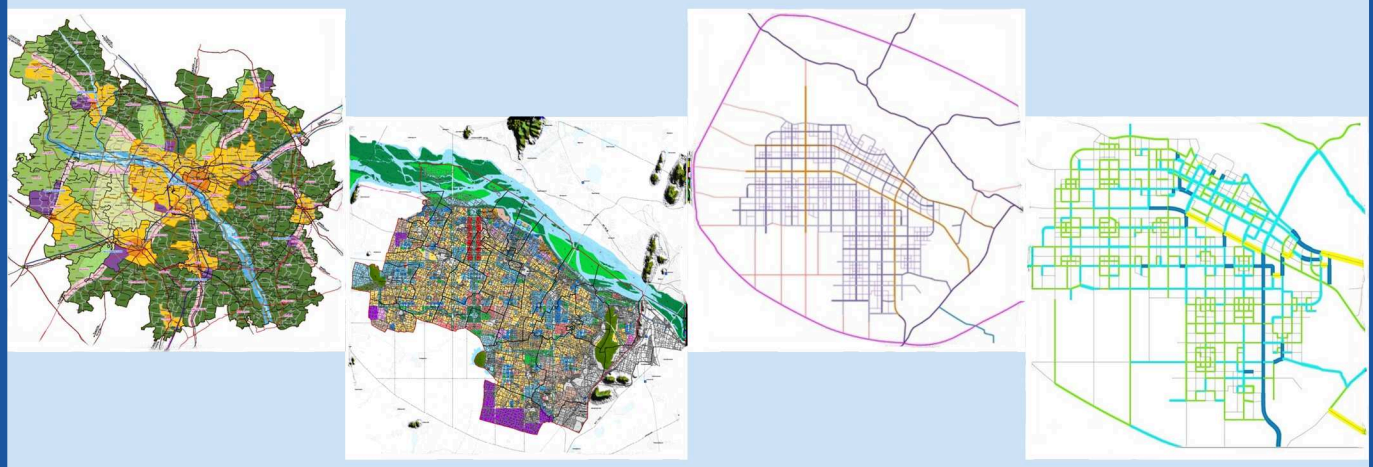
# GOVERNMENT OF ANDHRA PRADESH

AMARAVATI DEVELOPMENT CORPORATION LTD.

ANDHRA PRADESH CAPITAL REGION DEVELOPMENT AUTHORITY

SMART INTEGRATED INFRASTRUCTURE MASTER PLAN AND DETAILED PROJECT REPORTS FOR PHASE-I INFRASTRUCTURE WORKS FOR/AT AMARAVATI CAPITAL CITY - "DETAILED PROJECT REPORTS AND DETAILED DESIGNS ON DEVELOPMENT OF ARTERIAL AND SUB-ARTERIAL INTEGRATED ROAD INFRASTRUCTURE & DEVELOPMENT OF EAST-WEST AND NORTH-SOUTH URBAN ROADS INCLUDING INTERCHANGES/ GRADE SEPARATORS"



# Environmental Assessment and Environmental Management Plan

## for 10 Priority Roads:

## E6, E8, E12, N9, N4, N11, N14, E10, E14 & N16

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aarvee associates
architects engineers & consultants pvt. ltd.
An ISO 9001:2008 Certified Company

– GIIC 贵州海上丝路国际投资有限公司 JV
GUIZHOU MARITIME SILK ROAD INTERNATIONAL INVESTMENT CORPORATION

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| | |
|---|---|
| AAQ | Ambient Air Quality |
| ADB | Asian Development Bank |
| ADC | Amaravati Development Corporation Limited |
| AP | Andhra Pradesh |
| AP CRDA | Andhra Pradesh Capital Region Development Authority |
| APHA | American Public Health Association |
| APPCB | Andhra Pradesh Pollution Control Board |
| BA | Borrow Area |
| BIS | Bureau of Indian Standards |
| BOD | Biochemical Oxygen Demand |
| BoQ | Bill of Quantities |
| BRT | Bus Rapid Transit |
| BSI | Botanical Survey of India |
| C/L | Center Line |
| CBD | Central Business District |
| CD | Cross Drainage |
| CFE | Consent for Establishment |
| CFO | Consent for Operation |
| cm | Centimeters |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon dioxide |
| COD | Chemical Oxygen Demand |
| CoI | Corridor of Impact |
| CPCB | Central Pollution Control Board |
| CPSE | Central Public Sector Enterprises |
| CPWD | Central Public Works Department |
| CRZ | Coastal Regulation Zone |
| CSR | Corporate Social Responsibility |
| cu ft/s | Cubic Feet/Second |
| Cum | Cubic Meters |
| dB | Decibel |
| DFID | Department for International Development |

| | |
|---|---|
| DG | Diesel Generator |
| DMP | Disaster Management Plan |
| DPR | Detailed Project Report |
| DST | Department of Science & Technology |
| E | East |
| EA | Environmental Assessment |
| EC | Environment Clearance |
| EIA | Environmental Impact Assessment |
| EMC | Environmental Management Cell |
| EMP | Environmental Management Plan |
| ESMF | Environmental and Social Management Framework |
| FDS | Fine Dust Samplers |
| FHWA | Federal Highways Administration |
| FRL | Finished Road Level |
| GoAP | Government of Andhra Pradesh |
| GoI | Government of India |
| GW | Ground Water |
| Ha | Hectares |
| HC | Hydro Carbon |
| HFL | High Flood Level |
| HPa | Hecta Pascals |
| HYDS | High Yield Deformed Bars |
| IMD | Indian Meteorological Department |
| IRC | Indian Road Congress |
| IS | Indian Standard |
| ISO | International Organization For Standardization |
| JICA | Japan International Cooperation Agency |
| KCC | Krishna Canal Junction railway station code |
| KL | Kilo Litres |
| Km | Kilometre |
| KWD | Krishna Western Delta |
| LPG | Liquid Petroleum Gas |
| m | Metre |

| | |
|---|---|
| MDR | Major District Road |
| mm | Milli Metre |
| MoEF & CC | Ministry Of Environment, Forests And Climate Change |
| MoSRTH | Ministry Of Shipping Road Transport And Highways |
| MPN | Most Probable Number |
| MW | Mega Watts |
| N | North |
| NABL | National Accreditation Board For Testing And Calibration Laboratories |
| NGOs | Non-Governmental Organization |
| NHAI | National Highways Authority Of India |
| no. | Number |
| NOC | No Objection Certificates |
| NOx | Nitrogen Oxides |
| NSRCCA | Nagarjuna Sagar Right Bank Canal Command |
| NTTPS | Narla Tata Rao Thermal Power Plant |
| NTU | Nephelometric Turbidity Units |
| PAP | Project Affected People |
| PIA | Project Influence Area |
| PM | Particulate Matter |
| $PM_{10}$ | Particulate Matter < 10 Micrometre size |
| $PM_{2.5}$ | Particulate Matter < 2.5 Micrometre size |
| ppm | Parts Per Million |
| R.D | Relative Density |
| R.dom | Relative Dominance |
| R.F | Reserve Forests |
| R.F | Relative Frequency |
| REET | Rare Or Endangered Or Endemic Or Threatened |
| RHS | Right Hand Side |
| RoW | Right Of Way |
| RPM | Respirable Particulate Matter |
| RWH | Rain Water Harvesting |
| S | South |
| s | Second |

| | |
|---|---|
| SC | Scheduled Caste |
| SEIAA | State Environment Impact Assessment Authorities |
| $SO_2$ | Sulphur Dioxide |
| sq | Square |
| ST | Scheduled Tribe |
| SW | Surface Water |
| SWM | Solid Waste Management |
| TCE | Tata Consulting Engineers |
| TDS | Total Dissolved Solids |
| TIFAC | Technology Information, Forecasting & Assessment Council |
| ToR | Term of Reference |
| URDPFI | Urban and Regional Development Plan Formulation and Implementation Guidelines |
| VGTM UDA | Vijayawada Guntur Tenali Mangalagiri Urban Development Authority |
| W | West |
| ZSI | Zoological Survey Of India |

