accidents.*	*Yes*	**PLIA**
15.	*Explosive Act – 1984.*	*Safe transportation, storage and use of explosive material.*	*Yes*	**Chief Controller of Explosives**
16.	*Minor Mineral and concession Rules (MMCR).*	*For opening new quarry.*	*Yes*	**District Collector; MMCR**
17.	*Central Motor Vehicle Act – 1988 and Central Motor Vehicle Rules (CMVR) – 1989.*	*To check vehicular air and noise pollution.*	*Yes*	**Motor Vehicle Department; CMVR**
18.	*National Forest Policy 1952; National Forest Policy (Revised) 1988 (NFP).*	*To maintain ecological stability through preservation and restoration of biological diversity.*	*Yes*	**Forest Department; GOI; and (GOH); NFP**
19.	*The Mining Act (MA) – 1989.*	*The mining act has been notified for safe and sound mining activity.*	*Yes*	**Department of Mining (DOM); MA**

Widening Proposal

The proposed widening has been carried out through considering social and environmental aspects of the project. Concentric widening has been proposed in built – up portion to save acquisition of road side established or installed residential and commercial structures. Likewise eccentric widening (LHS or RHS) has been proposed in open areas to save tree from the other side. In other words, only one side tree requires to be felled. Out of total **"Existing Length 110.542 Km"** length concentric widening is **"Proposed"** for about **"109.08 Km"** mainly in built – up locations shown in **Tables 15 and 16**.

Table 15: Pavement Crust Thickness for Widening and New Construction.

Description	Proposed	
Pavement Crust Thickness for Widening and New Construction	**Rigid Pavement: PQC** – 300 mm (M40); **DLC** – 150 mm (M10); **GSB** – 150 mm; **Sub – Grade** – 500 mm	**Overlay: BC** – 40/ 50 mm; **DBM** – 50 mm

Table 16: Chainage References of Village Community/ Town (Solapur to Vijayapura Road).

Sr. No.	Existing Chainage (Km) Starting Point	Design Chainage (Km) Ending Point	REMARKS Name of Village/ Town/ Bypass/ Area
	From	To	
A	*B*	*C*	*D*
1.	Solapur Chainage: *00+000 Km* E – 75.9064° N – 17.6599° Z – 606 Meter or 1,988 Feet	Vijayapura Chainage: *110+542 Km* E – 73.8110 ° N – 21.1298° Z – 631 Meter or 2,070 Feet	Solapur to Vijayapura Forest Land Area

Major Bridge/ Minor Bridge and Cross Drainage Structures (Culverts)

There are existing **"DESIGN PARAMETERS"** for Proposed Structures are shown in the **Table 17** respectively. The flowing design standards have been assumed adopted and approved as per **"Indian Roads Congress (IRC) Guidelines",** contained in IRC: 73, IRC: 86, IRC: 38 and IRC: SP: 23.

Table 17: Details of Existing DESIGN PARAMETERS for Proposed Structures.

Sr. No.	Item	Plain/ Rolling Terrain
1.	*Design Speed (Km/ Hr)*	80 Km/ Hr – 100 Km/ Hr, As per IRC: SP: 84 – 2014, IRC: 73 – 1980 & IRC: SP 23 – 1983
2.	*Right of Way*	Proposed ROW is 60 m (Excluding at Horti Town Proposed ROW is 50 m from Design Ch 72+000 to Design Ch 74+000)
3.	*Land Width (m) Open/ Built – up Area*	In Open Areas – 60 m and in Built – up Areas 60 m (Excluding at Horti Town Proposed ROW is 50 m from Design Ch 72+000 to Design Ch 74+000)
4.	*Width of Carriageway (m)*	7.00 m
5.	*Paved Shoulders*	1.50 to 2.00 m
6.	*Unpaved Shoulders*	1.50 to 2.00 m
7.	***Camber/ Cross Fall***	-------
(i)	*Carriageway and Paved Shoulders*	2.5%
(ii)	*Earthen Shoulders*	3.0%
8.	*Maximum Super Elevation*	7.0%
9.	*Minimum Radii of Horizontal Curves (m)*	400 m Ruling/ 250 m Absolute Minimum
10.	*Minimum Length of Vertical Curves (m)*	50 m for every Deflection Angle of 5°
11.	*Drains*	As per Design
12.	*Sight Distance*	As per IRC: SP: 84 – 2014, IRC: 73, IRC: 86, IRC: 38 and SP: 84 – 2009
13.	***Gradient***	-------

Sr. No.	Item	Plain/ Rolling Terrain
(i)	*Ruling Gradient*	**2.5% to 5.0%**
(ii)	*Limiting Gradient*	**3.3% to 6.0%**
(iii)	*Exceptional Gradient*	**6.7% to 7.0%**
14.	*Vertical Clearance for Power/ Telecommunication Lines* *Low Voltage up to 110 V* *Electric Power Line up to 650 V* *Electric Power Line more than 650 V*	 **5.5 m** **6.0 m** **6.5 m**

10. ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROJECT

The environmental impact assessment has been carried out and which is based on status of the environment, and impact of proposed four lanning roads/ bridges based on these findings of the **"Environmental Management Plans" (EMPs)** have been prepared for the implementation in the project. Following section discusses status of the environment, and its complementary impact assessment work plan assigned to **"Environmental Management Plans" (EMPs)** required for the project development/ implementation system and process.

11. BASELINE ENVIRONMENTAL INDEX AND STATUS

Climate

The climate of the state has been roughly divided into the tropical, temperature and alpine zones. For most of the period in a year, the climate is cold and humid as rainfall occurs in each month. The area experiences a heavy rainfall due to its proximity to the Bay of Bengal. The rainfall in North district is comparatively less than of the other districts. The general trend of decrease in temperature with increase in altitude holds good everywhere. Pre — monsoon rain occurs in April – May and monsoon (South — West) operates normally from the month of May and continues up to early October. The climate of project areas is on the whole dry, hot in summer and cold in winter. The year may be divided into five seasons in every state/ region of concern. Weather and Climate Index has a great influence on human activities and it affects on the life style of the population and reduces efficiency of work. Man has made great progress in the field of **"Artificial Intelligence"** as well as in the field of irrigation, but the food production is still controlled by the climatic condition of any region as a whole around the world. The cold season from March to December is followed by hot season, which lasts till the onset of the North – Westmonsoon. The monsoon withdraws by 15th September and is followed by the Post — Monsoon or the **"Transition Period" (TP)**. Thunderstorms, in association with Pre — Monsoon and Monsoon rains occur mostly during June to September. During the winter also, a few thunderstorms occur in association with the Western Disturbances. A few thunderstorms may be accompanied by hail and hail storms. Occasional dust storm occurs during the hot season and contributes in increasing the level of **"Suspended Particulate Matter" (SPM)** in the upper atmospheric region, which causes increases of CO_2 level and **"Global Warming"** and **"Green House Effect" (GHE)**.

Sustainable Design and Life Cycle Management: More than any other human endeavour the built environment has direct, complex, and long lasting impact on the **"EARTH"** and its **"BIOSPHERE"**. Around one – tenth of global economy is devoted to **"CIVIL — CONSTRUCTION"** and about one half of world's major resources are consumed by **"CONSTRUCTION"** and related industries. The **"Three Columns of Sustainability Development — Environmental, Economic and Social Parameters"** are shown in **Figure 8**.

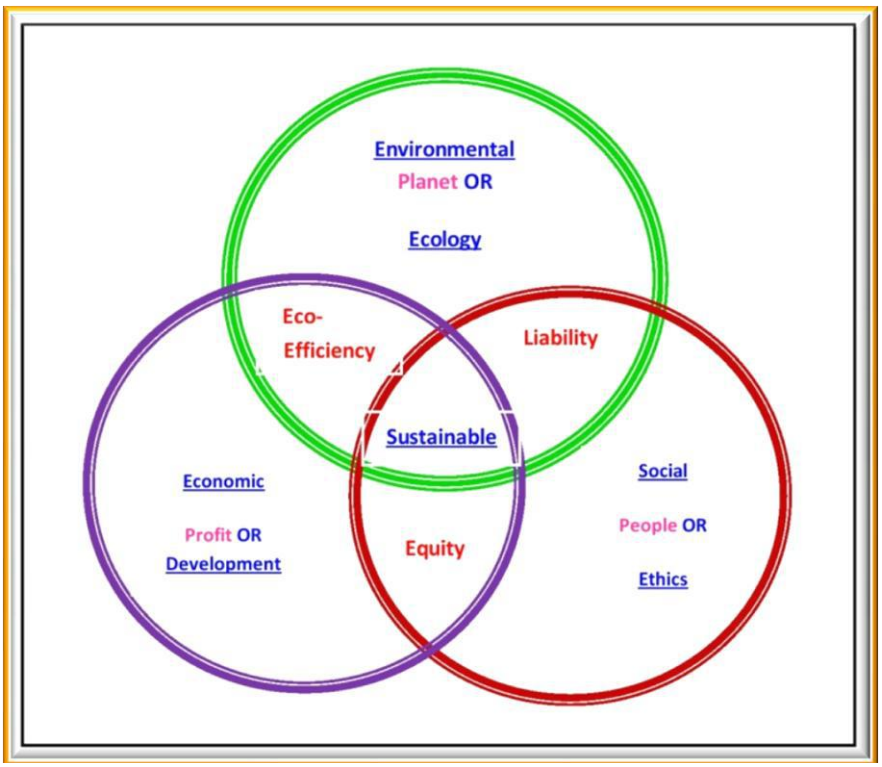


Figure 8: Three Columns of Sustainability Development – Environmental, Economic and Social.

While the situation is not so acute in India at present, increasing urbanization may push us in that direction. These statistics underline the importance of changing the **"CIVIL CONSTRUCTION PRACTICES" (CCP)**. To address these challenges, there is a need to develop effective approaches for life cycle design and management of **"CONSTRUCTIONS"** that will ensure their sustainability in terms of improved physical performance, cost effectiveness, and environmental compatibility. These optimized designs and management systems should provide the owners with the solutions that achieve an optimal balance between three relevant and competing criteria, namely, ***(i)* "Engineering Performance" (*e.g.*, Safety, Serviceability and Durability), *(ii)* "Economic Performance" (Minimum Life Cycle Costs and Minimum User Costs) and *(iii)* "Environmental Performance" (Minimum Greenhouse Gas Emissions, Reduced Materials Consumption, Energy Efficiency, etc.)**.

12. AIR, WATER AND NOISE LEVEL

Air Quality

The results analysis of air samplesis presented in general for all monitoring stations the PM_{10} values were monitored in the range 110 — 112 µg/ m^3. While comparing with the **"National Ambient Air Quality" (NAAQ)** Standard of 100 µg/ m^3 by the **"Central Pollution Control Board" (CPCB)** all the monitored PM_{10} values were found to be near the limit (Slightly Higher). This is because of high vehicular location and dryness of the areas. $PM_{2.5}$ values were ranging from 35 — 38 µg/ m^3. While comparing with the NAAQ Standard of 60 µg/ m^3 and the monitored $PM_{2.5}$ values were found to be well within the limit. Similarly monitored values for SO_X, NO_2 and CO are also found within the limits are as shown in the **Table 18**.

Table 18: AAQ Monitoring Result of Project Road.

Sr. No.	Parameters	Unit	SOLAPUR Chainage 01+070	VIJAYAPURA Chainage 109+630	Prescribed Limits (µg/m³)	Protocol
Date of AAQ Monitoring			30.09.2019	01.10.2019		
A – 01	PM_{10}		*98*	**91**	*100*	**IS: 5182 (Part – 23), 2006.**
A – 02	$PM_{2.5}$		*35*	**38**	*60*	**CPCB Guidelines.**
A – 03	SO_2		*17*	**17**	*80*	**IS: 5182 (Part – II), 2001.**
A – 04	NO_X		*19*	**25**	*80*	**IS: 5182 (Part – VI), 2007.**
A – 05	CO		*840*	**1,200**	*2,000*	**IS: 5182 (Part – 10).**

The maximum SO_2 and NO_X levels monitored were 23.41 µg/ m³ and 35.15 µg/ m³ respectively. While comparing with the NAAQ Standard (80 µg/ m³), the monitoring results were found to be well within the limits. The maximum CO concentration monitored was 1.8 µg/ m³ and most of the CO levels were monitored below the detectable limit of 2 µg/ m³. While comparing the NAAQ Standard, the monitored CO levels were found to be well within the limit. All Hydro — Carbon (HC) values were found to be below the detectable limit of 65 µg/ m³. All Particulate Lead values were found to be below the detectable limit of 0.01 µg/ m³ and within the NAAQ Standard of 1.0 µg/ m³ (24 — Hourly).

Noise Levels

Ambient Noise Standards

Ambient noise standards were established as per the CPCB/ MOEF Gazette Notification dated 26th December, 1989. It is based on the **"A"** weighted equivalent noise level, Leq are given in the **Table 19**.

Table 19: National Ambient Noise Standards.

Area Code	Category of Zones	Day* Limits of Leq {dB(A)}	Night* Limits of Leq {dB (A)}
A	**Industrial**	*75*	**70**
B	**Commercial**	*65*	**55**
C	**Residential**	*55*	**45**
D	**Silence Zone****	*50*	**40**

Sources**: GOI; CPCB, 1989.

Water Quality

Water Quality Standard

The rivers, canal, lakes and ponds located along the proposed project road are a source of water for the local, regional inhabitants, for domestic as well as agricultural uses. An analysis of their present status and the quality of the water has been done through and with the help of state/ local/ regional agencies. They have been classified as per the CPCB standard classification norms for best optimum use of data and report used as shown in the **Table 20**.

Table 20: CPCB Best Use Classification for Surface Water Bodies.

Sr. No.	ParaMeters	Class – A	Class – B	Class – C	Class – D	Class – E
1.	pH	6.5 – 8.5	6.5 – 8.5	6.0 – 9.0	6.5 – 8.5	6.5 – 8.5
2.	Dissolved Oxygen (as O_2), Mg/ l, Minimum.	6	5	4	4	-------
3.	BOD, 5 Days at 20°C, Maximum.	2	3	3	-------	-------
4.	Total Coli – form Organism, MPN/ 100 ML, Maximum.	50	500	5,000	-------	-------
5.	Free Ammonia (as N), Mg/ l, Maximum.	-------	-------	-------	1.2	-------
6.	Electrical Conductivity, Mhos/ Cm, Maximum.	-------	-------	-------	-------	2,250
7.	Sodium Absorption Ratio, Maximum.	-------	-------	-------	-------	26
8.	Boron (as B), Mg/ l, Maximum.	-------	-------	-------	-------	2

Class A	*: Drinking Water Source without Conventional Treatment but after Disinfection;*
Class B	*: Outdoor Bathing (Organized);*
Class C	*: Drinking Water Source after Conventional Treatment and after Disinfections;*
Class D	*: Propagation of Wild – Life and Fisheries;*
Class E	*: Irrigation, Industrial Cooling, and Controlled Waste Disposal;*
Below E*: Not Meeting A, B, C, D and E Criteria.*	

Environmental Impacts

Impact on Topography

During the construction of the proposed project, the topography will change due to excavation of borrow areas, fills for project road, especially construction of project related cross drainage structures and intersections etc. Provision of construction camp/ yard for material handling will also alter the existing topography. There will be change in topography at re – alignments as these re – alignments have been proposed through agriculture farming fields. The change in topography will also be due to the probable induced developments of the project. With adequate planning, all topographical impacts or signature could be made to enhance the local aesthetics. Similarly, it will invite benefits in the form of land leveling and tree plantations in the vicinity/ region/ area/ site of the projected road.

Impact on Climate

The widening and strengthening of project is not going to have impact on micro as well and macro – climate of the region on the site or area/ region.

