PROPOSED TERMS OF REFERENCE(TOR) FOR EIA & EMP STUDY

1.0 Introduction

The Government of India (GoI) is aimed at improving the connectivity in border areas under 'Bharatmala' Scheme, for which National Highways Authority of India (herein after referred to as the "Authority" or "NHAI") plays a key role. As part of this endeavour, NHAI has decided to undertake the project namely "Consultancy services for preparation of DPR for development of Economic Corridors, Inter Corridors, Feeder Routes and Coastal Roads to improve the efficiency of freight movement in India", through Public Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (DBFOT) basis or Engineering Procurement Construction (EPC) mode. In order to fulfil the above task, the NHAI has entrusted M/s Aarvee Associates Architects Engineers & Consultants Pvt. Ltd. (herein after referred to as the "Consultant") to provide services for Melur-Pillayarpatti-Karaikudi stretch of Tamil Nadu Bharatmala project.

In order to fulfill the above task, the NHAI has entrusted M/s Aarvee Associates Architects Engineers & Consultants Pvt. Ltd. (herein after referred to as the "Consultant") to provide services for Tamil Nadu Bharatmala project stretches. Details of Terms of Reference of Melur-Pillayarpatti-Karaikudi stretch of Tamil Nadu Bharatmala project is given in this Report. The index map showing the proposed project stretch is shown in Figure 1.

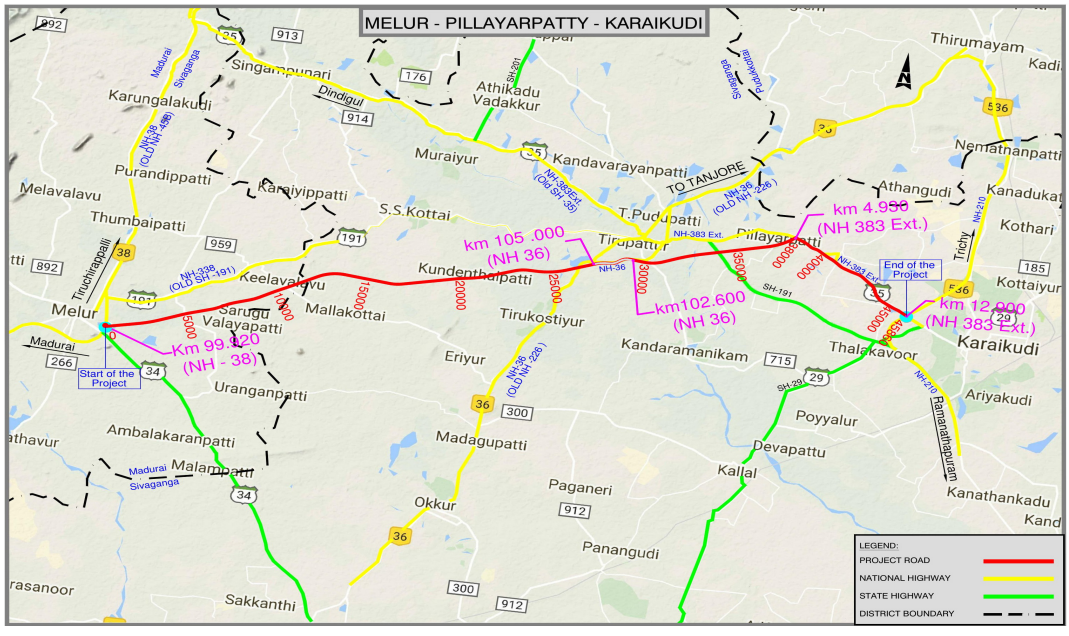

Figure 1: Index Map

2.0 Project Description

The proposed project stretch, Melur-Pillayarpatti-Karaikudi is passing through Madurai and Sivaganga districts in the state of Tamil Nadu and chosen as one of the Inter corridor route.

The existing project corridor starts on SH-191 at the intersection with NH-45B at Melur in Madurai district and ends at the intersection with SH-29 at Karaikudi in Sivaganga district. The existing project road is passing through the built-up areas Melur, Navinipatty, Keeliyur, Malampatti, Erumaipatti, S.S.Kottai, Kottaipatti, M.Krishnapuram, Karuppur, Thiruvudaiyarpatti, Tirupattur, Pillayarpatti, Kundrakudi, Patharaikudi, Karaikudi etc. The existing project corridor is following SH-191, SH-35 and SH-191A.

The proposed project corridor starts at the intersection with NH-45B near Melur in Madurai district and ends at the intersection of SH-35 with NH-210 near Koviloor in Sivaganga district. The proposed project road is bypassing built-up areas Melur, Navinipatty, Keeliyur, Malampatti, Erumaipatti, S.S.Kottai, Kottaipatti, M.Krishnapuram, Karuppur, Thiruvudaiyarpatti, Tirupattur, Pillayarpatti, Kundrakudi, Patharaikudi, Karaikudi etc. Majority of the proposed project road is greenfield alignment and some portions are following SH-35.. The details of the stretch is given in Table 1. The salient fetures of the project road are placed in Table 2 and Engineering features are placed in Table 3.

Table 1: Chainages of the proposed project stretch

S. No.	Design Chainage (Ch. Km.)		Greenfield/ Realignment Length	Remarks	Tentative Scheme of Widening
	From	To			
1	0.000	27.120	27.120	Melur – Ranasingapuram	Greenfield Alignment
2	27.120	29.700	2.580	Ranasingapuram – Thenmapattu West	Existing Alignment
3	29.700	37.970	8.270	Thenmapattu West – Pillayarpatti	Greenfield Alignment
4	37.970	45.855	7.885	Pillayarpatti – Koviloor	Existing Alignment
Total length of the proposed project stretch = 45.855 Km					