# Chapter 0
# EXECUTIVE SUMMARY

## 0.1 INTRODUCTION

Road projects are generally undertaken to improve the economic and social welfare of the people. At the same time, they may also create an adverse impact on the surrounding environment. The Government of Andhra Pradesh has envisaged the development of World Class People's Capital of Andhra Pradesh which is being located in between the cities of Vijayawada and Guntur. APCRDA has plans to develop World Class integrated transport infrastructure systems with facilities for seamless travel in line with rapid urbanization for the Amaravati Capital City. A grid network is proposed for the new Amaravati Capital city and it is classified based on functions & capabilities. The different types of roads proposed are major arterial roads, arterial roads, sub-arterial roads and collector roads. Road network length of major arterial roads are 44 km, arterial roads are 107 km, sub-arterial roads are 145 km, collector roads are 277 km and internal roads are 1100 km. Among the proposed road network, 10 priority roads are of primary interest and the EIA report is prepared package wise for the proposed roads.

Roads developmental activities will have an adverse effect on the neighboring Environment of the proposed project. Hence, these activities required to be well planned and should consider the environmental impacts. The Environmental Impact Assessment (EIA) is a technique which is necessary for identification, quantification and assessment of potential environmental impacts. Assessment of these impacts should commence early in the planning process of the project to enable full consideration of alternatives and to avoid later delays and complications in the proposed project. The environmental impact study is a part of the Detailed Project Report of the total roads prepared for the World Bank.

The MoEF&CC, Government of India, Notification of 14$^{th}$ September 2006 and its amendment enlist projects in Schedule that proposed Green Field Capital of Amaravati has already got Environmental Clearance for the entire project from State Level Environmental Impact Assessment Authority (SEIAA), Andhra Pradesh in their vide order no. SEIAA/AP/GTN-151/2015, Dated:09.10.2015. According to MoEF&CC EIA Notification, the sub-arterial roads are neither falling under Category -A or Category -B hence, Environmental Clearance is not required. As per the World Bank Safe Guard policy, the project is classified as Category "A". However, EIA and EMP report is prepared duly adopting both the National and WB norms (OP 4.01 Environmental Assessment).

## 0.2 Project Description

### 0.2.1 Location

The proposed road network is predominantly of rural character within the area of proposed capital city area of 217.23 sq.km. The grid network comprises roads designed and classified based on functions and capabilities. For classification of roads (as prescribed by the Urban and Regional Development Plan Formulation and Implementation Guidelines URDPFI 2014) were identified and used as the major classes of roads in the Master Plan are Major Arterial Roads, Arterial Roads, Sub-arterial, and Collector roads. Based on its classification, the Right of Way (RoW) and Length of the roads proposed in the project are given in Table -0.1.

**Table -0.1: Classification of Different Types of roads**

| S. No. | Type of Road | Nos. | RoW (m) | Length (km) |
|---|---|---|---|---|
| 1 | Major Arterial Roads | 3 | 60 | 44 |
| 2 | Arterial Roads | 17 | 50 | 107 |
| 3 | Sub Arterial Roads | 17 | 50 | 145 |
| 4 | Collector Roads | - | 25 | 277 |

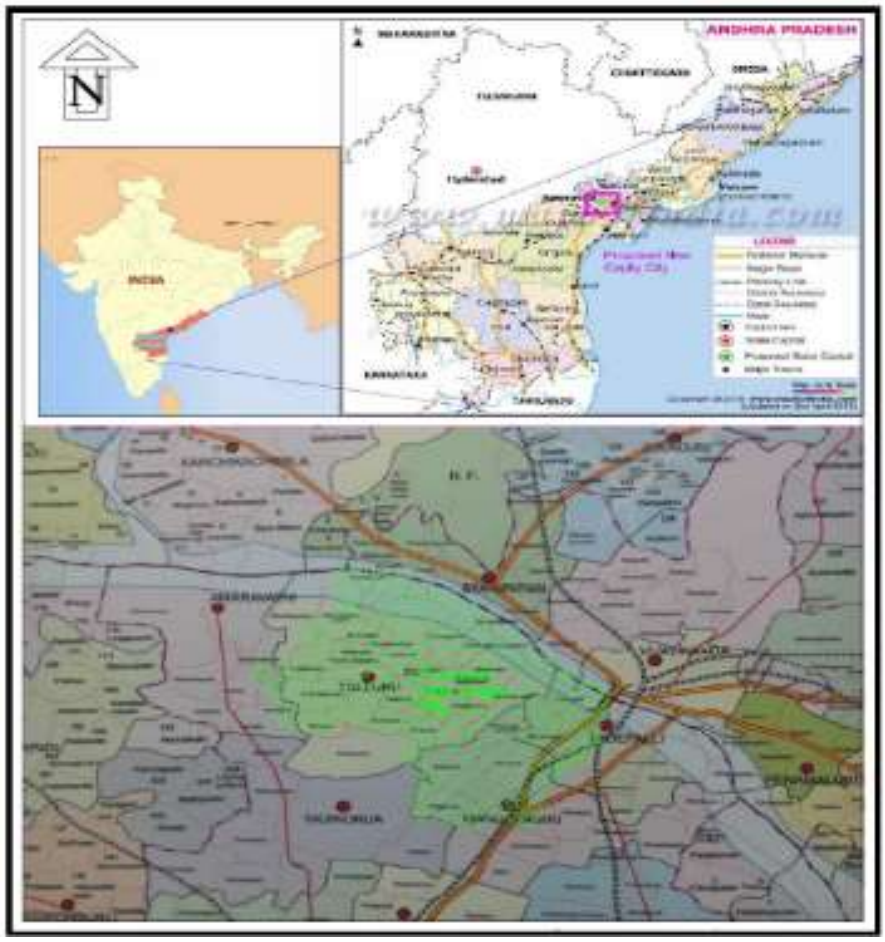



**Figure -0.1: Location Map Showing the Proposed New Capital City**

Unclassified roads such as collector, local and access roads are not identified at Master Plan level, however, detailed guidelines for local roads should be prepared by APCRDA to guide developers during development control. The proposed grid network will also be subcategorized based on the level of social interaction, in line with international practice to create streets for people in urban settings.

The proposed road network of 10 Priority roads (10 nos.) namely are falling under sub-arterial roads category.

### 0.2.2 Project Features

The new Capital city, Amaravati is an almost Greenfield site and is, therefore lacking in infrastructure. Major investment in transportation and infrastructure is required in the coming years to prepare the site as the new Capital of Andhra Pradesh. The transportation and infrastructural requirements, planning intention and objectives have been identified in the master plan. This is to guide the future detailed studies that will be conducted to develop detailed transportation and infrastructure plans for the Capital City. These recommendations have been included in the land use master plan to reserve appropriate land space for infrastructure development. The general features, environmental setting within 10 km radius of the project, other features of 10 Priority roads are given in Table -0.2, Table -0.3 & Table -0.4.