Impact on Air Quality

There will be rise in **"Suspended Particulate Matter" (SPM)** levels due to the construction activities, because the project runs entirely in plain areas. Since the emission will be fugitive in nature and it is difficult to quantify the SPM standards even expected to be violated, as the background values are not alarming rate at many places. **"Affected Persons" (APs)** should be completely well – versed even; if it is exceeded then it will be for very short time period. There will be some increase in levels of gaseous pollutant also, which are highly harmful to all or whole ecosystem surviving/ sustaining on this **"Precious Planet Earth"**. The impact on ambient air quality has been assessed using **"AERMOD – Lakes Environmental Software"** and **"CALINE4 – A Dispersion Model for Predicting Air Pollution Concentrations near Roadways or Road Network"**. The air quality predictions have been done for the horizon years 2010, 2020 and 2030. The results of various or numerous types of mathematical modelling applications shows that CO, SO_2, NO_X, HC, **"Respirable Particulate Matter" (RPM)** stuff concentration will remain within the limits of CPCB tills the end of project life. The SPM levels are well within limit at present also. But significant contribution of SPM is expected from vehicular emissions; transportation; industrial as well as domestic activities in future as given in **Figure 9**.

"Affected Persons" (APs) should be fully informed of their rights and responsibilities from the very beginning of the process to achieve transparency and understanding between the APs and the project implementers.

Primary stakeholders include the APs, the beneficiaries of the project, the host population, the **"Project Partner Agencies" (PPAs)** such as **"Urban Development Authority" (UDA),** and more importantly the project proponent and the **"Ministry of Defence and Urban Development" (MOD and UD),** Ministry of Finance and Ministry of Land and Land Development. The secondary stakeholders are those who have an interest in the project such as the National Government, the political authority, policy – makers, advocacy groups, NGOs and other private and public sectors which have indirect involvements with the project.

Therefore, PPA need to be assisted more closely in explaining and guiding them in resolving the issues in a more productive manner more favourable to the APs, as per involuntary resettlement principles and guidelines. This nature of consultation with the project APs and their profiling are mandatory as per the requirements of preparing the **"Resettlement Action Plans" (RAP),** which needs to be carried out as socio – economic and census surveys as an integral part of detailed designing.

Implementation Stage	***Involve APs in decision – making committees;*** ***Involve APs in monitoring and evaluation;*** ***Establish "Grievance Redress Committee" (GRC) procedures, representatives of APs;*** ***Arrange APs inputs to entitlements, income restoration and resettlement options;*** ***Consultations with APs on alternatives;*** ***Involve APs in assessing project impacts.***

Figure 9: Increase in Levels of Pollutant – Emissions – Impact on Future Generated Aspects/ Prospects from Various Sources.

Impact on Noise Levels

The impact of noise levels from the proposed project on the neighbouring communities is addressed by carrying out Noise Modelling using **"FHWA Model"** developed by **"Federal High Way Administration" (FHWA)**. It has been concluded after Mathematical Modelling that both day time and night time equivalent noise levels are within the permissible limits as right from start of project life. Noise sensitive receptors have been identified along the projected road site/ area. The noise sensitive receptors include school, hospitals, colleges; old orphan people's sensitive house zones (Ashrams) and other nearby housing transportation activities along the road side etc. The predicted levels indicate that the noise levels in future years will not exceed permissible limits right from start of project life as given in **Figure 10**. Hence there is no need to protect these noise sensitive receptors.

Figure 10: Noise Levels Impact Must Not Exceed the Permissible Limits in Sensitive Zones along Road Side.

Impact on Water Resources and Quality

The construction and operation of the proposed project roads will not have any major impacts on the surface water and the ground water quality in the area projected site/ region. Contamination to water bodies may results due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and **"Asphalt Crusher Plants" (ACP) or "Hot Mixing Plants" (HMP)**. This will be more prominent in case of locations where the project road crosses water streams; major canals distributaries, minor/ major ponds and minor/ major small lakes etc. Mitigatory measures have been planned; generated; initialized and finalized to avoid contamination of these water bodies are given in **Figure 11**.

Figure 11: Mitigatory Measures Plans Generated; Initialized and Finalized to Avoid Contamination Impact on Water Resources and Quality.

Impact on Ecological Resources and Soil Quality

There is no wildlife sanctuary in the close vicinity of the project road. The study area passes primarily through agricultural land in plain areas. There will be temporary impact on terrestrial ecology, as trees will be cut. But after construction no impact is anticipated as compensatory a forestation is planned. There are no endangered species or rare species of flora and fauna in the projected area. There is no major loss of vegetation; hence adverse impact in terms of availability of nesting sites for the bird doesn't arise in the region. Furthermore, there is no sensitive Environmental/ Natural/ Ecological area near the existing projected roads, so the impact will be insignificant or inconsequential. Brief potential impacts are shown in **Figure 12** and are presented in matrix below in the **Table 21**.

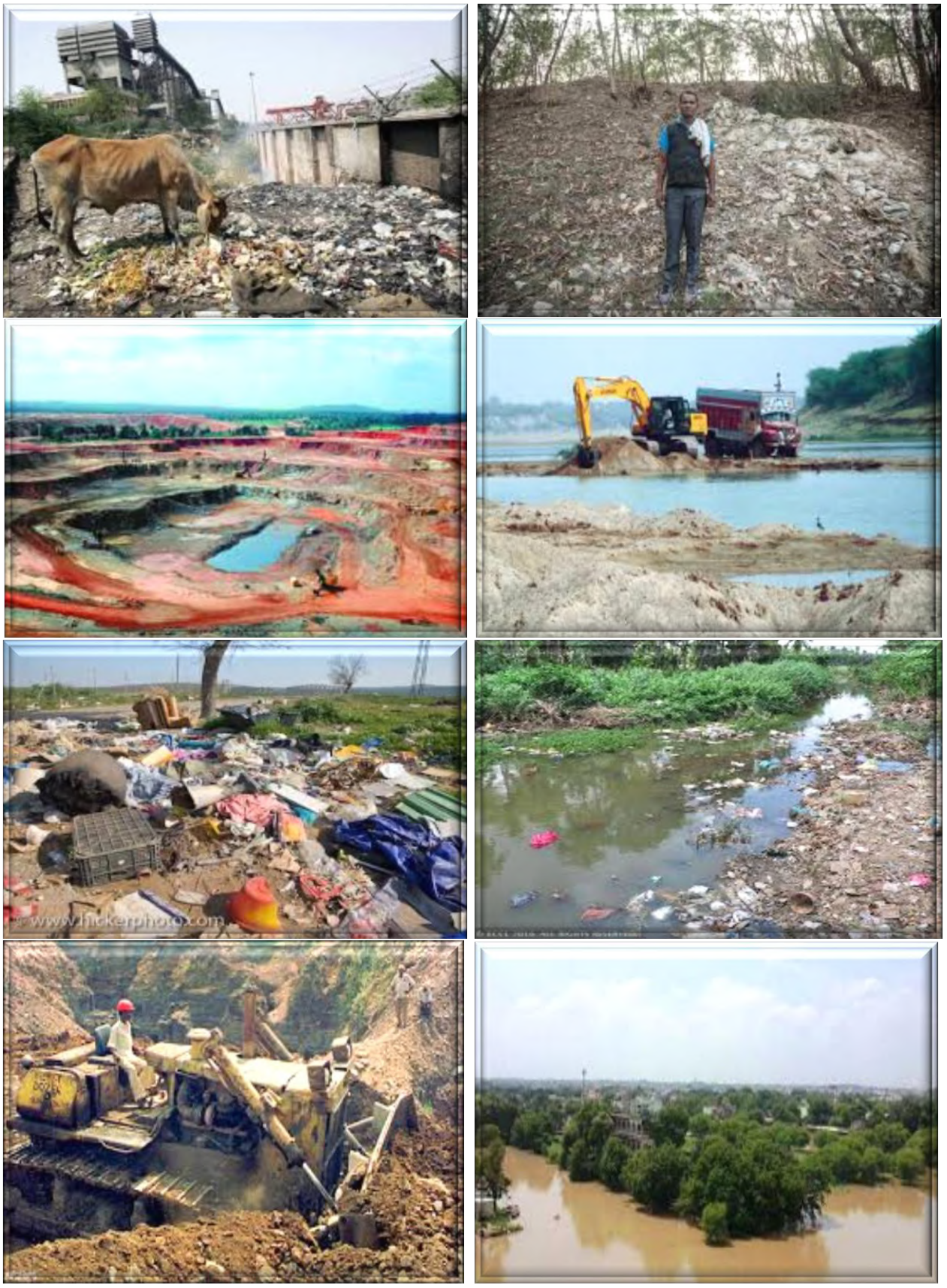


Figure 12: Plan Mitigatory Measures to Avoid Soil Contamination Impact on Agricultural Land and Other Sensitive Zones in Environmental/ Natural/ Ecological Vicinity/ Area/ Site.

Table 21: Potential Environmental Impacts.

Project Activity	Pre – Construction	Construction Phase						Operation Phase
Component Affected	**Land Acquisition**	**Site Clearance**	**Earth Moving (Borrow Pits)**	**Contractor Camps**	**Quarries Areas**	**Construction of Highway**	**Asphalt Crusher Plants**	**Operation**
Soil	*Loss of productive agricultural land*	*Loss of crops, and increase in soil erosion*	*Loss of top soil and erosion*	-------	*Increase in erosion, siltation and slope instability*	*Soil pollution*	*Pollution due to spills*	**Soil contamination due to surface runoff**
Ground Water	-------	-------	-------	*Water Extraction for drinking*	-------	*Exploitation of water for construction*	-------	**Maintenance of trees/ shrubs**
Surface Water	-------	*Change in water quality and siltation*	*Water logging and mosquito breeding*	*Water pollution from sanitary and other wastes*	*Water logging problems*	*Change in water quality*	*Water pollution due to spill into water bodies*	**Degradation due tospill – oversand roadrun off**
Drainage	-------	*Change in natural drainage pattern*	*Change in drainage pattern*	-------	*Modification in natural drainage*	*Interference with natural drainage, water logging*	-------	**Cleaning and maintenance**
Air Quality	-------	*Increase in air pollution*	*Particulate matter pollution*	*Atmospheric pollutiondue to fuelburning*	*Dust pollution*	*Dust pollution*	*SPM, SO_2*	**Increase in SPM, NO_X, CO**
Noise Quality	-------	*Reduced buffering of noise*	*Increase in noise levels due to machinery*	-------	*Vibration from blasting operations*	*Vibrators, concrete batching plants noise etc.*	*Increase in noise*	**Increase in noise levels due to increased traffic**
Forest	-------	*Habitat loss, and vegetation*	*Loss of forest*	*Encroachment into forest areas*	*Loss of habitat/ cover*	*Loss of forest*	-------	-------
Trees	*Tree cutting clearance*	*Loss of trees*	*Loss of trees*	*Cutting of trees*	*Tree cutting*	*Loss of trees*	-------	-------
Temples/ Mosques	*Clearance*	*Removal/ rehabilitation*	-------	-------	-------	-------	-------	-------

Impact on Drainage Pattern

The proposed widening and strengthening will not alter drainage pattern of the area as adequate cross drainage structures have been planned along the new alignments and existing culverts along the project road are planned for **"Rehabilitation and Resettlement" (R and R)**. Construction of bridges across water streams may result in siltation of water body, which can affect aquatic life and fauna in the

region/ area or proposed site. Proper mitigatory measures have been recommended in **"Environmental Management Plans" (EMPs)**.

Impact on Human Use Values

Impact on human use values are including **"Precious Planet Earth's",** common property resources such as temples, mosques, wells, hand pumps, stream channels, stream fountains and tube well etc. Impact on these has been minimized through proper planning of the alignments along roadside/ location site. The environmental impacts have been summarized as in **Figures 13 (a) to (b)** and **Table 16** given below.

Mitigation Avoidance and Enhancement Measures

The mitigation measures have been planned for identified adverse environmental impacts alignment enhancement design phase is being applied along roadside to reduce tree cuttings as compensatory plantation process or relevance. These mitigation measures have been identified as **"Environmental Management Plans" (EMPs)** during **"Planning, Construction and Operation Phase"**.

Design Phase

Figure 13 (a): Mitigation Enhancement as per Alignment Design Phase to Reduce Tree Cutting and Compensatory Plantation Relevance.

Anticipated; Recommended and Refined Enhancement Measures of Road Design Phase for ZERO Pollution Level... !!!

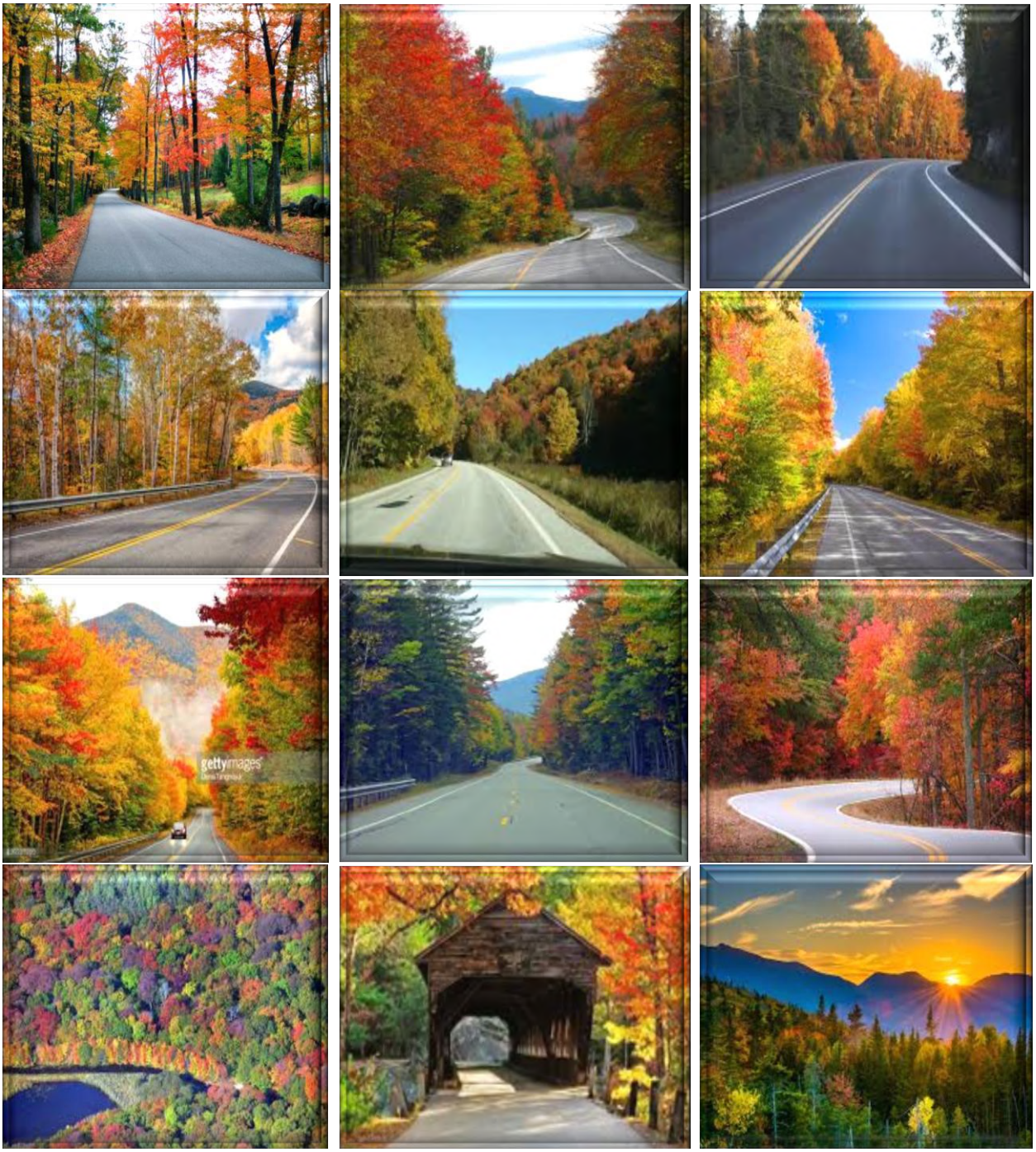


Figure 13 (b): Recommended Refined Enhancement Measures of Road Design Phase as per Alignment to Reduce Tree Cutting and Compensatory Plantation Relevance for ZERO Pollution Level.