Table 2 : Salient features of the project road

S. No	Particulars	Details
1	Location	Starts at the intersection of NH-45B with proposed stretch near Melur, Ch. Km. 0.000 and at the intersection of SH-29 with NH-210 near Koviloor, Ch. Km. 45.800
2	Latitude and longitude	10°01'36.19" N, 78°21'8.81" E (near Melur) to 10°5'1.36" N, 78°44'2.72" E (near Koviloor)
3	Elevation above mean sea level	88 m to 151 m
4	Terrain	Melur to Pillayarpatti: Plain Terrain 91%, Rolling Terrain 10% Pillayarpatti to Koviloor: Plain Terrain 100%
5	Major settlements along the proposed project stretch	Vatakkuvalayapatti, Sarugu Valayapatti, Ranasingapuram, Thriruppatur, Pillayarpatti, Kundrakudi, Patharaikudi etc.
6	Nearest National Highways	NH-210, NH-226, NH-45B, NH-536
7	Nearest railway station	Karaikudi Junction is around 8 km away from Ch. Km 45.800 (end point, Koviloor)
8	Nearest Airport	Madurai International Airport, around 35 km away from Melur
9	Nearest city	Madurai city, around 25 km away
10	Rivers/streams	Stream crossing at Ch. Km 14.800
11	Hills/valleys	--
12	Reserved forests/protected forest	--
13	National parks/wildlife sanctuary/core biosphere reserve	Vettangudi Bird Sanctuary, 3.5 km away from the proposed stretch
14	Archaeologically important places	Pillaiyarpatti Karpaga Vinayagar Temple is about 200m from the project site. Temple is carved out in a cave of Pillaiyarpatti Hillocks (500 BC to 1284 AD)
15	List of major industries	--

Table 3 : Engineering features of the project road

S. No.	Parameters		Existing	Proposed
1	Right of Way (m)		10-30	60
2	Design speed (km/h)		65	100
3	Bridges	Major Bridge	1/0	9/0
		Minor Bridge	2	19
4	Railway Over Bridge (ROB)		0	0
5	Railway Under Bridge (RUB)		0	0
6	No. of Culverts		28	72
7	Pedestrian/Cattle Underpasses		-	-
8	Vehicular Underpasses(VUP/SVUP /LVUP)		-	6/12/1
9	Overpasses / Interchanges		-	1/1
10	Fly Overs		-	1
11	Foot Over Bridges		-	-
12	Bus Bays/Bus shelters		-	2/16
13	Truck Lay Byes		-	4
14	Rest Areas		-	1
15	Toll Plazas		-	1
16	Bypasses/Realignments		-	1/4
17	Total number of trees affected		-	2406
18	Land to be acquired (including social forestry) in hectare		-	267
19	Project Cost in crore		-	1094.11

2.1 Site and its Environs

The reconnaissance survey and subsequent field studies were carried out in the study area which falls in Madurai and Sivaganga districts of Tamil Nadu state. Major aspects emphasized with respect to the geography, topography, soil, climate, drainage, demography etc., of the region were collected and analysed. The details of the same are given below.

2.1.1 Geographical Location

Madurai District:

Madurai District is situated in the Southern most part of Tamil Nadu state. It is the second largest in populous district of the state. The city of Madurai serves as the district headquarters and houses the world famous Sri Meenakshi temple and is situated on the banks of river Vaigai. Madurai district was bifurcated into Madurai and Theni districts in

1996 and retained Madurai as its head quarters. The district lies between $77^0$00" and $78^0$30" of the eastern longitude and between $9^0$30" and $10^0$30" of the northern latitude. It has an area of 3741.73 Sq. Km and is bounded on the west by Theni district, on the north by Dindigul district, on the east by Sivaganga district and on the south by Virudhunagar district. The district has got 2 revenue divisions, 6 municipalities, 11 blocks and 7 taluks respectively. The district is endowed with a semi arid tropical climate with normal rainfall of 827.1 mm as against 923.1 mm for the state. The proposed project stretch which starts from Melur, falls in the north eastern region of Madurai District.

Sivaganga District:

Sivaganga (usually called as Sivagangai in Tamil) is an administrative district of Tamil Nadu located in Southern Tamil Nadu. Sivaganga district was carved out from the composite Ramnad district on 6th July, 1984 and the district started functioning on 15th March, 1985. The city of Sivaganga is the headquarters of the district. Sivaganga district is having administrative divisions of 6 taluks, 12 blocks, 521 villages. The district is located between 9.43" and 10.42" North latitude and 77.47" and 78.49" East longitude. The district is bordered in the North and North-East by Pudukkottai District, on the South-East and South by Ramanathapuram District, on the South-West by Virudhunagar District, and on the West by Madurai District, and on the Northwest by Tiruchirrapalli District. The proposed project stretch falls in the northern region of Sivaganga district.

2.1.2 Topography

Madurai District:

The prominent geomorphic units in the Madurai district are structural and denudated land forms such as structural and denudational hills, residual wells, linear ridges, uplands and barred pediments. The district is predominantly by crystalline formations and alluvium is found along the courses of the river. Ground water occurs under phreatic conditions in weathered residuum and interconnected shallow fractures and under semi-confined to confined conditions in deeper fractures. The depth of weathering varies from 20-25 m bgl in Usilampatti, Sedapatti and Kottampatti area, while it varies from 30 to 40 m bgl in remaining parts of the district.

Sivaganga District:

In Sivagangai district, differing resistances of the geological formation has given rise to various land forms viz., structural hills, residual hills and pediment terrains in the district. The eastern and southern part of the district is characterized by flood plain. The structural hills are occurring north west of Sivagangai in Sivagangai taluk, while pediment terrain in Tiruppuvanam and Tiruppathur. Deep buried pediments seen in the north west of Tiruppuvanam and Tiruppathur in Sivagangai and Manamadurai taluks.

Flood plains are found along Vaigai river and alluvial plain in Devakottai, Sivagangai and Manamadurai Taluks.

2.1.3 Geology

In order to bring out detailed geological setup and geomorphological features along the alignment, Satellite Imagery data and published geological maps and reports of G.S.I and CGWB have been studied. Further, field traverses have been taken along the alignment to collect field geological data as relevant to the DPR of the proposed road alignment.