**Table -0.2: General Features of Proposed Roads (10 Roads)**

| Package | Road ID | Type of Road | Length (km) | TCS | No. of structures | Cost (Cr.) |
|---|---|---|---|---|---|---|
| Package-I | E8 | Sub-Arterial | 14.955 | 4-lane + 2 lane BRT | 3 Bridges & 17 Culverts | 329.20 |
| Package-II | N9 | Sub-Arterial | 13.168 | 4 lane + 2 lane BRT | 2 bridge & 17 Culverts | 358.67 |
| Package-III | N4 | Sub-Arterial | 7.170 | 4 lane | 2 bridges & 12 Culverts | 169.34 |
| | N14 | Sub-Arterial | 8.272 | 4 lane | 2 bridges & 7 Culverts | 152.96 |
| Package-IV | E10 | Sub-Arterial | 7.814 | 4 lane | 1 Bridge & 14 Culverts | 168.29 |
| | E14 | Sub-Arterial | 7.360 | 4 lane | 17 Culverts | 203.14 |
| | N16 | Sub-Arterial | 8.777 | 4 lane | 1 bridge & 12 Culverts | 136.51 |
| Package-V | E6 | Sub-arterial | 9.844 | 4-lane + 2-lane BRT | 4 Bridges & 19 Culverts | 161.09 |
| Package-VI | E12 | Sub-arterial | 6.79 | 4-lane + 2-lane BRT | 1 Bridge & 23 Culverts | 217.53 |
| | N11 | Sub-arterial | 8.657 | 4-lane + 2-lane BRT | 1 Bridge & 24 Culverts | 40.25 |
| **Total Length** | | | **92.807** | | **Total Cost (Cr.)** | **1936.98** |

**Table – 0.3: Environmental Setting within 10 Km Radius of the Project**

| S. No | Particulars | Details |
|---|---|---|
| 1 | Latitude and Longitude | North East Coordinate- 16º30'30" N, 80º37' E South West Coordinate-16º29' N, 80º25' E North West Coordinate-16º31' N, 80º22'30" E South East Coordinate-16º24'30" N, 80º34' E |
| 2 | Elevation above Mean Sea Level | Varying from 18m to 260m |
| 3 | Nearest Highway | NH16 passing within the boundary of the subproject influence area (SPIA) |
| 4 | Nearest Railway Station | Krishna Canal Junction Railway Station near Tadepalli |
| 5 | Nearest Airport | Gannavaram Airport 22 km, North-East Direction |
| 6 | Nearest City | Vijayawada, 3 km North-East |
| 7 | Rivers | River Krishna on the northern fringes of the subproject influence area, 160 m, North-East direction from N4 road |
| 8 | Hills/Valleys, Monuments | Tadepalli Hills, 1.40 km |

| S. No | Particulars | Details |
|---|---|---|
| 9 | Archaeologically important places | The Rock Cut Cave Temple, Undavalli, 1650 m, North East direction from E10 road |
| 10 | National Parks/ Forest areas | No National Park within 10 km radius<br><br>Reserve Forests (R.F) are as under:<br><br>Tadepalli R.F, 1.37 km, North-East direction from E12 road<br>Mangalagiri R.F, 2.49 km, South-East direction from E12 road<br>Karlapudi R.F, 2.3 km, West direction from E8 road<br>Motadaka R.F, 4.71 km, South-West direction from N16 road<br>and<br>Kondapalli R.F, 6.18 km, North direction from N14 road |
| 11 | List of major industries in 10 km radius | Dr. Narla Tata Rao Thermal Power Plant, 4.10 km North-East direction. |
| 12 | Wildlife Sanctuary | None within 10 km radius |
| 13 | Core Biosphere reserve | None within 10 km radius |

**Table-0.4: Other Features of the Project**

| S. No | Parameter (s) | Description |
|---|---|---|
| 1 | Location of Project | Amaravati Capital City |
| 2 | Terrain | Mostly Plain |
| 3 | Major Settlement along the Project Stretch | Modugulankapalem, Malkapuram, Lingayapalem, Abbarajupalem, Nelapadu, Penumaka, Velagapudi, Venkatapalem, Bethapudi, Neerukonda, Undavalli, Nekkallu, Sakhamuru, Krishnayapalem, Thullur, Navuluru, and Dondapadu |
| 4 | Rivers/ Streams/ Canals | Seasonal streams:Kondaveeti Vagu and Pala Vagu |
| 5 | Forest area and Sanctuaries | No |
| 6 | Length of the Existing Alignment | - |
| 7 | Existing Carriageway Width | - |
| 8 | Proposed Carriageway width | 14m carriageway with 7m BRT lane (2×2 Lane configuration of 7 m carriageway along with 2 lane BRT) |
| 9 | Administrative locations | Guntur District |
| 10 | State | Andhra Pradesh |

The major requirement of the natural resources such as borrow earth, moorum, aggregates, sand, cement, HYDS bars, bitumen, water etc., for the construction of the 2/4/6-laning of the proposed road infrastructure in the study area.

Borrow earth, moorum, sand and aggregate will be taken from operational licensed borrow areas and quarries located allocated for APCRDA by Department of Mines & Geology, GoAP. Steel, cement, bitumen, emulsion etc., would be sourced from authorized vendors. The water will be extracted from the nearest water bodies after getting formal approval from the irrigation department for construction and worker camps purposes.

### 0.2.3 Need of the project

Roads play a significant part in national and regional economies particularly in the development of trade, tourism, and investment. Construction of the proposed 10 roads and its operation are of great significance because they are expected to generate a wide range of economic activities which should help local development and because a wide communication network is generally felt to represent the new capital city of Amaravati.

### 0.2.4 Cost of the Project

The estimated cost of Rs. 1936.98 Crores is envisaged for the 10 Priority roads. Basic Environmental Management Plan (EMP) cost for Rs. 66.98 Crores and EMP cost included as integral part of the project is estimated to be Rs. 108.55 Crores.

### 0.2.5 Direct and Indirect Benefits:

Road widening project can harmonize with the surrounding environment and serve multiple users with the following benefits.

- The proposed roads will provide interconnectivity within the newly formed state capital of the Andhra Pradesh State and to the major National and State Highways
- Avenue Plantation: There are two rows of Avenue plants proposed along the roads as per IRC-SP-21: 2009. The Avenue plants proposed to be planted along the Proposed 10 roads are about 88,973 nos. either side of the road. The avenue plants proposed are i.e., *Ravi, Nalla tumma, Neem, Veduru, Nagajemudu, Mango, Teku, Maredu etc.* The budget allocation for the avenue plantation is Rs. 8.89 Crores.
- Median Plantation: Since the project is construction of four lane project median will be utilized. The median plantation is proposed in single/quadruple rows and the numbers of species proposed are 60,940 nos. The median plant proposed in the project are i.e., *Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria* etc. The budget allocation for the median plantation is Rs. 2.13 Crores.
- There will be improvements of the economic growth in the surrounding places due to establishment of more industries, institutions, MNCs and other organizations.
- Will improve the economic and social welfare of nearby people.
- Will Increase access to markets, jobs, education, and health services.
- Will Reduce transport costs for both freight and passengers.