Impacts during design phase is limited to removal of trees, acquisition of land and structures, relocation of water ways, water parks, water bodies, water locations, water streams or channels identification and management of borrow pits are as mentioned in **Table 22**.

Table 22: Impacts during Design Phase.

Impacts	Mitigation Measures
Land Acquisition	*Alignment design to minimize the land acquisition whenever applicable;*
Major Displacement	*Bypasses and detours to be considered preciously;*
Removal of Trees	*Alignment design to reduce the number, widening on the side of the road where less trees are required to be cut. Compensatory plantation to be planned;*
Impact on Public Utilities *e.g.*, Community Wells etc.	*Alignment design to be considered. In case of removal alternate arrangement to be done before;*
Impact on Cultural Sites	*Alignment design to be considered. Public consultation may be needed if impact cannot be avoided;*
Relocation of Waterways	*Hydrology to be considered. Public consultation will be needed, wherever applicable;*
Access Restriction	*Required alternatives, underpasses, proper signposts for people should be included in design all types of roads constructions;*
Congestion in Settlement Areas	*Service road to be provided everywhere all over the road network;*
Borrow Pits	*Locations to be selected considering minimum loss of productive land and redevelopment and resettlement;*
Environmental Specifications for Contractors	*Environmental qualifications specification should be included in pre – qualification packages for the contractors and structure designers.*

Construction Phase

Environmental management during construction phase is more crucial, because major impacts during construction like earthworks road network, movement of heavy machineries etc. causes lot of disturbances and management becomes essential at this stage during construction work. The construction workers camp will be located at least 500 Meters away from habitations. The construction yard, **"Hot Mix Plants" (HMPs)** and crushers like **"Asphalt Crusher Plants" (ACP)** etc. will be located at 500 Meters away from habitations and in downwind directions. The minimum distance of these will be kept 3.0 Km. from reserve forest areas. Adequate cross drainage structures have been planned to maintain proper cross drainage. ***"In order to compensate negative impacts on floral species due to cutting of trees the project plans compensatory plantation in the ratio of 1: 3 i.e., for everyone has to be applied... if one tree is cut...!!! Then three or more trees will be planted".*** The acquisition of forest area will be minimal and will be compensated through compensatory afforestation. The noise barriers have been planned closed to educational institute so that post project noise levels are within the specified limits. The project will take an opportunity to provide **"Environmental Enhancement Measures" (EEM)** to improve aesthetic activities in the projected area. The planned **"Environmental Enhancement Measures"** include ponds enhancement, plantation in median and in available clear space in **"Right of Way" (ROW)**, seating arrangements around trees must be installed or placed in the specific region. The pond **"Enhancement Measures" (EM)** will include such as stepped access; washing platforms and

seating arrangements ought to be applied etc. Some of ditches will be filled up due to embankment construction in the **"Right of Way" (ROW)**. In order to avoid contamination of water bodies during construction sedimentation chambers, oils and grease separators, oil interceptors at storage areas and at construction yard have been planned. The bill of quantities for mitigation and enhancement measures has been given in respective **"Environmental Management Plans" (EMPs)** of construction packages. **Table 23** below summarizes impacts and its **"Environmental Management Plan"** during **"Construction Period" (CP)**.

Table 23: Environmental Management Plan during Construction Period.

Impacts	Mitigation Measures
Soil Erosion	*Proper planning for slope stabilization, topsoil storage, plantation and turf on slopes;*
Loss of Topsoil	*Arable lands will be avoided for earth borrowing network. If needed, topsoil will be separated and refilled after excavation on operational site/ region/ area;*
Borrowing of Fill Materials	*Excavation from pre – selected locations. After excavation the borrow pits will be dressed to match with the surroundings. In specificcases borrow pits can be excavated in consultation with localpeople to use those pits as water harvesting point locations in particular areas/ sites;*
Disposal of Construction Waste	*No haphazard dumping of construction waste. Only pre – selected location maintaining local environmental regulations activities/ performance will be used for operational site;*
Disposal of Human Waste by Construction Workers	*Specific landfill sites should be identified to manage solid waste generated from habitation of construction workers on operational site/ area/ specified region;*
Generation of Dust	*Water will be sprayed during construction phase, in earth handling sites, asphalt mixing or crushing sites and other excavation areas for suppression of dust on operational site;* *In case fly ash is used, dust emission during its unloading, storage at open place and handling for road construction should be suppressed by water sprinkling at regular interval and operation with space and time;* *Dust emission from piles of excavated material should also be controlled by spraying water on the piles located areas/ sites/ regions;* *Special care should be taken when working near schools and medical facilities and other sensitive zones.*

Environmental issues change during operation phase and its mitigation plans are also related with vehicular movement, road safety and management of ecological as well as natural/ environmental/ ordinary issues. Environmental aspects are thus more or less related to vehicular emission; domestic; industrial or anthropogenic activities in the surrounding areas. The mitigation measures for different environmental aspects are discussed in **Table 24** below.

Table 24: Environmental Management during Operation Phase.

Impacts	Mitigation Measures
Dust	*Bad road maintenance of road gives high rise to dust pollution. Road Surface will be maintained properly and constantly;*
Gaseous Pollution	*All vehicles should be checked for **"Pollution Under Control (PUC)"**, certificates and occasional spot testing of emission from vehicles will be carried out in specified regions;*
Noise	*Noise level for different automobiles has been prescribed in Environment (Protection) Rules, 1986. Signs will be posted to restrict blowing of horns with high tons in front of highly sensitive locations or zones;*
Surface Runoff	*Surface runoff from the road will not be disposed directly in the water – bodies or surfaces used by people for bathing and washings purposes etc. It should also not be disposed directly in to any watercourse with good water quality;*
Wild Life	*There should be speed restrictions through specific forest area in the night and day time to prevent accident with wild animals. There will be proper signs and indications for the drivers to inform about these activities happening in the region/ area or site;*
Flora	*Tree plantations will be monitored continuously on regularly basis;*
Safety	*Safety signs and signals should be kept always clean and updated on regular basis;*
Public Amenities	*Bus stops, underpasses etc. should be kept in order for specified zones on the site/ region or area.*

Waste Water and Solid Treatment Process

Current treatment strategies are directed towards reducing the amount of solid waste that needs to be land filled, as well as recovering and utilizing the materials present in the discarded wastes as a resource to the largest possible extent. Different methods are used for treatment of solid as well as waste water and the choice of proper method depends upon refuse characteristics, land area available and **"Disposal of Human Waste by Construction Workers"** with disposal cost as they are given below in pyrolysis process as shown in the **Figure 14**:

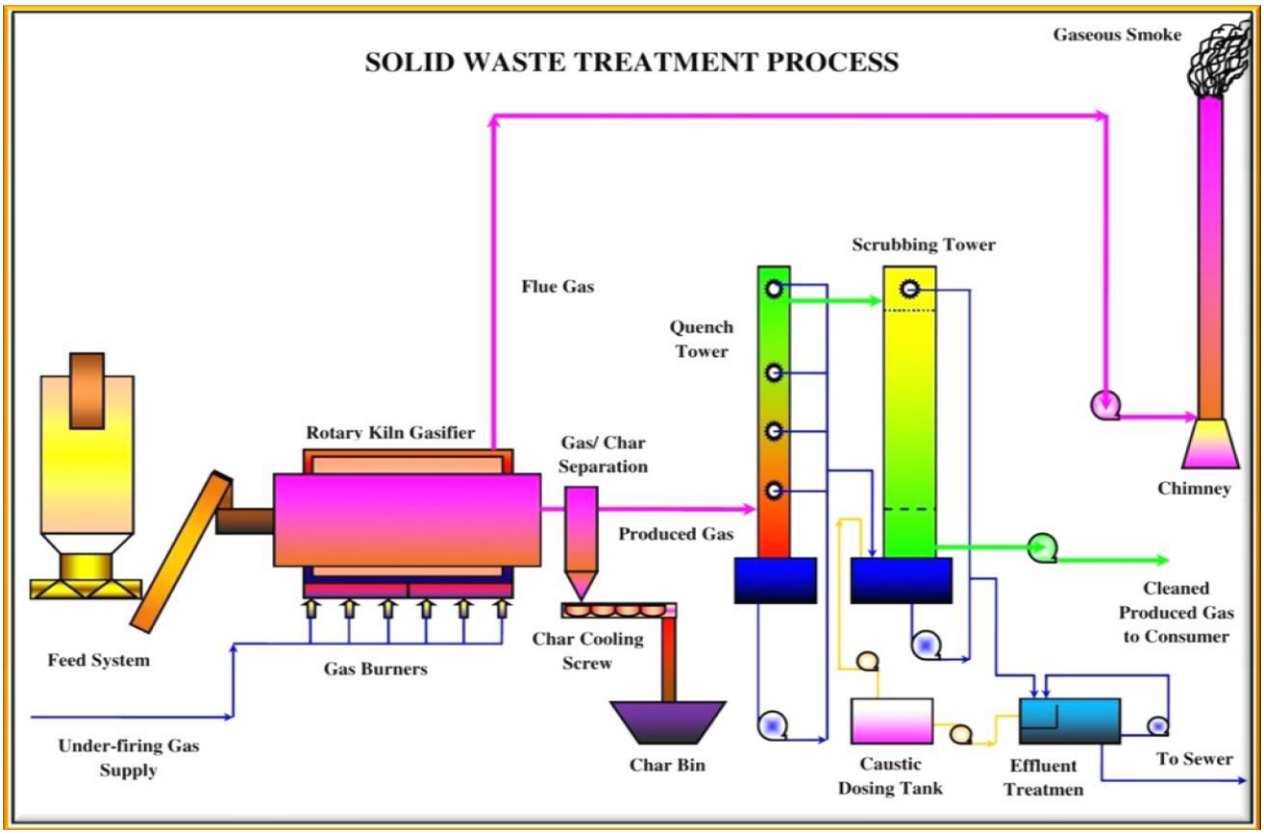


Figure 14: Process of Pyrolysis in Solid and Waste Water Treatment.

Pyrolysis: Pyrolysis is defined as thermal degradation of waste in terms of may be water or solid in the absence of air to produce char, pyrolysis oil and syngas, *e.g.*, the conversion of wood to charcoal also it is defined as destructive distillation of waste in the absence of oxygen. External source of heat is employed in this process. Because most organic substances are thermally unstable they can upon heating in an oxygen – free atmosphere be split through a combination of thermal cracking and condensation reactions into gaseous, liquid and solid fraction.

- *Incineration process;*
- *Compaction process;*
- *Pyrolysis process;*
- *Gasification process;*
- *Composting process.*

Solid Waste Handling Practice

Proper method should be adopted for management of solid waste disposal in a soil. Industrial wastes can be treated physically, chemically and biologically until they are less hazardous. Acidic and alkaline wastes should be first neutralized; the insoluble material, if biodegradable should be allowed to degrade under controlled conditions before being disposed off into the soil. As a last resort, new areas for storage of hazardous waste should be investigated such as deep well injection and more secure landfills. Burying the waste in locations situated away from residential areas is the simplest and most widely used technique of solid waste management.

Environmental and aesthetic considerations must be taken into contemplation before selecting the dumping site's soil condition and quality. Incineration of other wastes is expensive and leaves a huge residue and adds to air, water and soil as major pollutant in terms of residue as well. ***"Pyrolysis Practice or Technique"*** is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen as Solid Waste Handling Pyrolysis Technique shown **Figure 15**. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels. Pyrolysis of carbonaceous wastes like firewood, coconut, palm waste, corn combs, wheat pod, cashew shell, rice husk, paddy straw, barley pod, maize husk and saw dust, yields charcoal along with products like tar, methyl alcohol, acetic acid, and acetone and fuel gases.

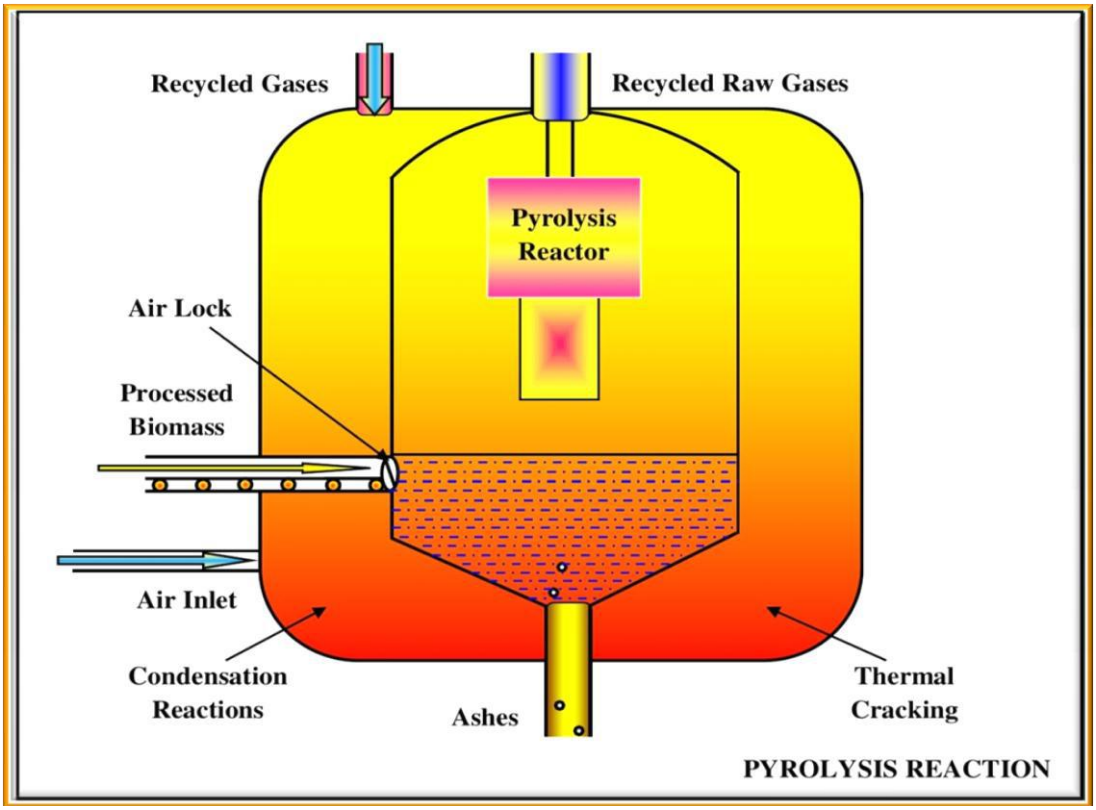


Figure 15: Solid Waste Handling Pyrolysis Technique.

Environment Baseline: Environmental, ecological and societal profile of the study region/ vicinity of project location are based on secondary data of Physiographic, Topology, Climate, Water Quality, Biological outline of town. The study has to be incorporated regarding ***"Sewage Treatment Plant" (STP)*** both in terms of theoretically and technically applicability for the specific region. The working model of Sewage Treatment Plant or principal subject matter has to be applied in the town so that it must play significant role for the people and its cultural civilization of the society as shown in the **Figure 16**. The flora and fauna recognized in the study spot are commonly found and not precise to the province due to the deficiency of forest in the study zone.