Geomorphology:

In any civil engineering project planning, knowledge of the land mosaic of the area is necessary, in order to locate ground water potential zones, to identify quarry sites, to locate dumping locations and to identify sites for development of greenery. Geomorphology, having genetic relationship with lithology and structural set up, describes such landscape which is carved out by different weathering agencies. The area is predominantly an undulatory terrain dotted with detached or scattered or isolated rocky mounds. The entire area covering the proposed alignment and surroundings is divided into the following geomorphological units a) structural hills, b) pediplain, c) floodplains and d) residual hills

a) Structural Hills

Structural hills are located west of Melur, which forms part of western Ghats. These structural hills are aligned along NE-SW direction and formed of metamorphic and igneous rocks. They do not extend into alignment proper.

b) Pediplain

Mazor part of the area between Melur and Karaikudi is a pediplain terrain. Pediplain constitutes dissected pediments and creep built plains. They are composed of deep red to medium red calcareous and non calcareous soils with slope ranging from 3-10. Thickness of soil varies from 2-5 m, the relative relief is low with slope ranging from 3-10. Pediments are the rugged surfaces of the plain which normally supports vegetation, fractures and sustains water. These are further devided into; Rocky pediments, shallow pediments, moderate pediments and deep pediments. Deep buried pediments occur NW of Thiruppuvan and Thirupatti.

c) Fluvial Deposits

Fluvial deposits occur on both sides of vagai river and extending between kollukudipatti vettangudi bird sanctuary and Tirupattur. They comprises of sandy soils, silty clayey soils and pebbles. This zone forms good aquifer.

d) Residual Hills

Residual hills formed of granites occur on either side of Kelavalavu village and north of alignment between Tirupattur and Karaikudi. The area forms part of vaigai river basin. Parallel and ephemeral dense drainage has developed in the area. The vagai river originates in the western slopes of the varushanad hills near kollaimalai and joins Bay of Bengal close to the Palk Strait.

Geology:

The area forms part of Southern Crystalline belt and occupied by metamorphic and igneous rocks. Broad stratigraphic succession of the area, as given by GSI is given below:

Table : Geological Succession

Period	Age	Group/Formation	Lithology
Quaternary	Holecene to Recent	Alluvium Colluvium	Fluvial and Fluvial marine sediments
Terttiary	Miopliocene	Cuddalore Formation Panampari Formation	Sandstone and Clay
Mesozoic	Lower Cretaceous	Sathaveedu formation	Shale, Limestone and Conglomerate
Archaeans	Precabrian	Crystalline Complex Migmatite Complex Peninsular Gneissic Complex Charnockite Group	Older granites/granitoids, pink migmatite, pink augen gneiss, hornblende gneiss, hornblende biotite gneiss, garnet if erousquartz of elspathic gneiss, garnet biotite gneiss, basic and ultrabasic rocks, magnetite quartzite, pyroxenite granulite and charnockite

The area is predominantly occupied by lithological units belonging to crystalline complex which are formed 2000 m. years back. Of these, granitic varients are predominant. Charnockite and pullangnichchi granite occurs south of alignment. These rock types are intruded by younger granites, dolerite dykes, quartz reefs and veins, at places. The strike of gneissic rocks is along E-W, ENE-WSW with southerely dips of 75-90. The strike of the rocks is almost perpendicular to the alignment, as such different lithological assemblages occur along the alignment. However, the outcrops are scattered. The General subsurface profile along alignments is inferred as:

Top soil: maximum 7 m Weathered zone: 0.5-55 m

Fractured zone:

Hard rock:

These granitoids form good aggregates and the granites and leptiniets are being quarried between Ch. Km. 2.1 and Ch. Km. 12.6 are being quarried for dimensional stones. These quarries are located Ch. Km. 0.700 to Ch. Km. 2.7 from the highway alignment. The highway road passes through safe distance from blasting operations and fly rock ejections. The granites are being quarried as undamaged dimensional stones without involving deep hole drilling and heavy blasting. It is reported that fragmentation and generation of lumps, fines or dust is negligible and water is being sprinkled for the suppression of air borne dust from mine approach roads, water dumps on regular intervals using water tankers. These multi coloured granite quarries are being operated for a maximum depth of 22 m, below soil cover.

It is reported that after completion of quarry operation the quarry out land will be fenced, and maintained with barbed wire to prevent entry of the cattle and public. Garland drains will be constructed around the quarry to prevent surface run off and rain water. The quarrying is being carried out by open cast, semi mechanized method 3.0 m bench at regular interval of 6.0 m vertical cut.

As the alignment runs through undulatory terrain, devoid of high hillocks bordering the highway path, problems due to any type of landslides are expected in the area. The area is not located in the seismic hazard zone and neo tectonic activity is not reported along the alignment. The area falls in seismic zone as per Seismic zonation map of India (IS1893-2014).

2.1.4 Soil

Madurai District:

The Madurai district is characterised by Red soil, Black clayey soil and alluvial soil. Red soil is found in all the blocks of the district while black clayey soil is found in Tirumangalam, Usilampatti and Peraiyur blocks of the district and alluvial soil is found along the courses of the river. The predominant soil type is red soil. This type of soil is found common in Madurai, Melur, Thirumangalam, Usilampatti and Vadipatti blocks with a combination of red soil and black soil. The soil type in central Madurai is predominantly clay loam, while red loam and black cotton types are widely prevalent in the outer fringes of the city. The land in and around Madurai is utilized largely for agricultural activity, which is fostered by the Periyar Dam. Madurai lies in the southeast of the Western Ghats, and the surrounding region occupies the plains of South India and contains several mountain spurs.

Sivagangai District:

Soil of the Sivagangai district is predominantly black. Part of Sivaganga district has red soil also. The classification of soil in the Sivaganga district is as follows: Lateritic soil and Red Sterile soii is found in the western part of Devakottai, Karaikudi and the entire Thiruppathur. Black soil is found in the western part of Sivagangai and North West of Manamadurai. Alluvium soil is found in the Eastern part of Devakottai and Northern part of Ilayangudi; Red soil is found in the central part of Sivagangai, Northern part of Manamadurai and Southern portion of Ilayangudi.

2.1.5 Drainage

Madurai District:

Vaigai, a major ephemeral river originates in western ghats of Theni district flow in NW-SE direction, in the central part of the Madurai district. In addition, tributaries of Vaipar and Gundar drain in south-western part of the district, while the tributaries of Pambar drained in north eastern part. The general flow direction of the drainage is NW-SE.