## 0.3 Base Line Status of Project Site

Secondary data of the project area has been collected from secondary sources like published literature from various government agencies, or institutions on physical, biological and social components of environment. The data were reviewed and verified for establishing existing environmental and ecological status within the project area. Following documents from different sources were consulted for collection of baseline environmental data. The primary baseline information on different environmental components were collected through field survey. Field surveys were carried out on primary information on the major environmental features such as settlement facilities, drainage pattern of the area, forest, trees within RoW of the alignment, water bodies, river crossing, sensitive receptors, etc. and were studied in detail, which helped in identifying areas of concern along the stretch and critical issues. Consultation with the

local officials and public were carried out also on the salient environmental features of the project area, etc.

Further, primary samples surveys for the environmental components, such as air, surface water, noise and soil quality that are critical in the context of the project were carried out through NABL approved laboratory. The Post-monsoon season monitoring was carried out in the months of October to November 2016.

### 0.3.1 Air Environment

After a preliminary reconnaissance of the subproject influence area and considering the meteorological (predominant wind directions, wind speed) & topographic conditions, proposed traffic volume, major settlements and details on existing industrial activities in the study area, 2,2,4,6,2,4 stations in Package – I,II,III,IV,V and VI respectively were identified for carrying out Ambient Air Quality Monitoring (AAQM) in the study area. The criteria adopted for selecting the monitoring stations, sampling and analysis was carried out as recommended by IS: 5182 and CPCB.

The Air Quality data for the study period were collected at each location on 24 hourly twice in a week for one season as per national guidelines. The parameters selected for analyzing ambient air quality status were Sulphur dioxide ($SO_2$), Nitrogen dioxide ($NO_2$), Particulate Matter ($PM_{10}$ & $PM_{2.5}$), Carbon Monoxide (CO) and Hydrocarbons. Package wise data reveals the findings as described below.

**Package-I:**

The Respirable Particulate Matter (PM10) values observed in the range between 38.5 – 48.3 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was recorded at Sakhamuru.The Fine Particulate Matter (PM2.5) values were found in the range between 16.0 – 21.6 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was found at Sakhamuru.The Sulfur dioxide values were observed in the range between 4.8 – 5.6 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was found at Sakhamuru.The Dioxides of Nitrogen (NO2) values were observed in the range between 14.2 – 16.1 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was recorded at Sakhamuru.The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be well within the stipulated standards of CPCB / WB-EHS Guidelines.

In general, the ambient air quality in the study area is satisfactory and well within the stipulated CPCB Standards.

**Package II:**

The Respirable Particulate Matter (PM10) values observed in the range between 53.6 – 62.6 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial

category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was recorded at Velagapudi.The Fine Particulate Matter (PM2.5) values were found in the range between 19.8 – 26.0 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was found at Velagapudi.The Sulfur dioxide values were observed in the range between 6.0 – 7.8 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was found at Velagapudi.The Dioxides of Nitrogen (NO2) values were observed in the range between 19.5 – 24.2 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was recorded at Velagapudi. The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be slightly exceeding for WB-EHS Guidelines for particulate matter and well within the stipulated CPCB standards for all the parameters.

**Package III**

The Respirable Particulate Matter (PM10) values observed in the range between 43.4 – 68.3 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was recorded at Krishnayapalem.The Fine Particulate Matter (PM2.5) values were found in the range between 19.6 – 28.4 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was found at Krishnayapalem.The Sulfur dioxide values were observed in the range between 5.0 – 8.0 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was found at Krishnayapalem.The Dioxides of Nitrogen (NO2) values were observed in the range between 16.2 – 24.4 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was recorded at Abbarajupalem.The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be slightly exceeding for WB-EHS guidelines for particulate matter and well within the stipulated CPCB standards for all the parameters.

**Package IV**

The Respirable Particulate Matter (PM10) values observed in the range between 42.6 – 56.8 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Bethapudi and minimum value was recorded at Nekkallu.The Fine Particulate Matter (PM2.5) values were found in the range between 18.8 – 24.8 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Penumaka and

minimum value was found at Nekkallu.The Sulfur dioxide values were observed in the range between 5.0 – 6.5 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Bethapudi and minimum value was found at Nekkallu and Krishnayapalem.The Dioxides of Nitrogen (NO2) values were observed in the range between 15.4 – 18.9 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Krishnayapalem and minimum value was recorded at Nekkallu.The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be slightly exceeding for WB-EHS guidelines for particulate matter and well within the stipulated CPCB standards for all the parameters.

**Package V**

The Respirable Particulate Matter (PM10) values observed in the range between 40.0 – 45.2 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.The Fine Particulate Matter (PM2.5) values were found in the range between 16.2 – 20.17 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was found at Nelapadu.The Sulfur dioxide values were observed in the range between 5.1 – 5.9 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.The Nitrogen dioxide (NO2) values were observed in the range between 15.3 – 17.2 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be well within the stipulated CPCB standards/WB-EHS Guidelines for all the locations.

**Package VI**

The Respirable Particulate Matter (PM10) values observed in the range between 34.6 – 50.3 µg/m3 as against the CPCB standard of 100 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was recorded at NerukondaThe Fine Particulate Matter (PM2.5) values were found in the range between 14.0 – 20.8 µg/m3 as against the CPCB standard of 60 µg/m3 for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Yerrabalem and minimum value was found at Neerukonda.The Sulfur dioxide values were observed in the range between 4.2-6.8 µg/m3 against the CPCB standard of 80 µg/m3 for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was found at Neerukonda.The Dioxides of Nitrogen (NO2) values were observed in the range between 13.2-19.3 µg/m3 against the CPCB standard of 80 µg/m3 for residential /

industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was recorded at Neerukonda.The carbon monoxide (CO) levels observed were <1.0 mg/m3 as against the CPCB standard of 4mg/m3 for residential / industrial category. The values were found to be well within the stipulated CPCB standards/WB-EHS Guidelines for all the locations.

**0.3.2 Water Environment:**

**Surface Water Quality:**

During the study period, 2,3,7,8,1 and 6 Surface Water samples were collected & analyzed for assessing the water quality in Packages I,II,III,IV,V and VI respectively. Samples were identified considering proximity to the project site, their activities and depending upon its utility by the people in the study area. Analysis was done for selected physicochemical parameters along with bacteriological indicators of pollution have been used for describing the baseline status of water environment. Package wise surface water quality of the study area is discussed below:

**Package -I:**

Data on physical characteristics indicated variations in pH ranged between 8.16 – 8.18 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics indicated that the total hardness observed to be constant in all samples and is in the range of 130 to 260 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values. The total dissolved solids observed are ranged between 252 mg/l to 738 mg/l and are well within the limits.The chlorides ranged between 45.0 – 220.0 mg/l and are well within the limits.The Nitrates ranged between 3.4– 6.3 mg/l and the Sulphates ranged between 16.4 – 76.8 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.The Fluoride values found to be in the range of 0.30 to 0.50mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.The Dissolved Oxygen in the sources is ranging between 4.5 mg/l to 5.4 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.Biochemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 5 – 24mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be ranged between 20-82 mg/l.

**Package-II:**

Data on physical characteristics indicated variations in pH ranged between 7.80 – 7.98 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics: The total hardness observed to be constant in all samples and is in the range of 160 to 700 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium

values.The total dissolved solids observed are ranged between 336 mg/l to 1428 mg/l and are well within the limits.The chlorides ranged between 75.0 – 430.0 mg/l and are well within the limits.The Nitrates ranged between 3.7– 9.4 mg/l and the Sulphates ranged between 11.8 – 53.9 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.The Fluoride values found to be in the range of 0.60 to 0.80mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.The Dissolved Oxygen in the sources is ranging between 4.4mg/l to 4.9 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes. Biochemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 14 – 30 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be ranged between 48-104 mg/l.