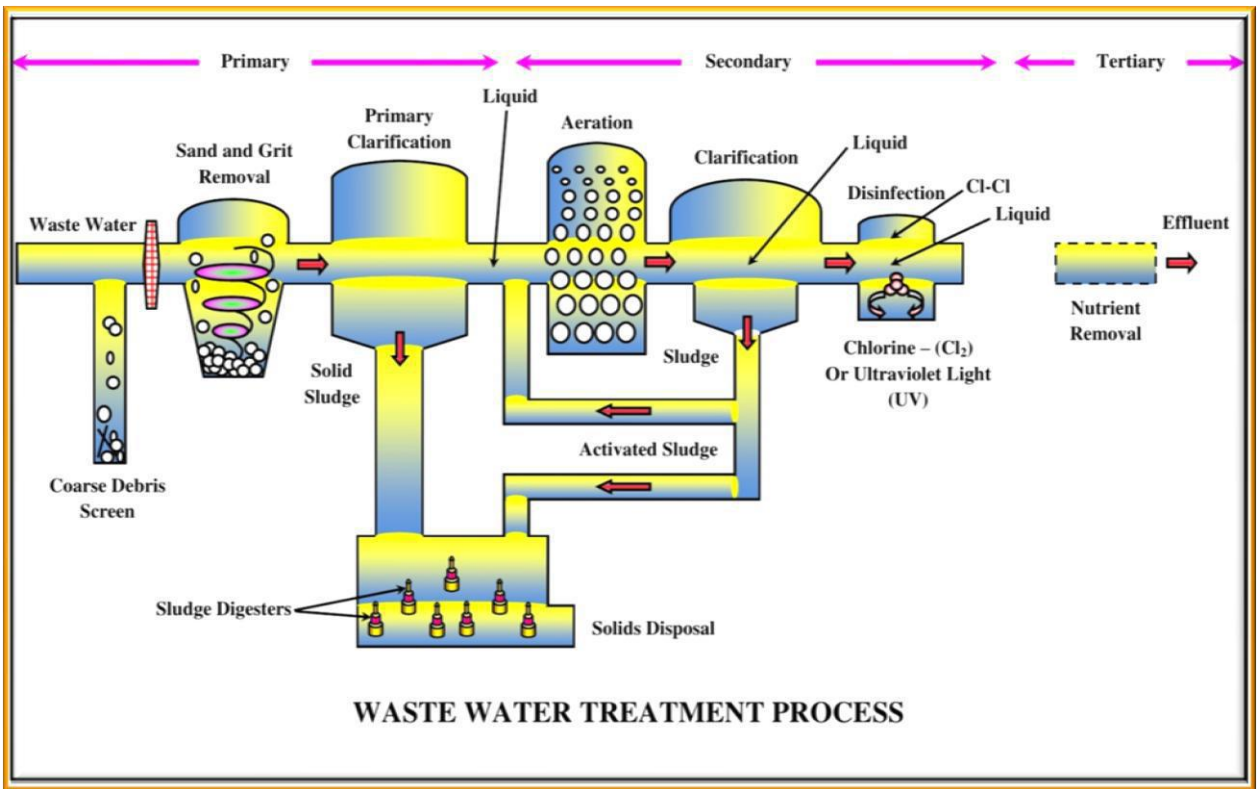


Figure 16: Sewage Treatment Process (STP) of Wastewater Layout.

13. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLANS

"National Highway Authority of India" (NHAI) has a well established **"Environmental Management Unit" (EMU),** Head by a Senior Officer **"Indian Forest Services" (IFS)** from "**Ministry of Environment and Forest" (MOEF),** who is supported by an officer of **Dy. G. M.** rank from **"State Pollution Control Board" (SPCB)**. Main responsibility of EMU will be established to monitor the progress regarding **"Environmental Management Plan" (EMP)**. **"Environmental Management Plan"** will be the responsibility of contractors and will be closely coordinated by the **"Engineer" (Supervision Consultant)**. **Table 25** as given below discusses about the remedial measures components, locations/ regions/ areas, time frame work and institutional responsibility with applicable criteria.

Table 25: Institutional Responsibility of Remedial Measures.

Environmental Components	Remedial Measures Components	Locations/ Regions/ Areas	Time Frame Work	Applicable Responsibility Criteria
Design – Phase				
Major Resources (Alignment, Public AmeVijayapuraes and Public Utilities)				
Alignment	*Avoid impacting school, health facilities, water bodies and residential quarters.*	*Throughout the Project Corridor.*	*During Design*	**Design Consultant**
Public Amenities	*Provision of service roads, underpasses, safety signs, bus stops, lay bees, parking spaces etc.*	*Throughout the Project Corridor as Mentioned in EIA Report.*	*During Design*	**Design Consultant**
Closure of Public Utilities *e.g.*, Tube – Wells, Wells, Bus Stops etc.	*Alternative arrangement.*	*Throughout the Project Corridor as Mentioned in Social Impact Assessment (SIA).*	*At the Beginning of Construction Activities.*	**Contractor, Supervising Engineer**

Construction – Phase				
Water Resources and Pollution (Water Bodies, Rivers, Drinking and Wastewater Water)				
Water Bodies	*Construction of embankments, de – siltation and environmental enhancement as mentioned in EIA report.*	*Water Bodies As Mentioned in EIA Report.*	*Throughout Construction Phase*	**Contractor, Supervising Engineer**
Rivers/ Nallahs	*Prevention of pollution of water.*	*Rivers/ Nallahs Mentioned in EIA Report.*	*Throughout Construction Phase*	**Consultant, Contractor, Supervising Engineer**
Water Requirement for Construction	*Arrange water without affecting local requirement. Do not use local water bodies. Drill boreholes with required permission. No water collection within forest area.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Drinking Water Requirement	*Arrange water without affecting local requirement.*	*Workers' Camps Working Site.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Wastewater from Workers' Camp	*Ensure proper sanitation and drainage. No direct wastewater discharge in water bodies or the rivers/ Nallahs.*	*Workers' Camps*	*Throughout Construction Phase*	**Contractor, Supervising Engineer**
Air and Noise				
Dust Generation	*Spraying of water, proper handling of fly ash.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Dust Generation near Sensitive Locations	*Spraying of water, work during scheduled period only.*	*Schools, PHCs as Mentioned in EIA Report.*	*During Construction Near the Vulnerable Sites.*	**Contractor, Supervising Engineer**
Asphalt Plant	*Location away from sensitive areas.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Stone Crushers	*Implementing proper air pollution control measure as per law.*	*Stone Crushers.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Gaseous Emission from Construction Work Vehicles	*Ensure checking of vehicular emission and obtaining Pollution Under Control (PUC) certificate.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Noise from Machineries and Construction	*Ensure machineries meeting noise level standards. Blasting to be done with required caution.*	*Throughout Projected Locality/ Region*	*Throughout Construction Phase*	**Contractor, Supervising Engineer**
Noise at Sensitive Locations	*Work only at scheduled period. Construct noise barrier if suggested. No work during night in forest areas.*	*At Schools, PHCs as Mentioned in EIA Report. In Forest Areas.*	*During Construction Near the Vulnerable Sites.*	**Contractor, Supervising Engineer**
Land and Soil				
Storage of Construction Materials, Debris. Fly Ash, etc.	*Prevent siltation from washing of construction materials.*	*Throughout the Project Corridor.*	*During Rainy Seasons.*	**Contractor, Supervising Engineer**
Soil Erosion	*Proper planning for slope stabilization, topsoil storage, plantation and turf on slopes.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Borrow Pits and Queries	*Excavation from pre – selected locations. After excavation the borrow pits will be dressed to match with the surroundings.*	*Selected Borrow Pits and Quarries as given in EIA Report.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Solid Waste from Construction Work	*Ensure dumping outside city area with permission from local authority or used as landfill material.*	*Throughout Project Area/ Site/ Region*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Flora (Plants' Life)				
Tree Felling	*Ensure plantation of trees on both sides of road and around in consultation with forest*	*Throughout the Project Corridor and Beyond.*	*Throughout Construction Phase.*	**Design Consultant, Contractor,**

	department.			**Supervising Engineer**
Fauna (Plants' Life)				
Forest Area	*No work after evening. No use of water bodies, safety regulations, no workers' camp.*	*In the Forest Area.*	*Throughout Construction Phase*	**Contractor, Supervising Engineer**
Others (Public, Religious and Aesthetics)				
Workers' Camp	*Ensure providing camp of proper dimension and environmental quality as given in EIA report.*	*Workers' Camps.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Public Facilities	*Ensure access to all important locations.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Religious Places	*Ensure minimum disturbance during festival time.*	*Throughout the Project Corridor.*	*Religious Festivals.*	**Contractor, Supervising Engineer**
Aesthetics	*Planting flowering creepers on medians, slope vegetations, suitable design of restaurants etc.*	*Throughout the Project Corridor.*	*Throughout Construction Phase.*	**Contractor, Supervising Engineer**
Operation – Phase				
Sources (Dust, Gaseous Pollution, Forest, Safety and Public AmeVijayapuraes)				
Dust	*Road maintenance.*	*Throughout the Project Corridor.*	*Throughout Operation Phase.*	**Contractor, Supervising Engineer**
Gaseous Pollution	*Check the vehicles for pollution control.*	*Throughout the Project Corridor.*	*Throughout Operation Phase.*	**Contractor, Supervising Engineer, Traffic Department**
Forest	*Speed restriction safety signs underpass maintenance.*	*In Forest Areas.*	*Throughout Operation Phase.*	**Contractor, Supervising Engineer, Traffic Department**
Safety	*Maintain all safety provisions.*	*Throughout the Project Corridor.*	*Throughout Operation Phase.*	**Contractor, Supervising Engineer, Traffic Department**
Public Amenities	*Bus stop and other ameVijayapuraes to be properly kept.*	*Throughout the Project Corridor.*	*Throughout Operation Phase.*	**Contractor, Supervising Engineer, Traffic Department**

14. PRINCIPAL COMPONENT ANALYSIS (PCA) INDICATORS

Significant Indicators as **"Principal Component Analysis" (PCA)** performed also indicates that indicators, which play significant role in explaining vulnerability among the districts states. Amongst all the indicators considered in particular sector indicators with weights greater than the average weight of all indicators are considered as important in explaining vulnerability study applications. **Table 26** gives the list of significant indicators in order of their importance for each sector. These indicators can play important role in decision making process/ system/ methodology in a goal to reduce vulnerability.

Table 26: Principal Component Analysis as Significant Indicators of Remedial Measures.

Sr. No.	Principal Indicators Analysis/ Aspects	Conceptual Basis
(A)	**Social Aspects/ Analysis**	
1.	*Population Served Per Health Centre (Community, Primary and Sub Health Centers);*	Adaptive Capacity
2.	*Percentage of Households With Access To Sanitation Facilities;*	Adaptive Capacity
3.	*Level of Urbanization;*	Adaptive Capacity
4.	*Percentage of Households With Access to Safe Drinking Water;*	Adaptive Capacity

5.	*Density of Population;*	Sensitivity
6.	*Number of Slum Dwellers Per Slum;*	Sensitivity
7.	*Percentage of Households Owning Radio, Transistor, Television and Telephones;*	Adaptive Capacity
8.	*Proportion of Elderly Population Aged 65 and Above;*	Sensitivity
9.	*Proportion of Child Population in The Age Group 0 – 6;*	Sensitivity
10.	*Literacy Rate and Growth;*	Adaptive Capacity
(B)	**Economic Aspects/ Analysis**	
11.	*Agricultural Credit Societies Per Lakhs of Population;*	Adaptive Capacity
12.	*Loan Disbursed by Agricultural Credit Societies Per Cultivator;*	Adaptive Capacity
13.	*Scheduled Commercial Banks Per Lakhs of Population;*	Adaptive Capacity
(C)	**Agricultural Aspects/ Analysis**	
14.	*Percentage of Land Holdings Below 1 Hectare;*	Sensitivity
15.	*Fertilizer Consumption and Utilization;*	Adaptive Capacity
16.	*Percentage of Net Irrigated Area to Geographical/ Physical/ Environmental Area By Surface Water;*	Adaptive Capacity
17.	*Percentage of Bio – Farming Villages in Total Villages;*	Adaptive Capacity
18.	*Percentage Share and Contribution of Agricultural And Cultivators Main Workers;*	Sensitivity
19.	*Yield and Capitulate of All Crops;*	Adaptive Capacity
(D)	**Water Aspects/ Analysis**	
20.	*Crop Water Stress, Strain and Sprain (Evapo – transpiration/ Potential Evapo – transpiration);*	Sensitivity
21.	*Surface Water Availability and Accessibility;*	Adaptive Capacity
(E)	**Climate Aspects/ Analysis**	
22.	*Warm Nights – Days, When Minimum Temperature > 90^{th} Percentile;*	Exposure
23.	*Warm Days – Cool Nights – Days, When Maximum Temperature > 90^{th} Percentile;*	Exposure
24.	*Warm Spell Duration Indicator (Annual count of days with at least 6 consecutive days when maximum temperature > 90^{th} percentile);*	Exposure
25.	*Cool Days – Cool Nights – Days, When Maximum Temperature < 10^{th} Percentile;*	Exposure
26.	*Cool Nights – Days, When Minimum Temperature < 10^{th} Percentile;*	Exposure
27.	*Flood Discharge;*	Exposure
28.	*Extremely Wet Days – Annual Total Rainfall, When Rainfall > 99^{th} Percentile;*	Exposure
(F)	**Health Aspects/ Analysis**	
29.	*Percentage of People Having Diarrhea and Other Dieses;*	Sensitivity
30.	*Index, Directory, Catalog, Guide, Manifestation or Indicator of Malaria;*	Sensitivity
(G)	**Pollution Aspects/ Analysis**	
31.	*Pollution of Rivers/ Wetlands, Degradation of Forests and Biodiversity Loss is Being Observed;*	Exposure
32.	*Effective Industrial Waste Management and Pollution Control;*	Exposure
33.	*With Increasing Pollution Increase in Respiratory Diseases and Allergies is Also Predicted to Increase on the Site;*	Exposure
34.	*Water Pollution is another Big Concern for the State. Depletion of Water Resources and Deterioration of Water Quality is Big Concern for the State;*	Exposure
35.	*Use of More Efficient Technology to Reduce Pollution. Effective Industrial Waste Management and Pollution Control;*	Exposure
36.	*Climate Change (CC) could Increase Air Pollution Levels by Accelerating the Atmospheric Chemical Reactions that Produce Photochemical Oxidants due to a Rise in Temperature;*	Exposure
37.	*Long Term Targets – By achieving renewable sources of environmental factors/ parameters through agriculture – ecosystem management, implementation of main schemes as soil carbon storage and metersing, enhancing soil health, reducing ground water pollution specially harmful chemicals and enhancing biodiversity modifications;*	Exposure
38.	*The other serious issues of groundwater quality are high concentration of fluorides (mainly in granitic terrain), agricultural, municipal and industrial or anthropogenic pollutions;*	Exposure
(H)	**Forest Aspects/ Analysis**	
39.	*Percentage of High Density Forest Area to Geographical Area;*	Adaptive Capacity
40.	*Non – Timber Forest Products (NTFPs) Diversity (Number of Varieties);*	Adaptive Capacity
41.	*Number of Joint Forest Management (JFM) Communities, Neighbourhood – Area – District – Groups of People;*	Adaptive Capacity
(I)	**Soil Aspects/ Analysis**	
42.	*Dependence on natural resources is the way of life but unsustainable practices of harvesting, irrigation, elimination of crop residue, forest degradation, deteriorating soil and water quality are augmenting the problems besides other impacts of Climate Change (CC) occur in the state;*	Adaptive Capacity
43.	*Mono – cropping reduces the crop diversity and adversely affects the soil health in the state or region;*	Sensitivity
44.	*Soil and water conservation innovative ideas must be applied through demonstration of best*	Sensitivity