Sivagangai District:

Sivagangai district is drained by Kottakaraiyar, Tirumanimuttar, Vaigai and Pambar and all these rivers are ephemeral in nature. In the major part of the district, the drainage pattern is sub-dentritic and dentritic and at places, the drainage pattern is controlled by geological structures also.

2.1.6 Climate

Madurai District:

In Madurai district, Rainfall is irregular and intermittent, with an average of approximately 85 cm per annum. The wind blows from Northeast direction during January–February, and from Southwest direction during May to July. Madurai is hot and dry for eight months of the year. The hottest months are from March to July. The district experiences a moderate climate from August to October, tempered by heavy rain and thundershowers, and a cool climate from November to February. Fog and dew are rare, occurring only during the winter season. Being equidistant from mountains and the sea, it experiences similar monsoon pattern with North east monsoon and Southwest monsoon with the former providing more rain during October to December. Temperatures during summer generally reach a maximum of 40°C and a minimum of 26.3°C, although temperatures up to 42°C are not uncommon. Winter temperatures range between 29.6°C and 18°C. A study based on the data available with the Indian Meteorological Department on Madurai over a period of 62 years indicate a rising trend in atmospheric temperature over Madurai city, attributed to urbanization, growth of vehicles and

industrial activity. The maximum temperature of 42°C for the decade of 2001 – 2010 was recorded in 2004 and in 2010.

Sivagangai District:

The Sivagangai district enjoys a tropical climate. The period from April to June is generally hot and dry. The weather is pleasant during the period from November to January. Usually mornings are more humid than afternoons. The relative humidity varies between 65 and 85% in the mornings while in the afternoon it varies between 40 and 70%. The district experiences a very dry and hot climate with low degree of humidity. Normally, the temperature varies from 22^0C to 39^0C. During the year 1999-2000, this district experienced 9561.8 mm of rainfall. There are no perennial rivers in the district. The river Vaigai is the only major one which enters the district near Tiruppuvanam and flows through Sivagangai block. The other seasonal rivers and minor streams flowing through the district are Sarugani, Bambar, Kottagudi, Manimuthar, Uppar, Uppargundam and Thenar in Trippathur block.

2.1.7 Minerals

Madurai District:

Considerable reserve of limestone is reported to be available in Peevandi and Sunnambur Villages of Melur Taluk, Kiliyorpatti in Madurai South Taluk and Thirumal Village in Thirumangalam Taluk of Madurai District. The total deposit available in these areas has been estimated at 10.31 million tonnes. Quality granite is found in Kilavalavu area of Melur Taluk. They are having White and Grey background mixed with orange color dots, blue wavy movement variation with Grey and White background. Granite quarry found near Kilavalavu area of Melur Taluk is shown in Figure -15. Substantial amount of graphite has been reported to have occurred at Urappanur and Pennamangalam villages of Thirumangalam Taluk, Kallithur Village of Usilampatti Taluk and Keeranur village in Melur Taluks. The deposit in these villages has been estimated at 17.5 million tonnes valued at Rs. 437.5 crores. Quartz is another mineral found in Peevanur village of Melur Taluk; however, total occurrence has not been estimated. During 1996-97 to 1998-99 quartz worth 2,04,545 tonnes valued at Rs. 18,89,565 has been exploited in the district for commercial purposes. Another mineral found in moderate quantity in Madurai district is feldspar. During the last 3 years 21,420 tonnes of feldspar valued at Rs. 3,34,470 was exploited commercially in Madurai district. Blue metal jelly occurs mostly in Sedapatti, Kottampatti, and Melur blocks of Madurai district. Though exact quantity of occurrence is not known, during the last 3 years 4 lakh tonnes has been exploited. They are mainly used for construction and road laying purposes. Gravel occurs in Melur, Sedapatti and Usilampatti areas. They are mainly used as filling material.

Sivagangai District:

Graphite reserves are found in Sivagangai district. Sivaganga graphite is of flaky variety with 14% average Fixed Carbon used in the manufacture of refractory bricks, expanded graphite, crucibles and carbon brushes. District has over 600 acres of graphite bearing land in Pudupatti, Kumaripatti and Senthiudayanathapuram of Sivaganga taluk. Estimated reserve of graphite ore in leasehold area is three million tonnes.

2.1.8 Transport

Madurai District:

Madurai district is well connected to all the cities and also with the intra-city transportation. On the aspect of infrastructure, the district has fared well in the case of roads, electrification of villages and transport facilities. The total road length in the district is 3173.75 kms. Road infrastructure in the rural blocks (especially backward blocks) of the district needs to be improved. There are variations across the blocks, for which reasons can be identified and based on the need, interventions can be taken up. In very remote villages of the block, especially, Kallikudi, T.Kallupatti, Sedapatti road infrastructure has to be improved. Madurai railway junction is one of the important and major junctions of south Tamil Nadu, which connects majority of the southern districts to the city. It is the second largest by revenue in southern railway.

Sivagangai District:

In Sivaganga district, Sakkottai block accounted for maximum road length of 22.17% of the district road length followed by Kalaiyarkovil (14.38%). The lowest road length was found to be in Thiruppathur (1.22%) followed by Manamadurai (2.47%). Policies to increase the road length of S.Pudur, Thiruppathur and Manamadurai blocks along with conversion of mud roads into BT roads are need of the hour.

2.1.9 National Parks/Wild life Sanctuaries

Vettangudi Bird Sanctuary:

The Vettangudi Bird Sanctuary is located in the Sivagangai district, although its administration is under the authority of Ramanad district. The sanctuary is about 2 km from Solasakarakottai village, about 10 km from Tirupattur and about 51 km from Madurai on Madurai-Melun-Tirupattur road. The Vettangudi Bird Sanctuary (38.4 ha) consists of three freshwater tanks: Periyakollukudikanmai (13.5 ha), Chinnakollukudi-kanmai (6.2 ha) and Vettangudi-kanmai (18.2 ha). All three tanks are in the vicinity of villages and were together declared as a sanctuary in 1997. The Sanctuary receives its major rainfall from the northeast monsoon, with 330-390 mm precipitation between October and December. The southwest monsoon also brings some showers between June and September, with a maximum rainfall of 300 mm. Thus, from June to December,

rainwater helps to sustain the breeding birds at Vettangudi. Besides this, Vaigai, the major river of the district, and surrounding paddy fields also provide foraging grounds. The area surrounding the wetland has been invaded by *Prosopis chilensis*, which was introduced a few decades ago. *Acacia nilotica* trees grow in the lake and remain submerged for a few months. On the bunds, large *Tamarindus indica*, *Azadirachta indica* and *Mangifera indica* trees are present which provide roosting sites for birds.