**Package III**

Data on physical characteristics indicated variations in pH ranged between 7.28 – 8.16 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics:

The total hardness observed to be constant in all samples and is in the range of 100 to 580 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.The total dissolved solids observed are ranged between 252 mg/l to 1436 mg/l and are within the limits.The chlorides ranged between 12.8 – 485.0 mg/l and are well within the limits.The Nitrates ranged between 3.1– 10.0 mg/l and the Sulphates ranged between 12.8 – 32.2 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.The Fluoride values found to be in the range of 0.30 to 0.90mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.The Dissolved Oxygen in the sources is ranging between 4.1mg/l to 5.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes. Biochemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 4.1 – 24 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be ranged between 20-82 mg/l.

**Package IV**

Data on physical characteristics indicated variations in pH ranged between 7.28 – 8.50 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics:

The total hardness observed to be constant in all samples and is in the range of 140 to 420 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.The total dissolved solids observed are ranged between 292 mg/l to 878 mg/l and are well within the limits.The chlorides ranged between 60 – 220.0 mg/l and are well within the limits.The Nitrates

ranged between 4.2– 6.3 mg/l and the Sulphates ranged between 14.4 – 76.8 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.The Fluoride values found to be in the range of 0.30 to 0.80mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.The Dissolved Oxygen in the sources is ranging between 4.1 mg/l to 5.4 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.Biochemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 6 – 24.0 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be ranged between 30-82 mg/l.

**Package V**

Data on physical characteristic indicated a pH value of 7.96 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics:

The total hardness observed is found to be 160 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.The total dissolved solids observed to be 448 mg/l and are well within the limits.The chlorides value is found to be 95 mg/l and are well within the limits.The Nitrates concentration is found to be 3.8 mg/l and the Sulphates concentration is found 72.1 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.The Fluoride concentration is found to be 0.30 mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.The Dissolved Oxygen is found to be 4.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.Biochemical Oxygen Demand (BOD) is found to be 14 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be 44 mg/l.

**Package VI**

Data on physical characteristics indicated variations in pH ranged between 7.20-8.29 as against IS standard of 6.5 – 8.5. Odour of water is unobjectionable. The Colour of water found to be well within desirable limit.

Data on chemical characteristics:

The total hardness observed to be constant in all samples and is in the range of 120-360 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.The total dissolved solids observed are ranged between 234-1186 mg/l and are well within the limits. The chlorides ranged between 65-310 mg/l and are well within the limits. The Nitrates ranged between 3.5-6.9 mg/l and the Sulphates ranged between 12.3-172.6 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits. The Fluoride values found to be in the range of 0.30-0.80 mg/l as against the desirable limits of 1 mg/l. Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are

found to be very well within desirable limit. The Dissolved Oxygen in the sources is ranging between 4.3-5.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes. Biochemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 4-20 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents into nearby water bodies. The COD is found to be ranged between 24-64 mg/l.

**Ground Water Quality:**

**Ground Water Quality:**

Ground Water 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 groundwater is at a moderate scale. For assessing the groundwater quality in the study area, 2,2,4,6,2 & 5 samples were collected from the identified bore wells/dug wells. Package wise analytical results are discussed in detail as below:

**Package -I:**

Data on physical characteristics indicated variations in pH ranged between 7.18 – 7.90 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 600 to 800 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits and the permissible limits. The Total Dissolved Solids observed to be high and ranged between 1527 mg/l to 1802 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l.The chlorides ranged between 320.0-370.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l the Nitrates and Sulphates values observed to be ranged between 7.6 – 13.3 mg/l and 257.4 – 291.5 mg/l. Samples are exceeding the permissible limits but within the desirable limits for both Nitrates and Sulphates.The Fluoride values found are in the range of 1.2 – 1.4 mg/l as against the desirable limit of 1.0 mg/l. The samples are within the permissible limit of 1.5mg/l. Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

**Package II:**

Data on physical characteristics indicated variations in pH ranged between 7.08 – 7.41 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 350 to 920mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. However, the total hardness values exceeded the permissible limits at Malkapuram. The Total Dissolved Solids observed to be high and ranged between 1014 mg/l to 1620 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the

desirable limits but well within the permissible limits 2000 mg/l.The chlorides ranged between 145.1-210.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.The Nitrates and Sulphates values observed to be ranged between 6.3 – 8.8 mg/l and 20.7 – 45.8 mg/l. Samples are not exceeding the desirable limits for both Nitrates and Sulphates.The Fluoride values found are in the range of 0.80 – 1.1 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples are not exceeding the permissible limit of 1.5mg/l. Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

**Package III :**

Data on physical characteristics indicated variations in pH ranged between 7.28 – 7.78 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 320 to 680 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. However, the total hardness values exceeded the permissible limits at two sampling locations namely Venkatapalem and Abbarajupalem. The Total Dissolved Solids observed to be high and ranged between 954 mg/l to 1714 mg/l as against the desirable limits of 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits of 2000 mg/l.The chlorides ranged between 170.0-410.1 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.The Nitrates and Sulphates values observed to be ranged between 6.3 – 14.5 mg/l and 16.4 – 174.7 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.The Fluoride values found are in the range of 0.80 – 1.30 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples found to be within the permissible limit of 1.5mg/l.

**Package IV :**

Data on physical characteristics indicated variations in pH ranged between 7.12 – 7.58 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 210 to 940mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. However, the total hardness values exceeded the permissible limits at three sampling locations namely Penumaka, Navuluru and Bethapudi. The Total Dissolved Solids observed to be high and ranged between 930 mg/l to 2868 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l except at Navuluru and Bethapudi.The chlorides ranged between 140.0-740.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.The Nitrates and Sulphates values observed to be ranged between 6.3 – 27.1 mg/l and 16.4 – 296.3 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.The Fluoride values found are in the range of 0.60 – 1.80 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples collected at Navuluru and Bethapudi are found to be exceeding the permissible limit of

1.5mg/l. Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

**Package V :**

Data on physical characteristics indicated variations in pH ranged between 7.33 - 7.46 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 660 - 1300 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits and the permissible limits. The Total Dissolved Solids are observed to be high and ranged between 1024 - 2488 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l except at Ananthavaram.The chlorides ranged between 160-750 mg/l. All samples are well within permissible limits of 1000 mg/l.The Nitrates and Sulphates values observed to be ranged between 19.4-28.9 mg/l and 255.9-621.8 mg/l. Samples are exceeding the permissible limits for Sulphates.The Fluoride values found are in the range of 0.6 – 2.1 mg/l as against the desirable limit of 1.0 mg/l. The samples are within the permissible limit of 1.5mg/l except at Nelapadu.Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

**Package VI:**

Data on physical characteristics indicated variations in pH ranged between 7.15 – 7.82 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.

Data on chemical characteristics:

The Total Hardness observed to be varying in all samples and is in the range of 80-2600 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the permissible limits at Ainavolu, Lingayapalem and Kurugallu.The Total Dissolved Solids observed to be high and ranged between 1024- 10970 mg/l as against the desirable limits 500 mg/l. Samples are well within the permissible limits of 2000 mg/l except at Ainavolu and Yerrabalem . TDS is found to be high in all locations. The chlorides ranged between mg/l and are within permissible limits of 250 mg/l – 1000 mg/l except at MandadamThe Nitrates and Sulphates values observed to be ranged between 7.6-58.6 mg/l and 21.4-254.3 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.