	engineering practices;	
45.	*Set up a knowledge management network to avail information on land – use pattern, soil types, weather or climatic conditions, genotypes of crops, water availability, pasture, off – season crops and agro – forestry practices etc.*	**Adaptive Capacity**
46.	*Develop capacity to run agriculture related climate models, decipher their projections, to understand the impact on crops, soils and water like precious and important factors etc. in the region/ area or state;*	**Adaptive Capacity**
47.	*Soil testing – practice and packages must be applied during civil construction work (soil kit to the farmers);*	**Exposure**
48.	*Undertake and revise soil resource mapping at village/ local/ regional or state level;*	**Exposure**
49.	*Promote use of water and soil conservation techniques, namely dry land farming, drip irrigation, intermittent flooding, drying sowing use of high yielding drought resistant cultivars as appropriate etc. in different areas or states;*	**Adaptive Capacity**
50.	*Promote agro – forestry and agro – climatic or weather conditions to increase forest biomass and hence soil moisture;*	**Exposure**
51.	*Identify critical unspecified areas within forests for soil and water conservation;*	**Exposure**
52.	*This effort would not only provide fodder to the animals, but also would curb or reduce further land degradation and soil erosion;*	**Exposure**
53.	*Soil moisture stress to the crops leading to their stunted growth in the region or state;*	**Exposure**
54.	*Soil and water conservation technologies will need to be strongly adopted after observing or seeing the rising temperatures and decreasing water conditions in the state;*	**Adaptive Capacity**
55.	*Soil and water conservation through demonstration of best practices: Application of mulching techniques, drip irrigation, and micro/ macro irrigation practices, techniques and methodologies etc. should be encouraged;*	**Adaptive Capacity**
56.	*Soil conditions may pose threat problems with an expected increase in acidity, alkalinity and salinity;*	**Sensitivity**
57.	*Soil temperature may increase in spring hence the planting time may also vary accord to space and time;*	**Sensitivity**
58.	*Further, it would be worthwhile to build and strengthen capacity in the state to run climate models, interpret their projections, and use the same to run the various bio physical models to understand the impact of Climate Change (CC) on crops, soils, water etc. and then to design appropriate adaptation strategies during construction of civil work or human made or designed, but not natural process;*	**Adaptive Capacity**
59.	*In some regions mono – cropping of soybean wheat is rendering the soil infertile, sterile, unproductive, barren, unfruitful, arid, uncultivable and may lead to over use of artificial fertilizer which may be detrimental in the long run;*	**Sensitivity**
60.	*Promoting and managing agro – forestry, agro – climatic specific crops farming practices and management including that of water, soil, pests, crops, cropping cycle and practices for harnessing the full productivity potential of the different zones should be done on high priority basis for regional areas or site locations;*	**Adaptive Capacity**
61.	*This would mean promoting measures for soil moisture conservation through development of watersheds and small catchments that would also increase biomass production and increase the fertility of the "Precious Soil" as well on "Precious Planet Earth";*	**Adaptive Capacity**
62.	*Also as the evapo – transpiration rate increases with increase in temperature, it will lead to depletion in moisture retention capacity of the different soil types and can pose a threat to agricultural activities;*	**Sensitivity**
63.	*Expansion of area of cultivation under mono – cropping of profitable crops without nutrition management is leading to rapid decline in soil fertility of these farms and agricultural fields;*	**Adaptive Capacity**
64.	*Simple soil and water conservation techniques, methodologies, applications, processes and overall watershed development including the rejuvenation of tanks is proposed to be the focus;*	**Adaptive Capacity**
65.	*Low capacity of natural water recharge and resources system in the sub – soil in most of the areas of "Maharashtra and Karnataka State" is also a major concern;*	**Sensitivity**
66.	*Water logging in canal command areas leads to soil salinity and needs immediate attention towards conjunctive use of surface streams, channels and ground water;*	**Sensitivity**
67.	*The state is characterized by a great diversity of parent rocks and minerals, which have weathered under different climatic conditions, vegetative covers and topographic situations to form soils with different characteristics in different zones;*	**Exposure**
68.	*Shifting of rainfall pattern affects cropping and farming patterns. Mono – cropping reduces the crop diversity and adversely affects the precious and significant soil health conditions.*	**Sensitivity**

Figure 17 (a): TCS: TYPICAL CROSS SECTION FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – I