2.1.10 Demography

Madurai District:

As per the census 2011, Madurai district has the total population of 3,038,252. There was an increase in population in all the blocks and the decadal population growth rate of the district was 17.84% in 2011. This increase in growth rate may be due to employment opportunities and urban context prevailing in the particular block. The sex ratio for Madurai had increased from 0.978 in 2001 to 0.990 in 2011. According to 2011 census, the literacy rate of Madurai district was 83.45%. The district literacy rate is higher than that of the state literacy average of 80.1%. The literacy rate of Madurai had increased to 83.45% in 2011 from 77.82% in 2001. Among the males, 89.72% were literates and among the females the rate was 77.16%. The female literacy rate had increased from 69.35% in 2001 to 77.16% in 2011.

Sivagangai District:

Sivaganga district had a population of 11,53,747 in 2001 and it increased to 13,39,101 in 2011 with a decennial growth of 16.1%. As a percentage of the State's population, Sivaganga district population was 1.9% in 2001 and remained the same in 2011 also. In Sivaganga district, Sakkottai had the highest population (2.48 laks) and Kannangudi (0.33 laks) had recorded the lowest during 2011. This may be attributed to out migration for better employment opportunities and/or better infrastructural facilities. Most of the blocks in the district registered a negative sex ratio for the years 2001 and 2011 except Manamadurai and Sivaganga which increased from 0.989 to 1.000 and 0.982 to 0.999 respectively. In Sakkottai block, sex ratio remained the same (1.004) during the reference years. In overall terms, the sex ratio was satisfactory in the district. Among the blocks, Sakkottai block stands at the top in male and total literacy rates, whereas in the female literacy rate, Devakottai stands first according to the Census 2011. In the year 2011, S.Pudur block scored last among the blocks in Sivaganga district. Though the female literacy rate of Sakkottai had increased by 14.54% and the total literacy rate by 4.2%, the male literacy rate had a steep drop by 9.43% in 2011 compared to 2001.

3.0 Scope of the Study

The report contains the findings of the study to identify risks, identification of most likely risks, health and Environmental hazards/Impacts along the Right of Way (RoW) & possible natural and man made disasters happening in the project area and suggesting suitable remedial measures in all stages of the projecti.e. Design phase, Construction phase, and Operation phase and preparation of Disaster Management Plan.

The scope of the environmental report is given below:

- Reconnaissance survey, environmental screening and categorization framework for the proposed project to include the environmental aspects from the planning stage of the project.
- Review of National, state and local environmental regulatory requirements on environmental aspects, including necessary clearances from State and Central Government in the context of proposed expressway project.
- Collecting secondary baseline data from relevant sources for various environmental attributes around the project site.
- Conduct environmental analysis of alternatives for different project components and provide specific inputs to technical analysis of alternatives.
- An environmental impact assessment for the proposed project to identify and quantify potential impacts of the project.
- Impact prediction and assessment of key aspects of the project such as ambient air, noise, water etc., and assessment of other aspects of the project with sustainable mitigative measures.
- Suggesting a typical environmental management plan with appropriate line estimates duly addressing the key environmental attributes.
- Suggesting post project environmental studies to be carried-out.

The objectives of the study are:

i. Identify the hazards

ii. Decide areas of hazards in the project and how it shows impact.

iii. Evaluation of risks and decide on precautions

iv. Record of findings and its implementation

v. Assessment of hazards likely likely happening due to result from the proposed project and suggesting suitable mitigation measures.

vi. Preparation of Disaster Management Plan in order to support in the event of road accidents (major road mishaps, gas tanker explosions, fire hazards etc.) and natural calamities (floods, cyclones, earth quakes etc.).

4.0 Terms of Reference for EIA study

4.1 Study Area

A detailed study of all the environmental features falling within the immediate corridor of impact, which has been considered as 500 m on both sides from center line of road. The other sensitive environmental issues such as protected areas notified under wildlife (protection) Act 1972, critically polluted areas as notified by Central Pollution Control Board, notified Eco-sensitive areas, interstate boundaries and international boundaries, water bodies of ecological significance etc., were identified within 15 km from the alignment. The detailed informations from the RoW as well as the area falling within 500 meters on the either side road were collected from primary sources and the other environmental features within 15 kms aerial distance as explained above were collected from secondary data sources. Rapid EIA studies will be carried out for the proposed project in accordance with the Environmental Impact Assessment Notification, 2006 and amendment thereof as well as MoEF EIA Guidance Manual, 2010.The Environmental Baseline data will be generated based on the EIA Guidance Manual, 2010. Environmental Baseline monitoring report will be prepared as per Standard ToR given in EIA guidance manual by MoEF and the same is enclosed in Appendix V. The details of the EIA study is given below.

4.2 Description of the Environment

The baseline data on various environmental features will be collected from secondary and primary sources from field surveys and investigations in order to describe the environmental settings of the project area. The data on different environmental components along the project corridor will be collected by site reconnaissance survey in order to establish environmental condition of the project area. The study area covers 15 km either side of the project stretch.

4.3 Baseline Data Generation

(a) Secondary Data Collection:

Secondary data will be collected from secondary sources like publishes, literature from various government and private agencies, NGOs, or institutions on physical, biological and social components of environment. The data will be reviewed for establishing existing environmental and ecological status within the project area.

(b) Field Survey:

Field survey carried out for the identification of the environmental sensitive zones within the study area and physical verification of all the identified sensitive zones with respect to the location of the project alignment and activities proposed. Field surveys are included with the measurement of environmental quality in terms of ambient air quality, water quality, soil quality, background noise level and ecology (Flora, fauna and roadside trees). Procedure for the measurement of environmental quality surveys carried out as per guidelines of the Ministry of Environment and Forests, Government of India. Following details on different environmental features will be collected either from the secondary sources or from field surveys.