The Fluoride values found are in the range of 0.8-1.80 mg/l as against the desirable limit of 1.0 mg/l. Samples are well within the permissible limit of 1.5 mg/l except at Bethapudi and Yerrabalem. Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

Overall, groundwater quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after pre-treatment.

### 0.3.3 Noise Environment:

The locations were selected based on the 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 ambient noise level monitoring. The analysis of the same is given below:

**Package -I:**

There are two residential locations i.e., Nekkallu and Sakhamuru monitored in the Package -I. The day and night noise levels are observed to be in the range of 53.5 to 54.1 dB (A) & 45.5 to 46.3 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the CPCB Standards/ WB-EHS Guidelines in all monitored locations.

**Package-II:**

There are two residential locations i.e., Malkapuram and Velagapudi monitored in the Package -II. The day and night noise levels are observed to be in the range of 43.8 to 53.0 dB (A) & 45.7 to 54.3 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day & night noise levels are found to be slightly exceeding night time limits for both CPCB standards/WB-EHS Guidelines.

**Package III:**

There are three residential locations i.e., Venkatapalem, Krishnayapalem and Abbarajupalem monitored in the Package -III. The day and night noise levels are observed to be in the range of 51.9 to 53.3 dB (A) & 41.7 to 45.1 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the limits for both CPCB standards/WB-EHS Guidelines.

The location Thullur fall under commercial category. The day and night noise levels are observed to be 68.6 dB (A) & 58.1 dB(A) as against the CPCB Standard of 65.0 & 55.0 dB(A) and the noise levels are not found to be well within the limits at Thullur but well within the limits of WB-EHS Guidelines (70.0 & 70.0 dB(A)). This may be due to temporal local activity/commercial activities observed during the study period.

**Package IV:**

There are six residential locations i.e., Krishnayapalem, Penumaka, Navuluru, Bethapudi, Nekkallu and Dondapadu monitored in the project study area. The day and night noise levels are observed to be in the range of 51.9 to 56.5dB (A) & 41.7 to 46.7 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the limits of CPCB Standards/WB-EHS Guidelines in all monitored locations except at Dondapadu. This may be due to temporal local activity/commercial activities observed during the study period.

**Package V:**

In Package V, all the monitored locations fall under residential category. The daytime noise levels are found to be in the range of 50.2 dB(A) to 51.6 dB(A) and night-time noise levels found to be in the range of 43.5 dB(A) to 43.7 dB(A) for residential

category. The day & night noise levels are found to be well within the limits for both CPCB standards/WB-EHS Guidelines.

**Package-VI:**

In Package V, all the monitored locations fall under residential category except Thullur, which falls under commercial category. The daytime noise levels are found to be in the range of 50.2 dB(A) to 51.6 dB(A) and night-time noise levels found to be in the range of 43.5 dB(A) to 43.7 dB(A) for residential category. The day & night noise levels are found to be well within the limits for both CPCB standards/WB-EHS Guidelines.

### 0.3.4 Land Environment

For land environment 2,2,4,6,2 & 5 numbers of soil samples were collected from different villages falling in the study area to understand the Physico-chemical properties of the soil for Package I,II,III,IV,V and VI respectively. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any, and all other factors governing the Physico-chemical properties of the soil.

**Package-I**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 7.99 – 8.02. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 166 – 466 µS/cm. The available Nitrogen in the soil is 498 – 536 mg/Kg, found to be average/sufficient requirement for the plantation. The available Phosphorous in the soil is 44 – 62 mg/Kg, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 234 – 252 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low. Overall, the soil quality in the study area is found to be satisfactory and fit for plantation.

**Package-II**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 8.02 – 8.14. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 316 – 398 µS/cm. The available Nitrogen in the soil is 546 – 612 mg/Kg, found to be average/sufficient requirement for the plantation. The available Phosphorous in the soil is 46 – 54 mg/Kg, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 228 – 264 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low. Overall, the soil quality in the study area is found to be satisfactory and fit for plantation.

**Package-III**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 7.98 – 8.12. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 124 – 866 µS/cm. The available Nitrogen in the soil is 456 – 596 mg/Kg, found to be average/sufficient requirement for the plantation. The

available Phosphorous in the soil is 47 – 66 mg/Kg, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 239 – 264 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low.

**Package IV**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 7.98 – 8.12. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 124 – 866 µS/cm. The available Nitrogen in the soil is 456 – 596 mg/Kg, found to be average/sufficient requirement for the plantation. The available Phosphorous in the soil is 47 – 66 mg/Kg, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 239 – 264 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low.

**Package V :**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 8.09-8.14. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 105 - 248 µS/cm. The available Nitrogen in the soil is 528 - 544 Kg/ha, found to be average/sufficient requirement for the plantation. The available Phosphorous in the soil is 54-68 Kg/ha, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 244-268 Kg/ha, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low.

**Package VI:**

The soil along the study area is classified as silty- clay in nature. Characterized by pH, the values are in the range of 7.96-8.14. If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples, EC is found to be in the range between 90-158 µS/cm. The available Nitrogen in the soil is 528 - 548 Kg/ha, found to be average/sufficient requirement for the plantation. The available Phosphorous in the soil is 44-58 Kg/ha, found to be average requirement for the plantation and agricultural purposes. The available Potassium in the soil is 228-266 Kg/ha, found to be sufficient requirement for the plantation and agricultural purposes. Trace metal concentrations found to be low.

### 0.3.5 Biological Environment

**Land use:** Project area general terrain condition is plain, hilly near the Rock Cut Cave Temple, Undavalli and near Ananthavaram village area and gently sloping towards of Krishna river basin area. The project area covered by Amaravati capital city is 217.23 sq km. About 75% land is developable, 2% of hills, 8% of Islands, 7% Village settlements, 6% of water bodies and 2% of River Krishna and rest is others. The proposed landuse is 25.7% primary green spaces, 20.7% rivers/streams/farm ponds, 8.8% of roads, 9.0% village settlements, 14.5% of residential/commercial, 7% industries, rest is others. There is no forest area present well within the corridor of impact and no rare and endangered species are present well within 10Kms radius of study area.

**Flora & Fauna:** The proposed project of construction of roads in Capital City is passing through plain terrain and occasionally rolling terrain. The major crops grown in the sub-project influence area are paddy, chilli, cotton, red gram, black gram, among pulses, cereals like jowar and maize, sorghum, jute, fodder grass, subabul and commercial crops like turmeric. Whereas in the sub-project area no cultivation is envisaged. Faunal species like Common Mongoose, Squirrel, Indian Hare, Monkeys etc. are found in the study area. Some of the most common birds found in the project includes Doves, Yellow-throated sparrow, Maina, Bulbul, Jungle fowl etc.

### 0.4 Identification and Prediction of Impacts

This section summarizes the pollution potential of the proposed road project and its possible impact on the surrounding environment during construction and operational phases.

### 0.4.1 Impact on Land Environment

An engineering design of the road is prepared incorporating all environmental safeguards as per WB Environmental guidelines for highway projects. Design of roads is strategically carried out to ensure minimal negative impact on environment. About 1743 nos of trees & 78 nos of farm ponds are avoided from the corridor of impact in the proposed roads. However, there are a total of 39 nos of farm ponds whose lost water spread area of about 17.65 acres is lost and 849 nos. of trees are falling under the proposed alignments of 10 Priority Roads. Apart from these, there are no groundwater sources and cultural properties in corridor of impact.