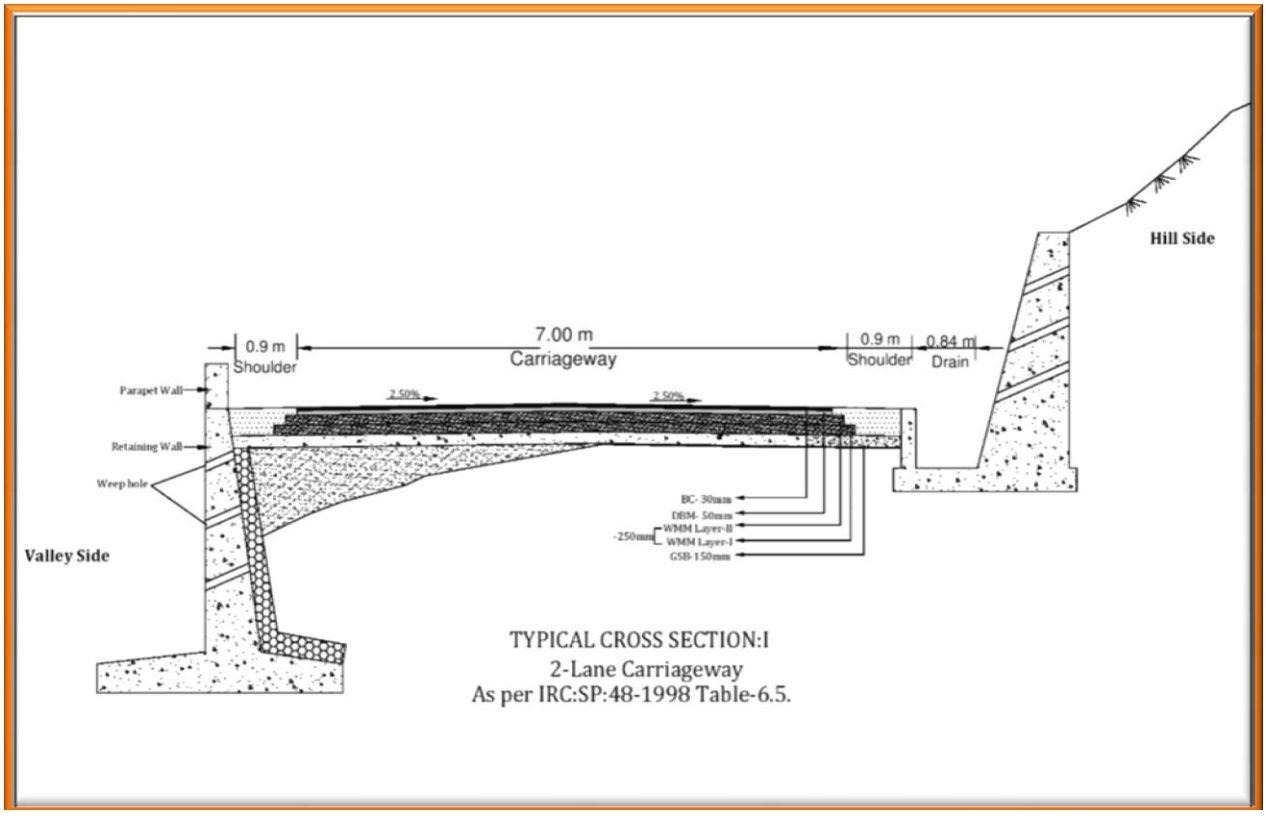


Figure 17 (b): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – II

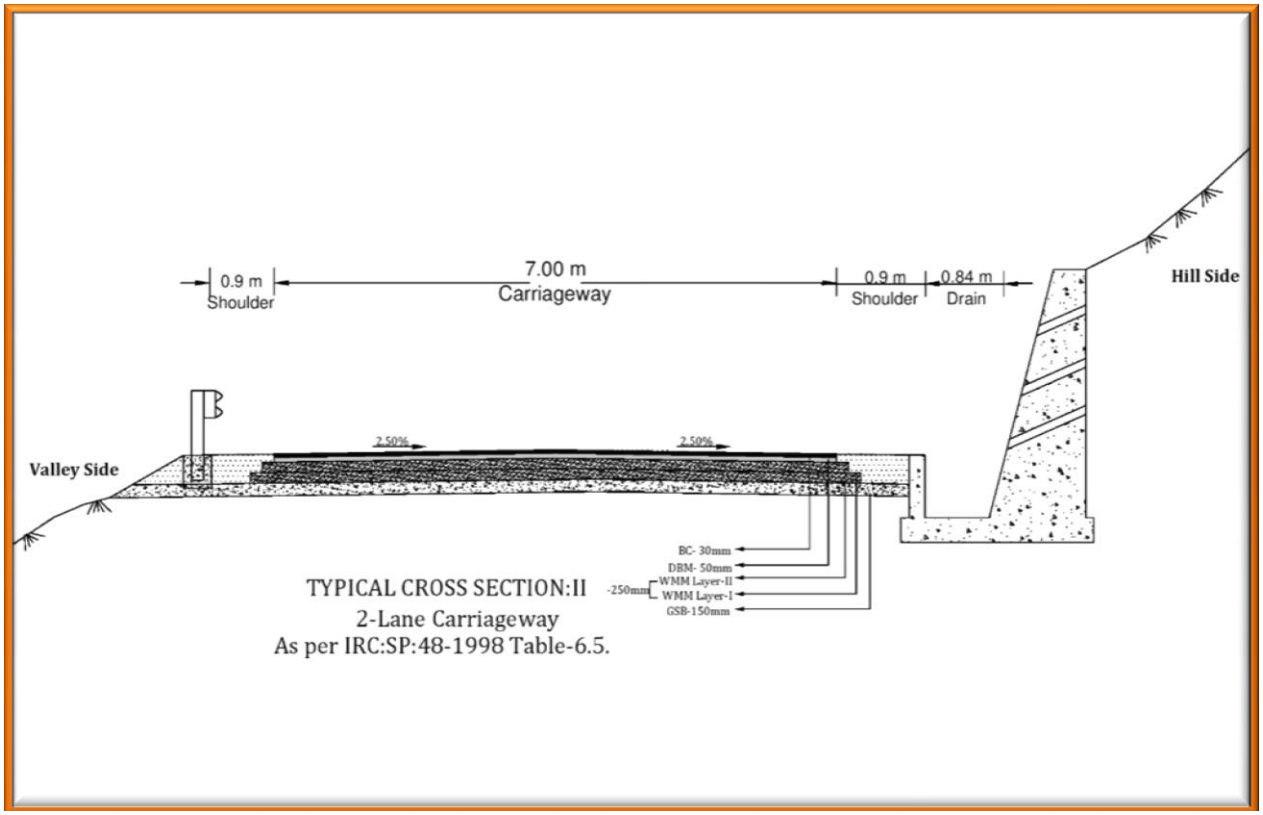


Figure 17 (c): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – III

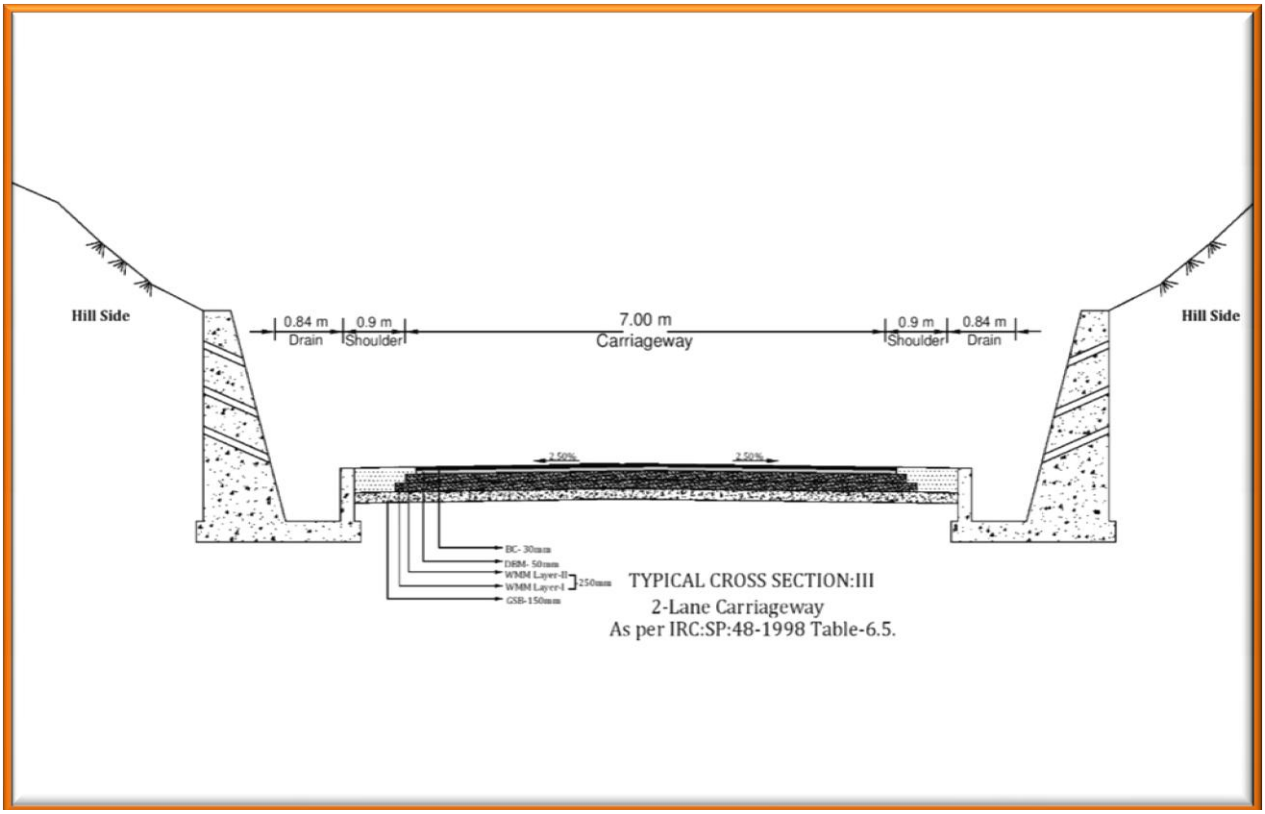


Figure 17 (d): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – IV

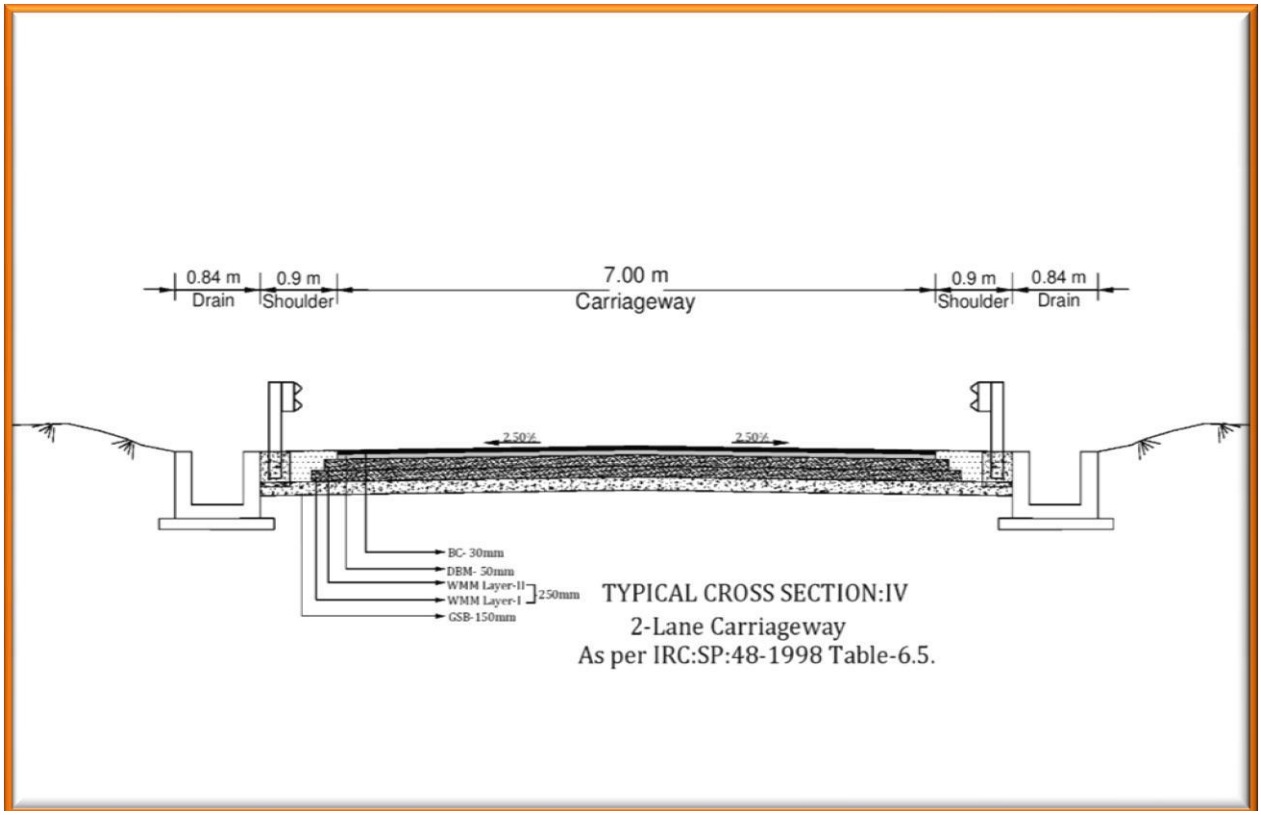


Figure 17 (e): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – V

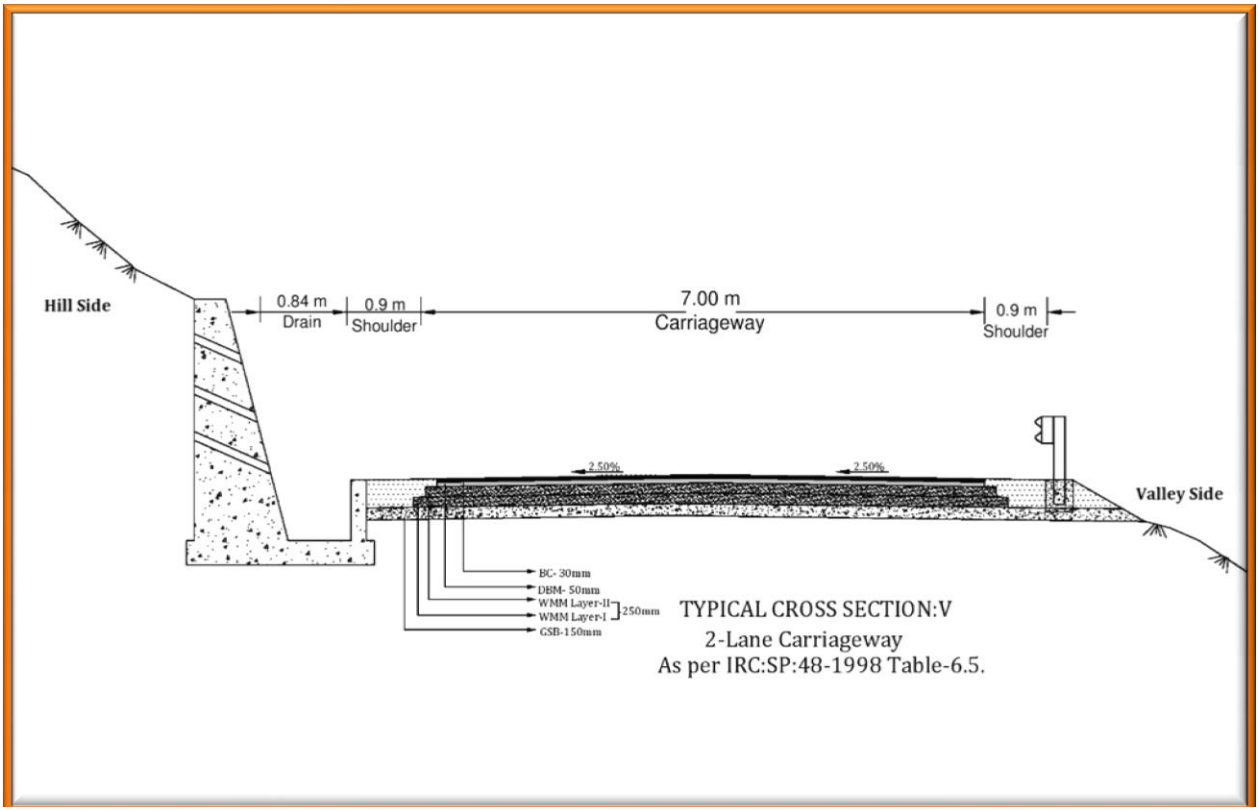


Figure 17 (f): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – VI

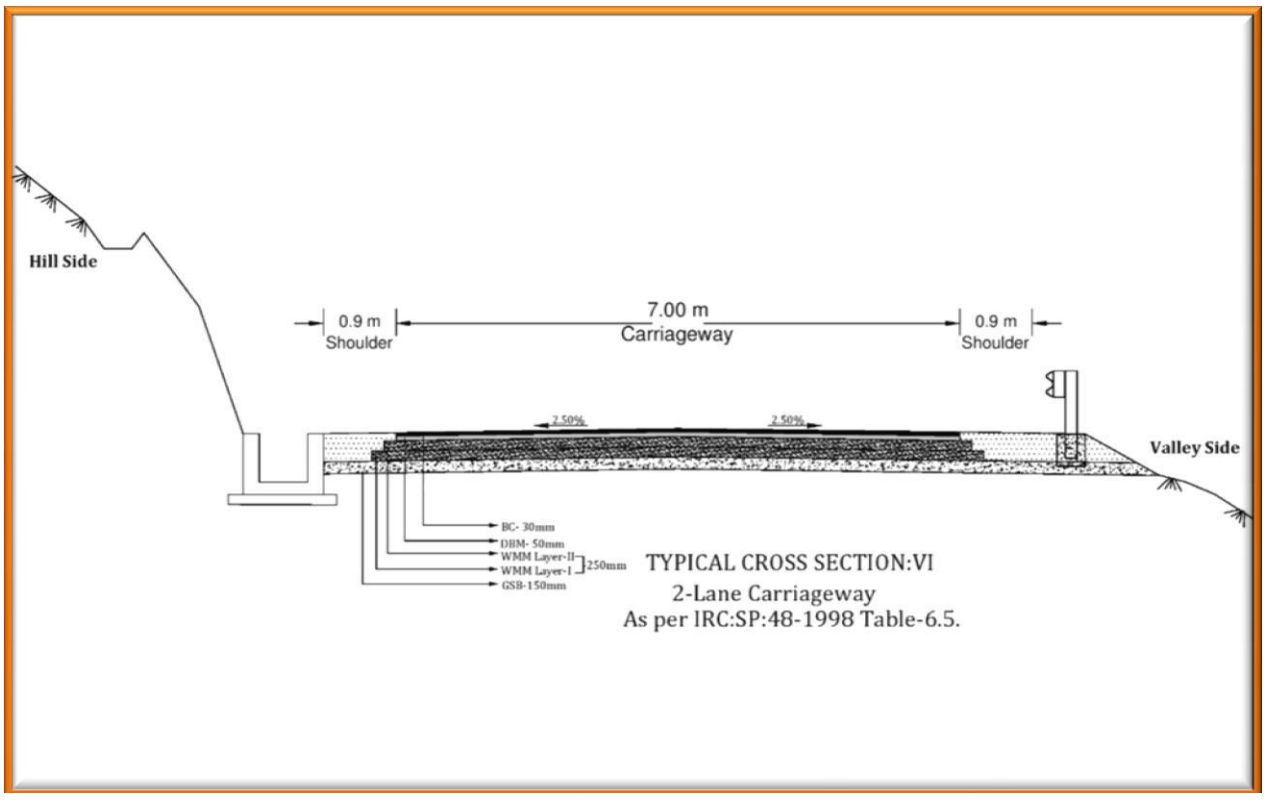


Figure 17 (g): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – VII

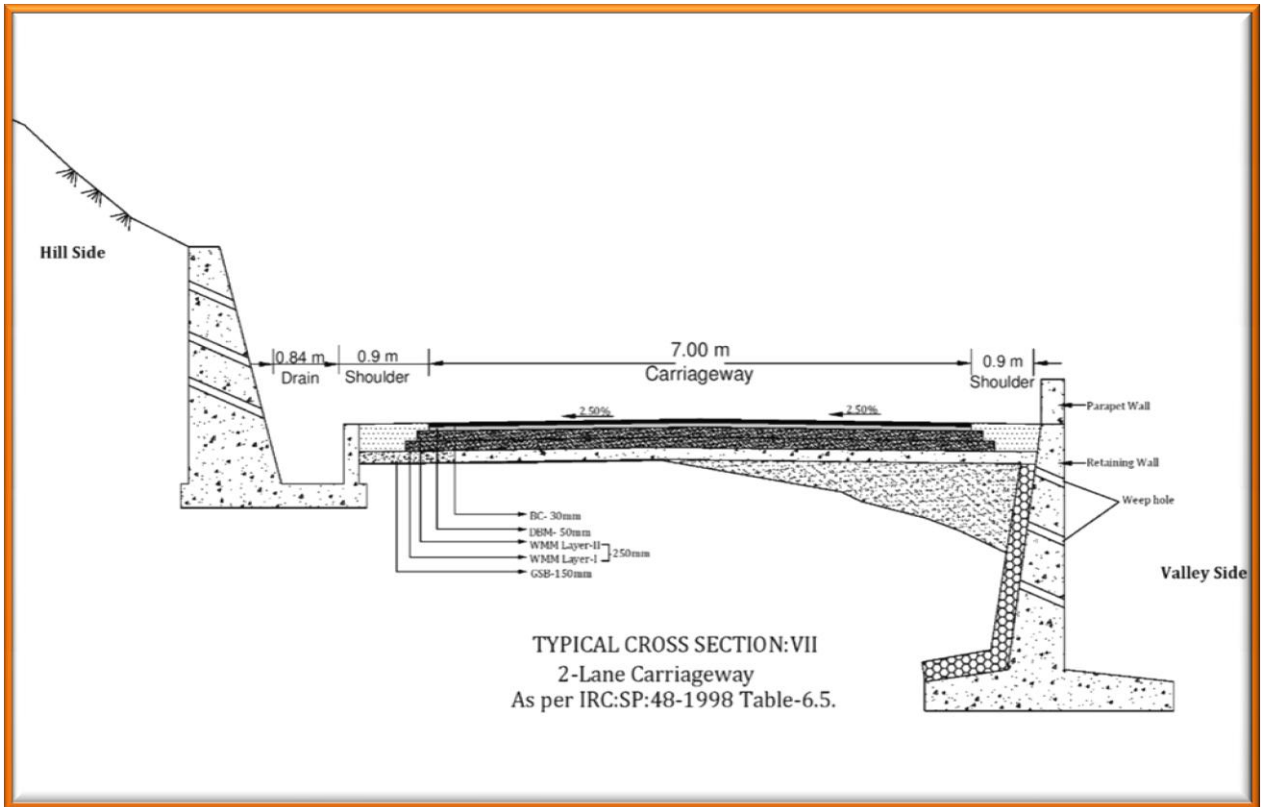


Figure 17 (h): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.
TYPICAL CROSS SECTION – VIII

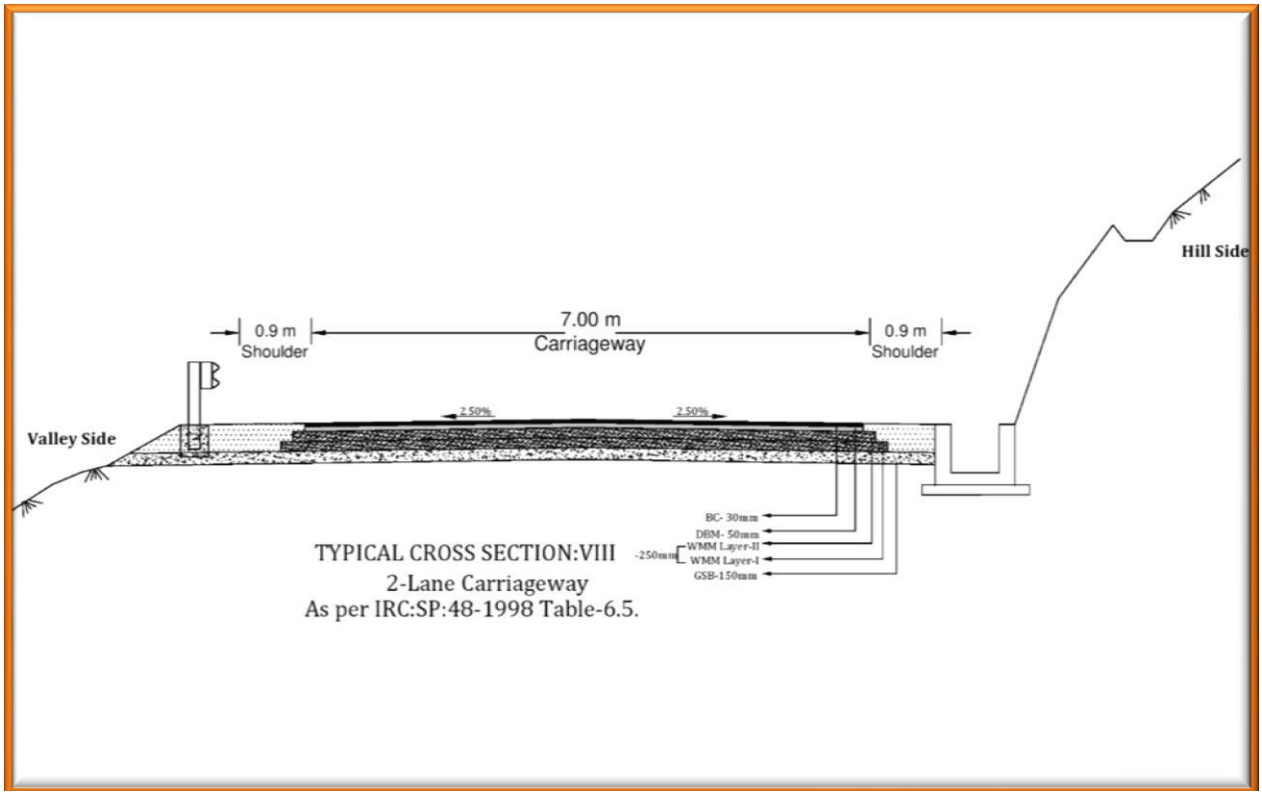
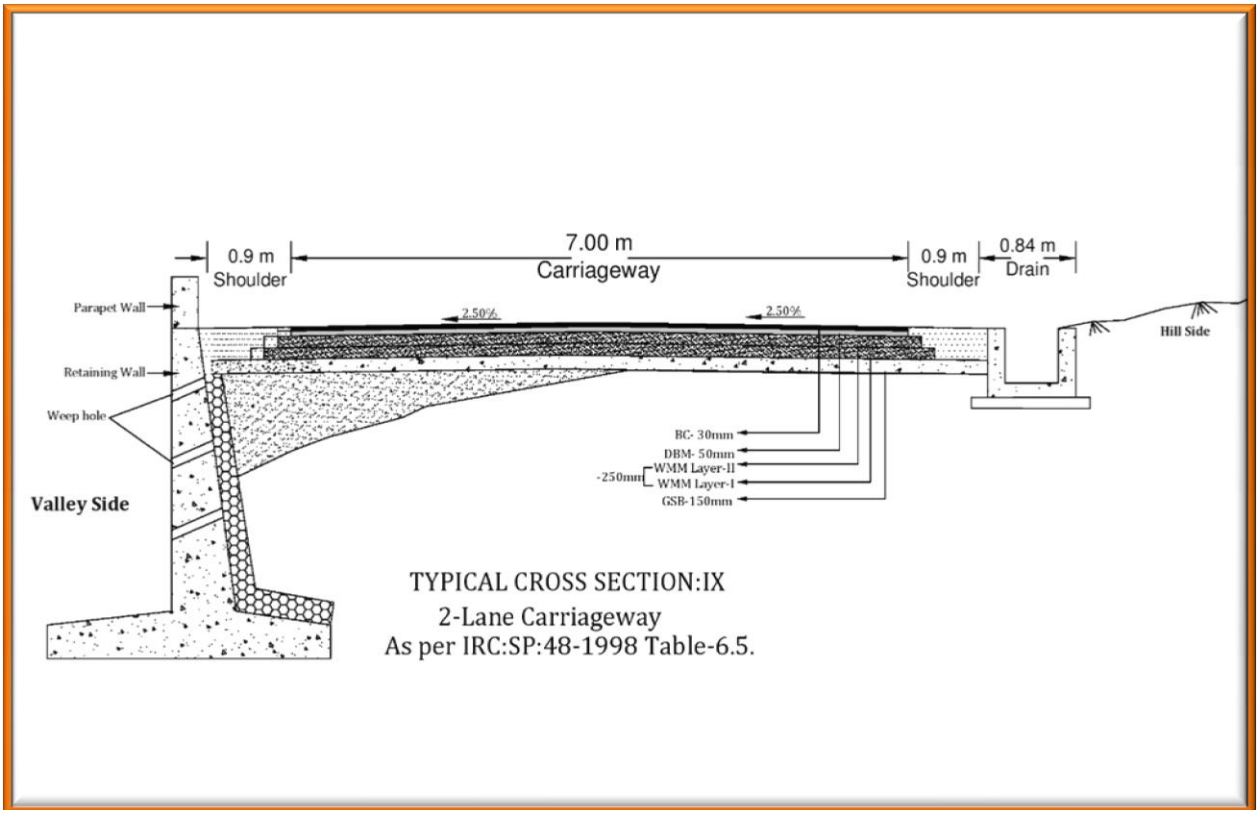


Figure 17 (i): TYPICAL CROSS SECTION: FOR 2 – LANE CARRIAGEWAY.