(i) Physical Environment:

- **Topography:** Topography, ground conditions, altitude, slope, etc.

- **Soil and Geology:** Soil type and it characteristics, soil erosion and land slide problem, geology of the area.

- **Water Environment:** An inventory survey of all water bodies located within 500 m on either side of the project road sections will be carried out. Details of rivers, streams, springs, lakes, reservoirs within 500 meters of the proposed road right of way will be collected from the site along with their usage and importance for the local population. Study of hydrology of the project road, natural drainage of the project region, existing drainage pattern of the project road, runoff flow direction, possible flooding, erosion were collected. Information on ground water table, ground water availability in the project area, exploitation of ground water was studied from the generated primary data.

- **Meteorological Data:** Meteorological data covering maximum and minimum wind speed, wind direction, rain fall, relative humidity and temperature for last 30 years period will be collected from the nearest Indian Meteorological Department (IMD) station i.e station. History of special weather phenomenon like cyclones, cloud bursts, etc., will be collected from the nearest meteorological station for a period of 50 years. The wind velocity, wind direction and wind rose, rainfall, temperature and relative humidity along the proposed alignment are being recorded using a micro-meteorological station during the study period.

- **Environmental Quality:** Baseline environmental quality data in terms of water, ambient air, noise levels and soil quality would be generated as follows:

Ground & Surface Water Resources and Quality: Water samples from ground water and surface water resources along the project road alignment will be collected and analysed for the physico-chemical & biological parameters. Surface water samples will be collected from different water bodies/rivers/streams along the project stretch and ground water samples from most commonly used ground water sources along the project road. Surface water samples will be analysed for Temperature, pH, Turbidity, EC, Colour,TSS,TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, Lead, Mercury, Boron, Chromium, Phenols, Cadmium, Total Coliform, Faecal Coliform etc., and ground water samples will be analysed for Temperature, pH, Turbidity, EC, Colour, TSS, TDS, Odour, DO, BOD, COD, TKN, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Ammonia, Chloride, Sulphate, Phosphate, Nitrate, Fluoride, Surfactants, Dissolved Iron, Copper, Zinc, Manganese, Arsenic, lead, Mercury, Boron, Chromium, Phenol, Cadmium, Total Coliform, Faecal Coliform etc.

Ambient Air Quality: Ambient air quality monitoring process will be carried out all along the project stretch covering different category of land use (residential, commercial/industrial, sensitive zones like schools, college and hospital) with a frequency of twice a week for one month. The ambient air quality monitoring are being carried out for Particulate Matter (size less than 10 µm) or PM_{10}, Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) by following the MoEF guidelines.

Noise Environment: The noise monitoring will be carried out along the project alignment covering sensitive locations such as residential, hospitals, schools, sanctuaries etc. The noise monitoring will be done for 24 hrs at each location. During nigh time and day time, equivalent noise levels will be generated for each monitoring locations to have an idea of noise pollution levels in the study area.

Soil Quality: The soil samples of different area along the project stretch will be collected for assessing the physico-chemical characteristics of the soil in the project area. The quality parameters are pH, electrical conductivity, sand, silt,

clay, texture, moisture retention capacity, infiltration rate, bulk density, porosity, organic matter, nitrogen, potassium, phosphorous, Pb, iron and organic carbon.

Existing Land Use Pattern: Land use pattern will be established along the project road classifying forest area, agriculture land, barren land, urban & rural settlements, water bodies, hills etc., along the project road.

Environmental Monitoring Locations

The samples (surface water, ground water, noise and soil) were collected by the 1st week of May and air sampling is going on since mid of March. Interpretation and analysis of air, water, noise and soil monitoring results will be presented in the draft EIA/EMP report. The stated parameters will be collected and analysed as per the MoEF EIA Manual for Highways, 2010. References adopted from MoEF EIA Manual for Highways are given in the following Table.

Table : References adopted from MoEF EIA Manual for Highways

S. No.	Characteristics	No. of samples	Selection of the parameters
1	Micro-meteorological data (The wind velocity, wind direction & wind rose, rainfall, temperature and relative humidity)	1 station x 90 days = 90 samples	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page-17, Section 4.4: Air Environment) Meteorological data covering maximum and minimum wind speed, wind direction, rain fall, relative humidity and temperature for atleast 10 years period should be presented from the nearest meteorological station.
2	Ambient Air Quality Monitoring (Particulate Matter (size less than 10 µm) or PM_{10}, Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_X) and Carbon Monoxide)	5 stations x 2 days x 12 weeks = 120 samples	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.4: Air Environment) Baseline data for the parameters - Particulate matter size less than 10 µm or PM_{10} µg/m^3, particulate matter size less than 2.5 µm or $PM_{2.5}$ µg/m^3, Sulphur dioxide (µg/m^3), Nitrogen dioxide (µg/m^3) and Carbon Monoxide (µg/m^3) in the study area should be generated for one season other than monsoon as per CPCB norms.
3	Water Quality Monitoring - Surface and Ground water (Physico-Chemical, bacteriological and heavy metals analysis)	11	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.3: Water Environment) Details of surface water bodies within right of way and within 500 m from the right of way should be

S. No.	Characteristics	No. of samples	Selection of the parameters
			documented along with the present usage. The samples should be collected and analyzed as per the standard procedures.
4	Noise Quality Monitoring (L_{eq} day, L_{eq} night, L_{eq} min, and L_{eq} max)	9	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.5: Noise Environment) While selecting the monitoring locations specific importance is to be given for sensitive environmental receptors like thickly populated areas, hospitals, schools, wildlife corridors etc. Hourly monitoring of noise levels (L_{eq}) should be recorded for 24 hours by using integrated noise meter. Noise standards have been designated for different types of land use, i.e. residential, commercial, industrial areas and silence zones as per the Noise Pollution (Regulation and Control) Rules 2000.
5	Soil Quality Monitoring (Physico-Chemical and heavy metals analysis)	6	EIA Guidance Manual for Highways - Prepared by MoEF, 2010 (Page - 17, Section 4.2: Land Environment) The soil profile of the highway alignment should be presented based on the soil series maps of National Bureau of Soil Survey and Land Use. The suggested parameters for soil analysis are pH, Electrical conductivity, sand (%), silt (%), clay (%), texture, moisture retention capacity (%), infiltration rate (mm/hour), bulk density (gm/ cc), porosity (%), organic matter (%), nitrogen (mg/1000g), potassium (mg/1000g), phosphorous (mg/1000g), sulphates and sodium sulphates.