The estimated construction & demolition (C&D) waste and muck generated from 10 priority roads are given below :

| Road | C&D (m3) | Muck (m3) |
|---|---|---|
| E8 | 1895 | 655470.54 |
| N9 | 121.29 | 511576.3 |
| N4 | 62.04 | 264308.03 |
| N14 | 1769 | 365590.71 |
| E10 | 0 | 390988.9 |
| E14 | 474.15 | 366528.74 |
| N16 | 0 | 438391.33 |
| E6 | 686.28102 | 1093818.23 |
| N11 | 70.79973 | 400716.97 |
| E8 | 34.10999 | 344801 |

The total cost for the disposal of the C&D and muck is estimated to be Rs. 40.63 Cr and provision for the same is made in the EMP.

### 0.4.2 Impact on Air Quality

Road construction will involve earth excavation, backfilling and concreting. Impacts on air during the construction phase could be due to earth excavation, backfilling and transportation of construction materials, D.G sets which may lead to rise in air pollution. It is estimated that a total reduction of 18731078.52 Tonnes/year of $PM_{10}$ and 41624618.93 Tonnes/year of $PM_{100}$ in fugitive dust emissions from haulage roads, excavation and loading & unloading activities during construction phase of 10 Priority Roads with an effective implementation of EMP throughout the construction phase. However, the impact on ambient air quality will not be significant, since the dust and gases generated is

confined to the proposed area and as it will be taken care of by adopting suitable control measures as described in EMP. Also, this impact is localized.

During operation phase, significant negative impact on the ambient air quality is envisaged due to increase of traffic in the Greenfield area. CALRoads (US EPA Preferred / recommended model) is an air quality model used to predict pollutant concentration near urban roads/ highways. Model requires source strength, meteorology and site geometry, the model can predict pollutant concentrations for receptors located within 500m of the roadway. The model runs based on crosswind Finite Line Source Gaussian formulation and the thermal turbulence created by hot vehicle exhaust & mechanical turbulence created by moving vehicles. The predicted air quality results and isopleths are given in impact assessment chapter. All the predicted values found to be well within the stipulated CPCB Standards for $PM_{10}$, $NO_2$ & CO for the year 2050 in most of the locations.

### 0.4.3 Impact on Water Quality

To prevent accumulation of water by the roadside, adequate cross drainage (CD) structures in the form of culverts with adequate discharge and drainage along the road capacity will be constructed. During reconstruction of old cross drainage structures and construction of new ones, diversion is required to aid uninterrupted movement of traffic. Material will not be put in the drainage to avoid blockage and prevent the erosion. This will help in protecting the aquatic ecology. There are 17 bridges (proposed) and 162 box/pipe culverts (proposed) operated for adequate discharge of cross drainage in the project. No permanent impact is anticipated on water quality due to the project.

Construction activities may temporarily deteriorate surface water quality in terms of increased turbidity as well as oil and grease. The mitigation measures to protect the water quality include proper disposal of water and other liquid wastes arising from construction. Also, stream courses and drains will be kept free from dumping of solid wastes and earth material.

**River/Lakes/Farm ponds Abutting/Falling in the project:** River Krishna is flowing in the study area from NW to SE of the project location. There are 74 nos. of farm ponds/ streams/canal abutting close to the 10 Priority roads. River Krishna is a perennial river, major streams such as Kondaveeti vagu & Pala vagu are having low-flow regime during March – July whereas farm ponds and lakes are dry between March – July.

There are 39 nos of farm ponds falling within the corridor of impact. The lost water spread area on account farm ponds works out to be about 17.65 acres. Enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.

The farm ponds/ lakes falling in the corridor of impact and sub-project influence area are mostly developed for meeting the agricultural needs of the villagers. These farm ponds/ lakes, canals & streams and River Krishna are having very common aquatic flora & fauna. Avia fauna are also found to be common species as identified in the Chapter -6. There are no migratory, rare, endangered and threatened species identified in the farm ponds falling under the proposed alignments of project. However, due importance will be given to the ecological habitat during improvement or rehabilitation of Kondaveeti vagu, Pala vagu and other streams. Population of local fauna is very minimal & translocation is not feasible.

### 0.4.4 Impact on Noise Quality

The impact of noise levels from the project on the neighboring communities would be anticipated with the increase in vehicles and vary with vehicles speed. The increased noise level is attenuated by vegetative noise barriers (two rows of plants) in all the sensitive receptor areas as identified in Table 6.71. The major sources for noise pollution during construction will be movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. The construction equipment with high noise levels, loading and transportation of material near the borrow areas will affect the construction personnel and other humans in the area.

During operation phase, prediction of noise model under diverse traffic conditions in newly formed Andhra Pradesh State capital of Amaravati is really a challenging task as there is no traffic exists on the road. The noise model showed better results than earlier developed noise model for Indian traffic conditions and it was developed by Environmental Systems Design Modeling Division, CSIR National Environmental Engineering Research Institute, Nagpur, Maharashtra, India. The model has been developed to calculate equivalent traffic noise based on four input variables i.e. equivalent traffic flow (Qe), equivalent vehicle speed (Se) and distance (d) and honking (h). The traffic data is predicted and statistically analyzed peak hour (morning & evening rush hours) for the ultimate year 2050. The package wise assessment of noise levels is given in impact assessment chapter. Overall the predicted values found to be well matching with the similar density of population of India.

The impact of noise levels from the project on the neighboring communities would be anticipated with the increase in vehicles and vary with vehicles speed. The increased noise level is attenuated by vegetative noise barriers (two rows of plants) in all the sensitive receptor areas as identified in Table 6.71. The major sources for noise pollution during construction will be movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. The construction equipment with high noise levels, loading and transportation of material near the borrow areas will affect the construction personnel and other humans in the area.

### 0.4.5 Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment during the project construction and operation phases. Several marginal activities and jobs would be available to the locals in the project. The project will provide livelihood opportunities during construction phase. The project will provide improvements in road network leading to improved socio economic status of the study area. The land prices are anticipated to rise. Increasing access to markets, investments, jobs, education, and health services.

### 0.4.6 Impact on Land and Soil Quality

Construction of 4 lane/ 4 lane + 2 lane BRT road with urban roads norms may lead to a change in the land use pattern of areas adjacent to the road. The existing land adjacent to the road at present is mostly of barren and very partially agricultural use, Government of AP has already collected about 98% Capital City area under Land Pooling Scheme for the development of People's Capital of Andhra Pradesh.

The project corridor lies mostly in plain and thus, no disfiguration of land is envisaged due to construction activities except for the opening of borrow pits.

## 0.5 Environmental Management Plan

Based on the detailed evaluation of the likely impacts on various environmental parameters, an environmental management plan is prepared. The mitigative measures for minimization of adverse impacts, green belt development/plantation program have been incorporated in the chapter on environmental management plan. Post-project Monitoring and analysis shall be carried out as described in the EIA report. The frequency, methodology of sampling and testing for various pollutants specified by CPCB/APPCB will be followed. This plan also specifies the organizational requirements and institutional strengthening necessary for sound environmental management of the project. The major components of the EMP are:

1. EMP Implementing Agency
2. Monitoring of the EMP implementation
3. Training on Environmental management
4. Budget for EMP implementation

ADC/APCRDA will establish an Environmental Management Cell (EMC) to supervise and implement the mitigation measures as documented in the EMP. This EMC must also be adequately empowered to discharge the responsibilities as outlined in the EMP. To ensure smooth implementation of EMP the project proponent will have to collaborate with various government agencies like Public Works Department, Revenue Department, State Pollution Control Board, State Forest Department, Police Department and other allied departments.