TYPICAL CROSS SECTION – IX



Aspects of Transparent Skeleton – Flowers in Rainy Season, Diphylleia Grayi Rare – Plants.

Figure 18: BOTHER... SAFEGUARD; PROTECT; CONSERVE AND PRESERVE OUR PLANET EARTH'S NATURAL – MOTHER... (ECO – NATURAL – GREEN – ENVIRONMENT)...!!!

IMPACT ON THE INDIGENOUS PEOPLE

"The indigenous/ local/ native/ original people who are presently confined to local area only shall look – after the development of road and thus transportation infrastructure will get more exposure to education, health, markets and other informative and innovative activities etc. for Solapur to Vijayapura Regions in Maharashtra as well as Karnataka State". The area is not vulnerable to migration settlements from external people. Since the major occupation of people in local area is agricultural based and there are no proper warehousing facilities for storage of agricultural product in the area the indigenous people will be benefited by road development projects. **The Figures 19 (a) to (d): "ENVIRONMENTAL MANAGEMENT PLAN" (EMP) for "Solapur to Vijayapura Road in the State of Maharashtra and Karnataka"**.

Figure 19 (a): Overview of the Environment and Social Framework.

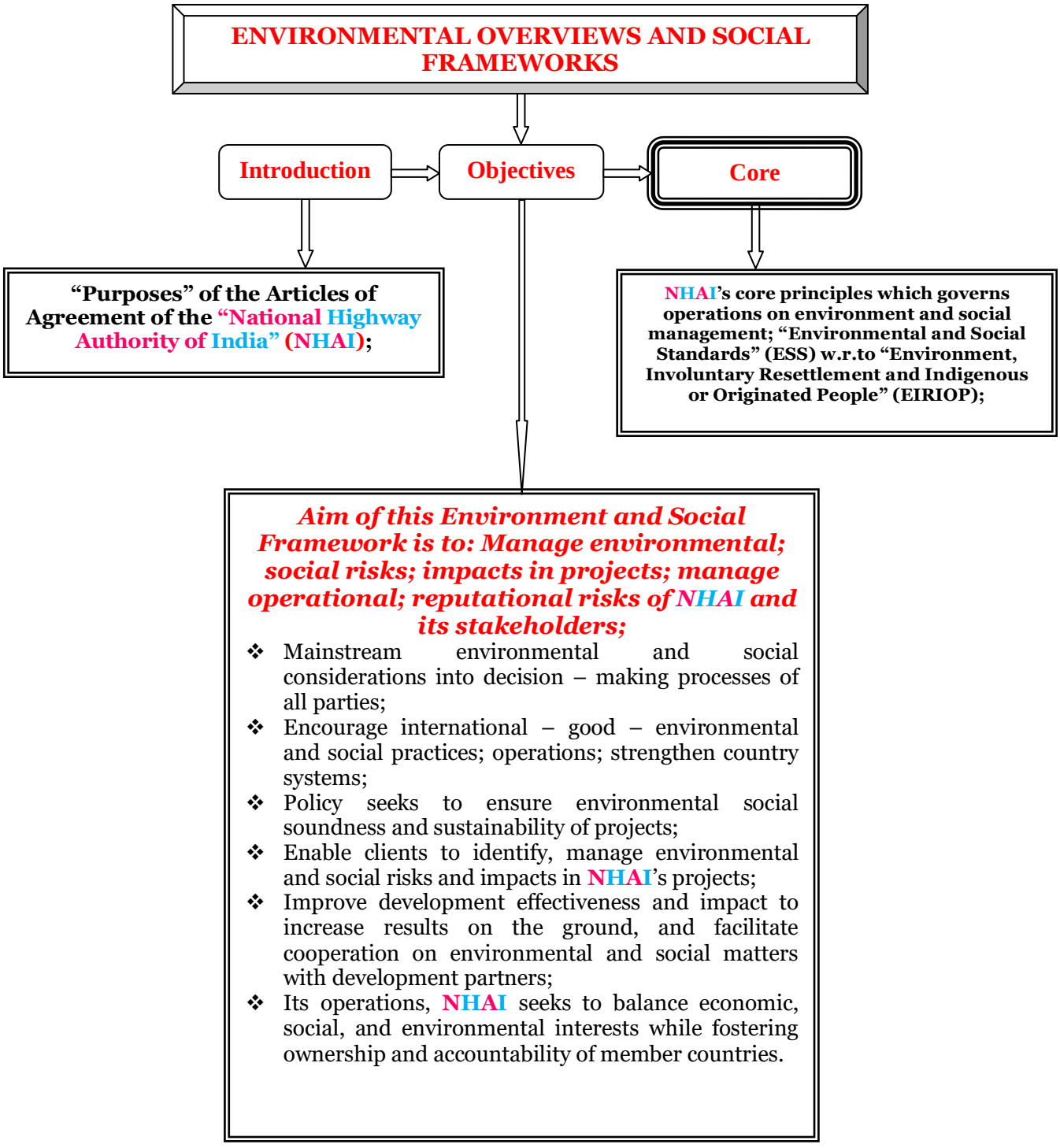


Figure 19 (b): Core Principles of the Environmental and Social Framework.

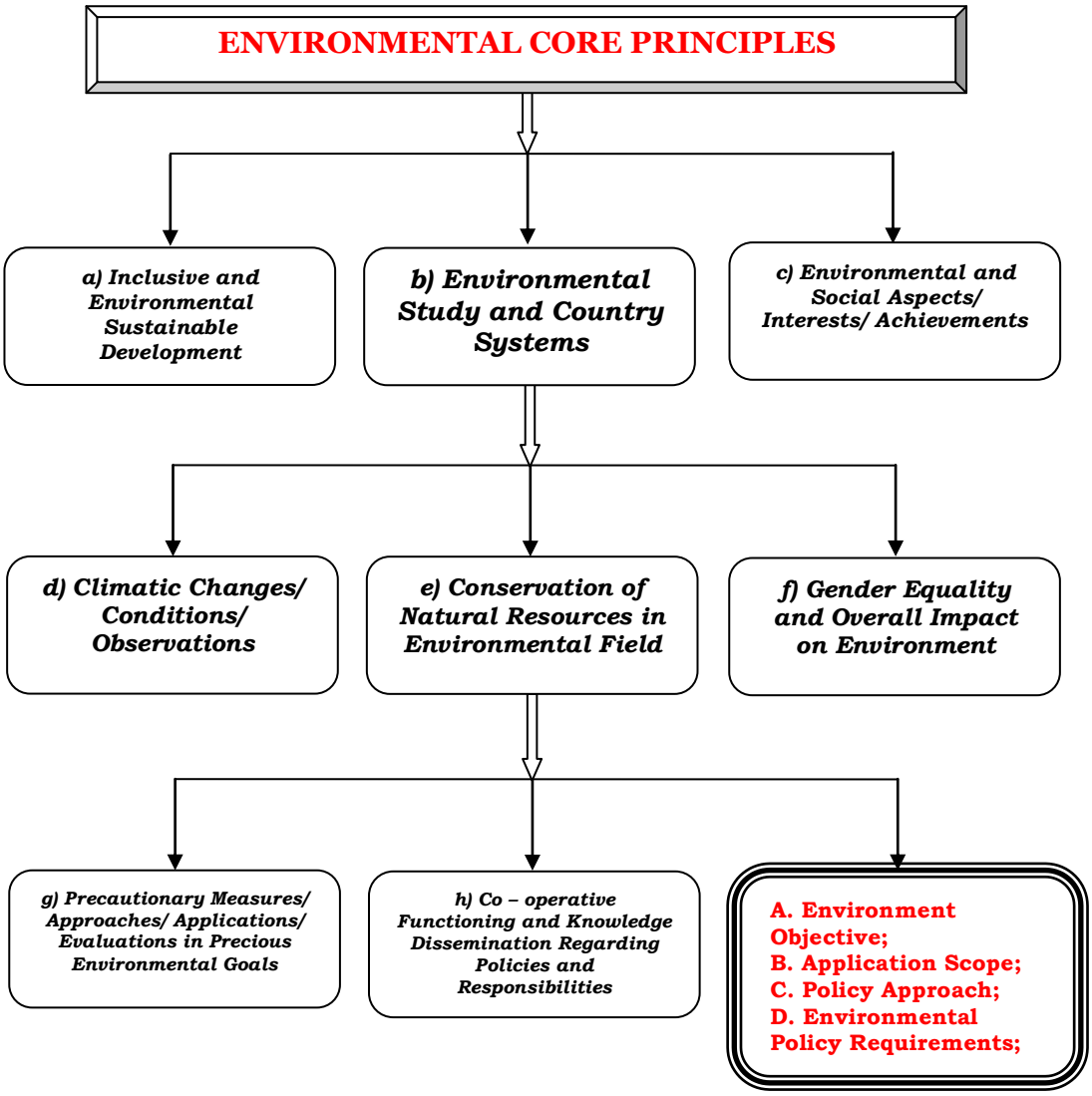


Figure 19 (c): The Environmental Objectives; Application Scope; Policy Approach of the Environmental and Social Framework.

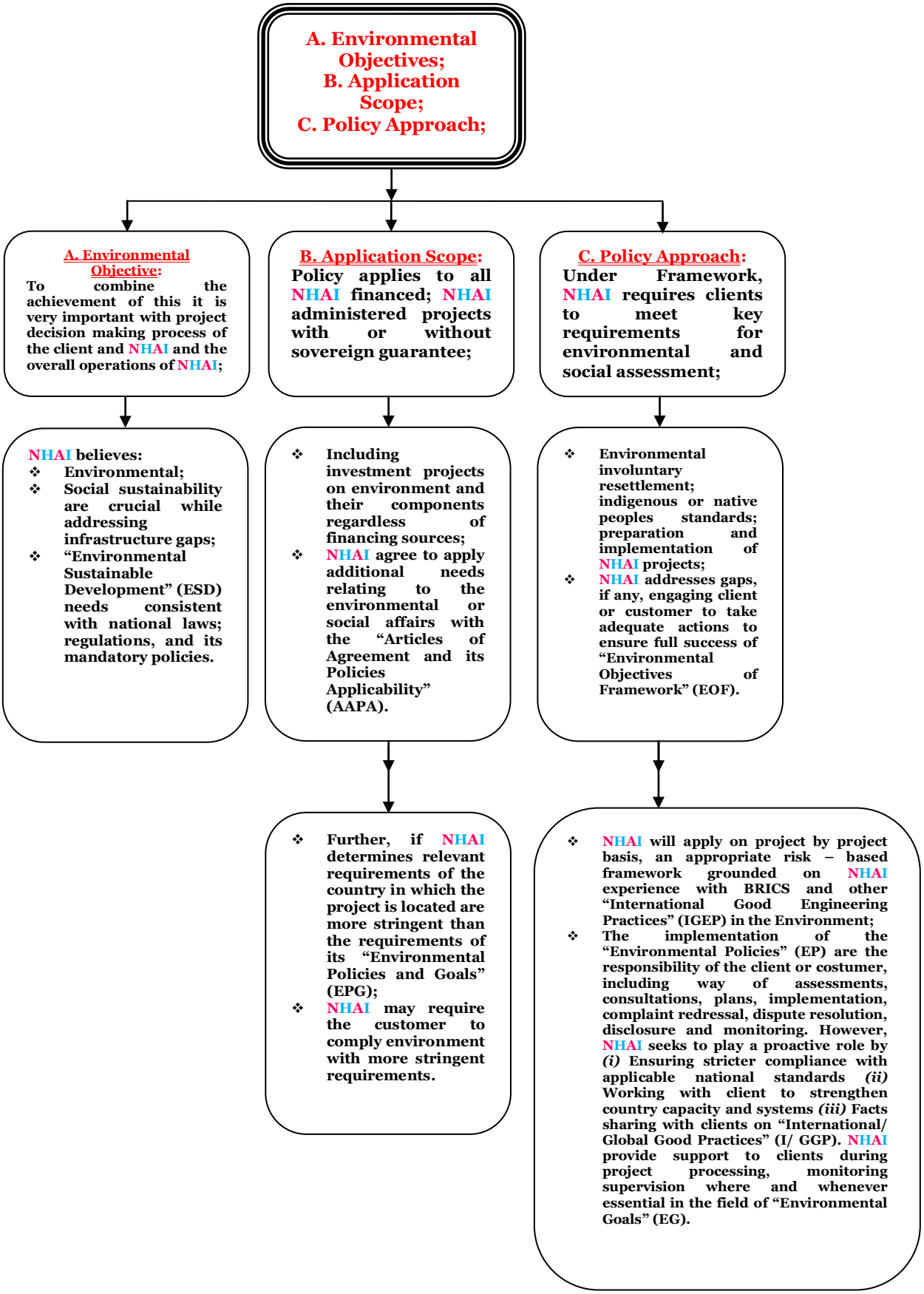


Figure 19 (d): The Policy Requirements; Roles and Responsibilities of the Environment and Social Framework.