Air Environment

Standard methods/procedures are adopted during environmental monitoring analysis. After a preliminary reconnaissance of the study region and taking into account the meteorological (predominant wind directions, wind speed), topographic conditions, major settlements & its traffic volume and details on existing industrial activities in the study region, one (01) micro-meterological station and five (05) ambient air quality monitoring stations were identified in the study area spread along Melur to Karaikudi road alignment. Micro-meterological station gives climatological condition of the study area by giving temprature, relative humidity, wind direction, wind speed and rainfall data. The parameters being monitored by air quality monitoring instruments are PM_{10}, $PM_{2.5}$, SO_2,

NO_2 and CO. List of the micro-meterological station and ambient air quality monitoring locations are given in the following Tables.

Table : Micro-Meterological station Location

Location Code	Location	Latitude	Longitude
MM 01	Pillayarpatty	10.120287	78.668045

Table : Ambient Air Quality Monitoring Locations

Location Code	Location	Latitude	Longitude
AAQ-1	Melur	10.025917	78.351783
AAQ-2	Thriruppatur	10.110833	78.611617
AAQ-3	Pillayarpatti	10.12355	78.66815
AAQ-4	Kundrakudi	10.111467	78.6964
AAQ-5	Koviloor	10.082883	78.731733

Water Environment

Selected physico-chemical parameter along with bacteriological indicators of pollution will be used for describing the baseline status of water environment. Generation of baseline data for water quality covers sources of groundwater and surface water. The assessment of water quality in the study area includes:

- Surface water quality (IS 2296)
- Groundwater quality (IS 10500)

Surface Water Quality

During the preliminary assessment, six (06) surface water sampling locations were identified for assessing the water quality. These monitoring locations were identified by considering proximity to the project site, their activities and depending upon its utility by the people in the region. The details of the proposed sampling locations are given in Table 16 and photographs of some sampling locations are shown in the following Table.

Table : Surface Water Quality Sampling Locations

Location Code	Location	Latitude	Longitude
SW-1	Pattalam lake near Melur	10.030222	78.344187
SW-2	Quarry site, waterbody at Keelavalavu	10.066992	78.424099
SW-3	Pond near Pillayarpatti	10.117802	78.668851
SW-4	Oorani pond near Kundrakudi	10.111777	78.698043
SW-5	Pond near Saali	10.10151	78.720755
SW-6	Waterbody near Koviloor	10.084329	78.742294

Groundwater Quality

Groundwater is one of the main sources of water in the project corridor for domestic, commercial and other irrigation use hence the rate of extraction of ground water is at a massive scale. For assessing the groundwater quality in the study area, five (05) sampling locations were identified (bore wells/dug wells). Selection of samples considered as per the utilization of the people along the proposed project stretch. The details of the proposed groundwater sampling locations are given in the following Table.

Table : Groundwater Quality Sampling Locations

Location Code	Location	Latitude	Longitude
GW 1	Melur village	10.024112	78.346363
GW 2	Thiruppathur Town	10.100661	78.603274
GW 3	Pillayarpatti village	10.11987	78.670191
GW 4	Kundrakudi village	10.113458	78.698447
GW 5	Koviloor village	10.083258	78.737495

Noise Environment

Keeping in view of the proposed highway project, field monitoring were carried out and nine (09) noise monitoring locations were identified. The locations were selected based on land use pattern, traffic intersections and diversions along the existing alignment. Precision integrated sound level meter having statistical unit with digital display was used for 24 hour noise level monitoring in the present study. The noise quality monitoring was planned and executed as per protocol for ambient level noise monitoring. Noise levels are recorded as L_{eq} day and L_{eq} night. The details of the proposed Noise Level Monitoring locations are given in the following Table.

Table : Noise Level Monitoring Locations

Location Code	Location	Latitude	Longitude
N 1	Near 0 Chainage, junction	10.022574	78.351473
N 2	Junction near Keelavalavu village	10.060022	78.43652
N 3	Junction near Ranasingapuram village	10.093910	78.579408
N 4	Junction near Tiruppathur town	10.098757	78.605417
N 5	Junction at Pillayarpatti	10.120340	78.667492
N 6	Junction at the joining of MPK and PT road	10.121663	78.676102
N 7	Junction near Kundrakudi village	10.110829	78.695835
N 8	Junction near Patharaikudi village	10.090392	78.722911
N 9	Junction near Koviloor village	10.083709	78.733734

Land Environment

The soil samples of different area along the project stretch were collected from six (06) locations near agricultural areas for assessing the physic-chemical characteristics of the soil in the project area. The quality parameters will include pH, electrical conductivity, sand, silt, clay, texture, moisture retention capacity, infiltration rate, bulk density, porosity, organic matter, Nitrogen, potassium, phosphorous, iron and organic carbon. Soil sampling locations are listed in the following Table.

Table: Soil Sampling Locations

Location Code	Location	Latitude	Longitude
S 1	Melur	10.027629	78.351262
S 2	Kundenthalpatti	10.078511	78.521735
S 3	Tiruppatur	10.098679	78.606464
S 4	Pillayarpatti	10.120453	78.676366
S 5	Kundrakudi	10.103598	78.705699
S 6	Koviloor	10.084478	78.734411

(ii) Biological Environment

Flora and Fauna: Information on vegetation within the study areas will be collected from secondary source as well as through site investigation. The vegetation study includes forest area & road side plantation within the proposed RoW. List of flora and fauna within 10 km on either side of project road will also be collected.

Ecological Sensitive Locations: Details of ecological sensitive locations, such as Wildlife Sanctuary, National Parks, Bio-Reserve etc., will be collected & studied within 10 km on either side of project road.