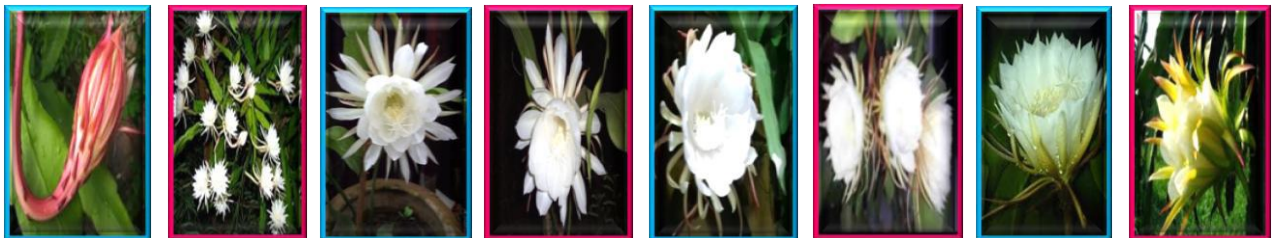
D. Environmental Policy Requirements; E. Roles and Responsibilities;

D. Environmental Policy Requirements:

- **The screening covers three types of concerns of ESS, *i.e.*, environmental, involuntary resettlement and indigenous or originated or native people;**
- **"Environmental and Social Management Framework" (ESMF).**

E. Roles and Responsibilities:

- **(a) Screening each project to assign a category to it;**
- **(b) Undertaking due diligence review of the "Client's or Customer's Environmental and Social Assessment Reports" (CESAR);**
- **(c) Determining the feasibility or practicability of NHAI financing for the project.**
- **(d) Monitoring and supervising the Client's compliance with its environmental and social obligations under the legal agreement between NHAI and the Client;**
- **(e) Establish and maintain a fair and effective grievance redress mechanism for "Environmental and Social Safeguards" (ESS).**



15. STRATEGIES AND RECOMMENDATIONS

Two Rivers Bhima and Seena at Solapur very far from crusher; road construction site and not much water in these Rivers, but partially it may get contaminated, more over natural environment along road side. Here it is found to be mostly green area and less traffic pollution as compared to Matros and other cities. But roads currently which are under construction phase may contribute some chances of Land, Air, Water contamination in some sensitive zones like residential sites, schools, colleges, hospitals, **"ASHRAMS" (Old Age Homes)** occurred/ falls on roadside network...!!! There may be a variety of environmental applicability and necessities/ provisions during road construction network. The city has inadequate pedestrian infrastructure and there is no foot over bridges, sub – ways, pedestrian – only traffic signals at few places. In fact the city lacks in provisions for dedicated **"New Measurement Tracks" (NMT)** lanes and dedicated parking facilities for cycle rickshaws. The creation of new planning tools should aim to increase public involvement in the development of transportation and land use policies.

Develop policies that encourage concentrated mixed land use development along the public transport corridors. These share policies, principles and strategies intended to preserve and even enhance valued natural and cultural resources and facilitate **"Healthy",** sustainable communities and neighborhoods. These approaches also tend to foster a balance of mixed uses (including housing, educational, employment, recreational, retail, and service opportunities) which recognize the importance of spatial or geographic proximity, layout and design of those uses. In addition, the consideration of long term and broader (even global) impacts of land use decisions on our natural and human – made environment, including transportation systems and facilities, is critical to these concepts, as well. As per observation Environmental Experts/ Specialists recommonds that cities should have **"New Measurement Tracks" (NMT)** on all major roads within a year. In view of above said this indicator reflects the availability of dedicated cycle track along all the arterial, sub arterial roads and public transport corridors, its encroachment and parking facilities.

Climate change is already happening and even if we take immediate and drastic steps to reduce emissions, significant change is going to occur throughout the world. This will be a major change, but moving to a low carbon economy and transport system also presents huge opportunities; not just for climate change but for our prosperity, health, and the wider environment. Characterized by a heavy reliance on cars and trucks for both passenger and freight movement, transportation is a major consumer of fossil fuels and a big contributor to climate change. Solar Technology can also be used extensively as an alternative to regular energy production as it enables energy security through reliance on an indigenous, inexhaustible and mostly import – independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating **"Stroking/ Potential/ Prospective Climate Change"** and keep **"Fossil Fuel"** prices lower in Solapur, Maharashtra and Karnataka States. Solar lights and signals can be installed within the city to minimise the energy consumption. Working out the mobility plan, which is economically, socially, environmentally and technologically sustainable as climate resilient to achieve the goal of low carbon and inclusive transport incorporating development plans/ master plans. Choice of street furniture and other installations should consider the performance in humid climates in terms of maintenance, durability and human comfort. This will be a major change, but moving to a low carbon economy and transport system also presents huge opportunities; not just for **"Prospective Climate Change",** but for our prosperity, health and the wider environment.

Recently...!!! There are no potential threats identified, but in **"Solapur to Vijayapura Regions"** higher levels of air pollution at few places due to vehicular activities. Solapur and Vijayapura can become economically vital/ essential and could be a hub for various services like industrial and educational institutional etc.

Construction Materials Applications

India's road infrastructure has seen consistent improvement in the last few years. Connectivity has improved and road transportation has become a focus of rapid development. Roads are providing better access to services, ease of transportation and freedom of movement to people. Recognizing the significance of a reliable and swift road network in the country and the role it plays in influencing its economic development, the **"Ministry of Road Transport and Highways" (MORTH)** has taken up the responsibility of building quality roads and highways across the country.

The seven phased **"National Highway Development Project" (NHDP)** is being implemented initiated by the **"National Highway Authority of India" (NHAI)** with a total estimated expenditure of

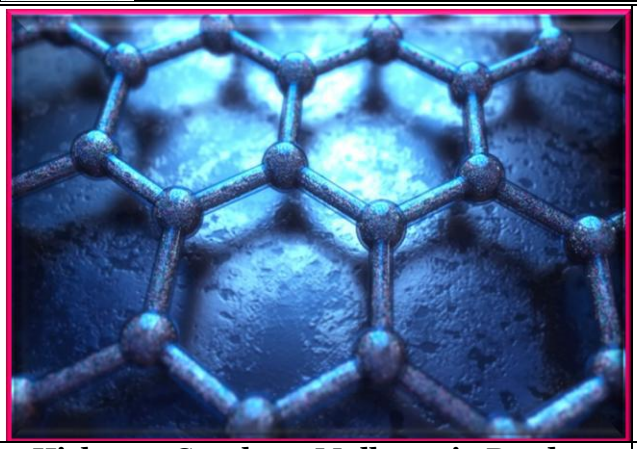
USD – 92 Billion. As the largest highway development project in the country since 2000, more than 49,260 Km of the roads are being upgraded to match international standards.

Key Projects' Applications under NHDP include the following under its various phases and development of National Highways to 4/ 6 lane standards on the following routes:

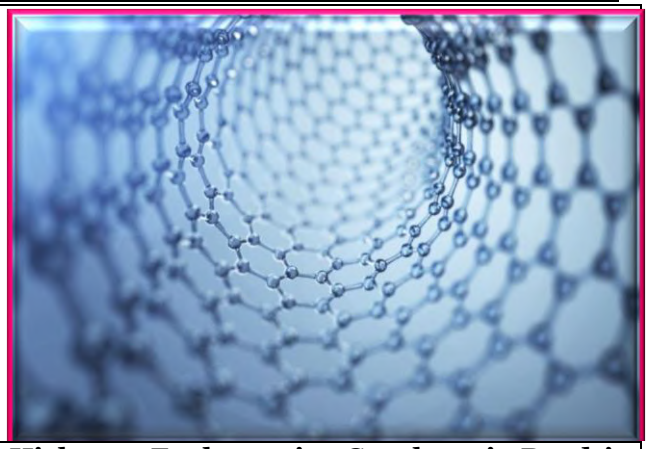
- *Golden Quadrilateral connecting 4 major metropolitan cities viz. Delhi – Mumbai – Chennai – Kolkata. North South and East West Corridors (NS – EW) connecting Srinagar to Kanyakumari and Silchar to Porbandar with a spur from Salem to Cochin;*
- *Road connectivity of major ports of the country to National Highways;*
- *As the 4 – laning of 4,000 Km of National Highways Upgradation of about 20,000 Km of National Highways to 2 – lane paved shoulder;*
- *Six laning of 6,500 Km of existing 4 – lane National Highways;*
- *Development of 1,000 Km of fully access controlled expressways under* ***"Public Private Partnership" (PPP)****; model following* ***"Design – Build – Finance – Operate" (DBFO)*** *approach. Nine such expressways have been identified along High – Density Corridors. These corridors will seek to ensure quicker connectivity;*
- *Construction of standalone Ring Roads, Bypasses, Grade Separators, Flyovers, Elevated Roads, Tunnels, Road Over Bridges, Underpasses, Service Roads, etc. on* ***"BOT" (Toll)****;*

Many innovative methods and applications are emerging in India and throughout the globe for improving the life of the pavements like emulsified bituminous mix, foam bituminous mix, fiber reinforced bituminous mix, composite pavements, perpetual pavements etc. There are several materials which can be characterized as **"Smart"** and are used for pavement construction. **"Self – Healing Material" (SHM),** for instance, has the ability to heal damages automatically and autonomously, that is, without any external intervention. Incorporation of self – healing properties in man – made materials very often cannot perform self – healing action without an external trigger. Nano – technology is focused on materials in the nano – scale, while civil engineering infrastructure, especially road pavements, is focused on the macro scale. Different types of procedures, methods and materials are used to attain a very good, sustainable and economic concrete construction. The process of self – healing of cracks or self – filling up of cracks due to bacterial reaction in the concrete after hardening is known as **"Self – Healing Concrete" (SHC)**. ***"It can be observed that small cracks that occur in a structure of width in the range of 0.05 to 0.1 mm get completely sealed in repetitive dry and wet cycles. The mechanism of this autogenously healing is the width of 0.05 to 0.1 mm that act as capillary and the water particles seep through the cracks. These water particles hydrate the none or partial reacted cement and the cement expands, which in turn fills the crack. The bacteria used for self – healing of cracks are acid producing bacteria. These types of bacteria can be in dormant cell and be viable for over 200 years under dry conditions; they acts as a catalyst in the healing process of cracks"***.

Super – Strength Roads to Contain Miracle Material Graphene: "Graphene Engineering Innovation Centre" (GEIC) to see how the wonder material can improve the road network and Graphene is up to 200 times stronger than steel and just one atom thick. Highways engineering believes adding graphene into maintenance and renewals operations has the potential to extend asset life and make the network perform at an **"Iindustry Changing Level" (ICL)**. Highways engineers will now work with the GEIC to explore the operational and road user benefit of incorporating graphene into assets such as road surfacing and road markings as well as help to drive the development of a low carbon and digital road network. ***"GEIC is at the forefront, having made the discovery in Manchester, UK and by building collaboration with operations teams who understand the challenges is looking to deliver improved safety and performance of the roads"***.



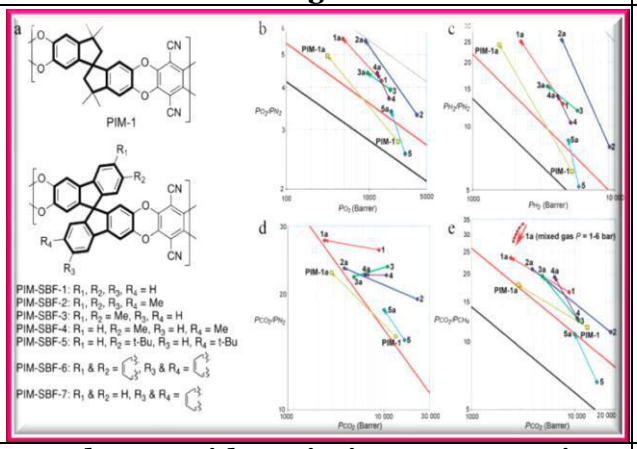
Highways Graphene Mulls use in Roads.



Highways Explore using Graphene in Roads' Network.

Highways – GEIC – Main to Create Low Carbon and Digital Network.

Graphene Roads' Network.



Membranes with Intrinsic Mocro – Prosity Structure.

Examplified Representation/ Model of Road Construction.

Highways England, a government responsible for motorways and major roads, has partnered with the **"Graphene Engineering Innovation Center" (GEIC),** in order to use graphene to address challenges experienced by the road network in England, such as the deterioration of surfaces.

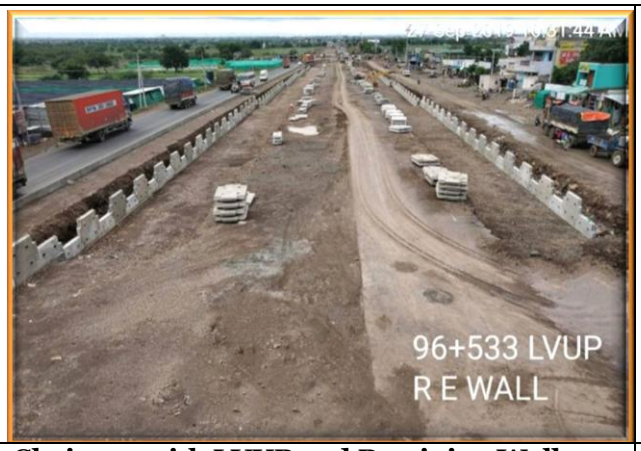
Similarlly Highways India, the government is answerable for motorways and foremost roads, has collaborative effort amalgamated with the **"Graphene Engineering Innovation Center" (GEIC),** in order to use graphene to address challenges experienced by the road network, such as the worsening of surfaces. Highways Engineer believes adding graphene into maintenance and GrapheneCA recently introduced a new product line called **"Original Graphene" (OG)**. OG Concrete Admix, aimed at the retail concrete industry, reportedly imbues cement with graphene's superior properties to make it stronger, lighter,

and more resistant. GrapheneCA's focus on a price – sensitive application is said to lead to taller, faster, lighter, and more durable constructions overall, with the added benefit of being eco – friendly. The launch of **"Original Graphene Cement" (OGC)** admix targets multiple improvements in cement from a single additive reducing cracking, improving strength and weather resistance to build structures that last. The Curbridge works, which were delivered by subcontractor **"Aggregate Industries" (AI),** involved removal and reinstatement of the existing carriageway to a depth of 150 mm over a 750 m – long section. One lane was replaced using conventional materials, while the opposite **"Trial"** lane was resurfaced using the asphalt enhanced by the innovative asphalt modifier.

Global infrastructure services firm Aecom is reportedly developing one of the UK's first 3D – printed commercial products made from **"Graphene – Reinforced Polymer" (GRP)**. Aecom has produced a graphene arch using additive manufacturing techniques. It believes the method could reduce the time and cost of installing digital signalling systems and transform the digitization of transport networks. The 4.5 – meter high, lightweight arch is being tested on outdoor track at Network Rail's workforce development center in Bristol. GrapheneCA, graphene producer and developer of grapheme – based technology for industries and consumers, has announced that it has signed a memorandum of understanding with Apis Cor to develop 3D – printing system capable of printing graphene materials. GrapheneCA and its partner Apis Cor, a developer of specialized concrete 3D – printing equipment, are discussing a future co – operation in which GrapheneCA will design an extruder and mixing system that can be embedded into Apis Cor's 3D – printer. ***"Together, supplementary innovative companies are expecting to develop 3D – printing system capable of printing graphene material in forthcoming days; time all over Indian regional/ statewise road network programme".***

16. FOREMOST APPROACH TO SOLAPUR – BIJAPUR ROAD PROJECT WITH BOT

- ***Project:*** *Four to Six Laning of Solapur and Bijapur of NH – 13 (New NH No. 52) on BOT Basis;*
- ***Client:*** *National Highways Authority of India (NHAI);*
- ***Concessionaire:*** *Vijayapura Tollway Private Limited;*
- ***EPC Contractor:*** *IJM (India) Infrastructure Ltd.;*
- ***Total Project Cost:*** *Rs.2,325 Cr;*
- ***Length of Stretch:*** *109.08 Km;*
- ***Date of Commencement:*** *June 2018;*
- ***Expected Completion:*** *December 2020;*

	
Chainage with LVUP and Retaining Wall on Highway Roads.	**Highways' Exploration may use Graphene in Road Construction Network.**
	
Highways – Main ought to Create Low Carbon and Digital Network.	**Graphene Roads' Network might be Suggested for Construction Work.**

Name: Er. Harish Kumar Gupta
Designation: Environmental Expert