Ecological Studies: Terrestrial and aquatic ecological studies will be conducted along & within the proposed RoW. Common trees, shrubs, other vegetation, common fauna, rare and endangered species are surveyed, identified and studied. The roadside trees within the proposed RoW will be surveyed for botanical & vernacular name of species, girth wise enumeration etc.,

(iii) Socio-Economic and Cultural Environment

Socio-economic Details: Study of demographic details including population, schedule caste, schedule tribe, literacy, occupation pattern in the settlements along the project

road, economic and social conditions, life styles, etc., along the project road and study of infrastructure facilities in the settlements along the project road. The social study comprising socio-economic survey along the project road and reflect the number and details of Project Affected Persons (PAPs) along the project road. Following data will be collected:

- Details of the properties, houses, businesses etc.
- Activities likely to be effected by land acquisition and annual financial loses.
- Data covering the vulnerable groups or persons including women, children, elderly.
- People below the poverty line, indigenous people and people in notified settlements
- Data on diseases in the locality and existing health care facilities
- Data on demography including traditional skills and sources of livelihood along the proposed site.

Places of Tourist, Historic, Archaeological and Religious Interests: Places of tourist interest, historical, archaeological and places of religious interests (if any) will be identified along the project road in the immediate vicinity and also within study area (15 km on either side of the project road).

Common Resources: An inventory of common community resources such as educational institutions, health centres, recreation centres, courts, libraries, community centres, public toilets, religious and cultural features etc., situated along the project corridor are prepared.

4.4 Analysis of Alternatives to the Project Road

In-depth study of related maps, topographic sheets, physical inspection and environmental and social screening will be carried out in order to find out the technically and environmentally sound, most feasible and environmental friendly alignment. Alternatives are considered for the analysis of "without" and "with" project situations and components. The selected alternatives will be compared in terms of their potential social & environmental impacts, capital & recurrent costs, suitability under local conditions, institutional training and monitoring requirements. For each alternative, environmental costs and benefits will be quantified and criteria for the selection of alternative will be stated. Analysis of alternative includes alignment selection, finalization of bypasses, road

widening to reduce the cutting of tree, minimizing the demolition of structures, grade separators, services roads, vehicular, pedestrian and cattle underpass, quarry materials, road safety, etc.

4.5 Anticipated Environmental Impacts and Mitigation Measures

The environmental impact assessment will be conducted in accordance with the requirement of the Ministry of Environment & Forests (MoEF) norms and guidelines. The collected primary and secondary data are compiled and analyzed to establish a comprehensive database and assess the existing baseline environmental condition. After establishing the baseline status of the study corridor and analysis of the project proposals and activities, the potential impacts on environmental components would be identified for pre-construction, construction and operational stages of the project. On the basis of the existing baseline environmental condition within the project area and the nature and extent of activities envisaged in construction/operation phase, **the impacts would be identified and assessed for "Without and With Project Scenario"** during construction and operation phases of the project**.** Wherever practicable, a quantitative analysis will be performed for the impacts by using appropriate modeling method. All potential direct and indirect influence due tothe proposed project will also addressed. The scope of work not confined only to alignment but the impacts due to the associated construction activities assessed. The following aspects are given due importance during assessment of impacts and recommending remedial measures:

- Alignment of the project road and topographical changes.
- Roadside drainage to avoid water logging, erosion & environmental degradation.
- Impact on soil along the project road.
- Impact of solid waste generated and solid waste management plan.
- Impact on borrow area and quarries.
- Impact on road safety.
- Impact on ambient air quality due to air pollution during construction activities and vehicle movement. Prediction of ambient air quality due to projected vehicular traffic would be carried out using computer based CALRoads View software (CAL3QHCR).
- Impact of noise level during construction activities and vehicle movement. Prediction of noise levels would be carried using Federal Highways Noise Administration (FHWA) model during operation phase.
- Assessment of impacts of road construction on ground and surface water sources in the study area.

- Impact of solid waste generated during construction phase of the project.
- Nature, quantity and disposal of construction spoils, wastes and waste water.
- Impacts of flora and fauna and ecological resources due to construction and operation of the project.
- Public health & sanitation, and occupational health & safety of construction workers.
- Impact on safety of local people during construction and operation phases.
- Population affected and socio-economic impacts.

4.6 Public Consultation and Information Disclosure

Public consultations will be conducted in the affected areas along the project road. The issues discussed during public consultation will be incorporated in the design framework, environmental management and mitigation plan.

4.7 Environmental Monitoring Programme

Environmental monitoring plan for construction and post construction phases of the project road will be formulated to ensure effectiveness of implemented environmental mitigation measures. Cost of Environmental Monitoring Plan for construction and post construction phase of the project will be given in EIA/EMP report.

4.8 Environment Management Plan

After detailed analysis of all the environmental impacts and issues, a proper and adequate Environmental Management Plan (EMP) will be prepared with the aim to avoid, mitigate or eliminate the adverse impacts due to the project. This will cover roles and responsibilities for mitigation operations, emergency response procedures & supervision, financing, monitoring and reporting. EMP also includes the prospects of environmental enhancement within the project area. EMP will envisage the plans for the proper implementation of mitigation measures to reduce the adverse environmental impacts due to project activities during construction and operation phase. The following issues are addressed in the EMP:

- Preventive, mitigation, compensatory & enhancement measures for minimization & abatement of the undesirable impacts caused during the construction and operation stage.
- Details of management plans (compensatory plantation, solid waste management plan, borrow area management plan, occupational safety and health plan)

including their implementation schedule and supervision programme.

- Identified/recommended institutional set up for implementation of the EMP including institutional requirements, staffing and training.
- Environmental monitoring programme during construction and operation phase including performance indicators, monitoring mechanisms, implementation programme and cost.
- Resettlement action plan for affected families as per NHAI Policy and NRRP 2007.
- Environmental Management Budget considering the environmental aspects for the project.

4.9 Structure of EIA Report

EIA report is followed the structure as per EIA Notification, 2006 and consists of the following Chapters:

- Introduction
- Project Description
- Analysis of Alternatives (Technology and Site)
- Description of the Environment
- Anticipated Environmental Impact & Mitigation Measures
- Public Consultation
- Resettlement and Rehabilitation Plan
- Project Benefits
- Environmental Monitoring Program and Environmental Management Plan
- Summary & Conclusion