The EMC constituted by the APCRDA/ADC shall be the prime agency for monitoring all the activities during both the phases. Contractor will implement the day to day environmental monitoring, mitigation & management activities whereas; PMC will take care about the supervision of the day to day monitoring of environmental works. The Director, Landscape & Environment of APCRDA/ADC shall review & supervise all activities are monitored as per EMP. In addition to implementing and monitoring different environmental attributes, EMC shall also be actively involved in imparting training and raising environmental awareness level of Contractors and the construction staff so as to enable them to take the environmental aspects into consideration as and when required.

## 0.6 Costs towards Implementation of Environment Management Plan

The design and construction of the project involves several items such as sprinkling on haulage roads, muck/debris disposal, plantation, erosion prevention, rehabilitation of Borrow areas, safety signage, etc., which are included in the contractor cost. Only those items that are not covered under the budget for construction are shown in the EMP implementation budget. The Budget for Environmental Management Plan for Items to be covered in BoQs works out to be Rs. 66.98 Crores and the budget for Environmental Management Plan for Items included in Project Cost works out to be Rs. 108.55 Crores.

## 0.7 Disclosure of EA & EMP Report

Draft EA & EMP report was prepared and disclosed on APCRDA website on 4th March 2017, subsequently advertised both in leading Telugu and English daily Newspapers inviting public, NGO's and other interested groups for public consultation workshop, and the same was held on 4th April 2017. Additional time was announced for submission of suggestions on the EA &

EMP report by Email, post or by hand (none received). Additional public consultations were held at seven distributed villages from 19th to 22nd July 2017. The latest EA and EMP report was prepared duly incorporating all the minutes of meeting of public consultations/workshop and The World Bank comments issued in the month of June 2017. This report will be disclosed and once again presented at the proposed public consultation meeting to be held in the last week of August 2017. Upon receiving the comments if any, the final EA & EMP report will be delivered.

# Chapter 1
# INTRODUCTION

## 1.0 Introduction

Road projects are generally undertaken to improve the economic and social welfare of the people. At the same time, they may also create an adverse impact on the surrounding environment. People and property in the direct path of the road works are affected. The environmental impact of road projects include damage to sensitive Eco-systems, soil erosion, changes to drainage pattern and thereby groundwater, interference with animal and plant life, loss of productive agricultural lands, resettlement of people, disruption of local economic activities, demographic changes, accelerated urbanization and increase in air pollution. Road development and operation should, therefore, be planned with careful consideration of the environmental impact. To minimize these adverse effects that may be created by urban road development projects, the techniques of EIA become necessary. The Government of Andhra Pradesh has envisaged the development of World Class People's Capital of Andhra Pradesh which is being located in between the cities of Vijayawada and Guntur.

The Andhra Pradesh Capital Region Development Authority (AP CRDA) comprises parts of Krishna and Guntur districts in Andhra Pradesh state. The AP CRDA is constituted through Andhra Pradesh Capital Region Development Act, 2014 replacing Vijayawada Guntur Tenali Mangalagiri Urban Development Authority (VGTM UDA). The Capital Region covers broadly an area of about 8352.69 $km^2$ from 56 mandals is the largest urban development region in the country. It includes 30 mandals from Krishna and 26 mandals from Guntur District. The region also includes the capital city of Andhra Pradesh state scheduled to develop in an approximate extent of 217 $km^2$. In view of this, Andhra Pradesh Capital Region Development Authority (AP CRDA) was enacted by Government of Andhra Pradesh by AP CRDA Act, 2014. The proposed capital city is being developed with 'state-of-the-art' infrastructure including world class roads, water supply facilities, administrative and institutional complexes, drainage, sanitation, Solid Waste Management (SWM) facilities, river front development etc., among others.

APCRDA intends to prepare a Smart Integrated Infrastructure Master plan & Detailed Project Reports for Phase -I Infrastructure works for / at Amaravati Capital City. Under this project, a detailed Infrastructure Master plan consisting of individual master plans for transport, water, energy, ICT, landscapes, fire, disaster management. As a part of

the sub-project design of the transport, APCRDA has plans to develop World Class integrated transport infrastructure systems with facilities for seamless travel in line with rapid urbanization for the Amaravati Capital City. A grid network is proposed for the new Amaravati Capital city and it is classified based on functions & capabilities. The different types of roads proposed are major arterial roads, arterial roads, sub-arterial roads, collector roads and internal roads.

Road network length of major arterial roads is 44 km, arterial roads is 107 km, sub-arterial roads is 145 km, collector roads is 277 km and internal roads is 1100 km. Among the proposed road network, 10 Priority roads namely E8, N9, N4, N14, E10, E14, N16, E6, N11 and E12 are of primary interest and the EIA report is prepared package wise for 10 Priority roads.

The Urban Roads developmental activities effect adversely on the neighboring Environment of the proposed project. Hence, these activities required to be well planned and should consider the environmental impacts. The Environmental Impact Assessment (EIA) is a technique which is necessary for identification, quantification and assessment of potential environmental impacts. Assessment of these impacts should commence early in the planning process of the project to enable full consideration of alternatives and to avoid later delays and complications in the proposed project.

**1.1 Objectives**

The major objective of this study is to establish present environmental condition along the project corridor through available data / information supported by field studies to evaluate the impacts on relevant environmental attributes due to the construction & operation of the proposed project; to recommend adequate mitigation measures to minimize / reduce adverse impacts and to prepare an Environmental Management Plan (EMP) for timely implementation of the mitigation measures to ensure that the project will result in a high quality and safe road to users in a sustainable and environment-friendly manner. An Environmental Impact Assessment (EIA) study basically includes:

- Establishment of the present environmental scenario;
- Study of the specific activities related to the project;
- Evaluation of the potential environmental impacts;
- Undertake an analysis of alternatives by bringing in environmental considerations into the upstream stages of sub-project planning and design;

- Preparation of Environmental Management Plan that specifies the measures to mitigate adverse impacts and enhance positive impacts of the sub-project on the environment, along with the monitoring, capacity building and institutional arrangements.

## 1.2 Scope of the Study

**The scope of the environmental report is given below:**

- An environmental screening and categorization framework for the proposed project to identify the environmental analysis and planning aspects of the project as per MoEF & CC EIA guidelines, 2006 & subsequent amendments thereof/ Amaravati Sustainable Capital City Development Project (ASCCDP) Environmental & Social Management Framework prepared duly considering the WB Guidelines. (Detailed Environmental Screening process is given in Chapter -3).
- Review of National /International, state and local environmental regulatory requirements on environmental aspects, including assisting APCRDA /ADC in getting necessary approvals from the funding agencies.
- Establishing environmental baseline, covering the specific location of project sites – such as major towns, junctions, existing bypasses, proposed bypasses, forest stretches, proposed quarries, borrow areas, sensitive locations (schools, temples, hospitals, archaeological sites etc.).
- Carryout environmental study in the light of baseline conditions and proposed project activities to identify key environmental issues and defining the scope of detailed environmental assessment to be carried out as part of Infrastructure Master plan to APCRDA. During screening, consideration shall be paid to:
    - Location of the project stretch with respect to environmentally sensitive areas, and community concerns.
    - Volume, nature and technology of construction. The screening process shall include stakeholder consultations.
    - Conduct environmental analysis of alternatives for urban roads bypasses and provide specific inputs to technical analysis of alternatives.
    - The objectives of such analysis shall be to minimize environmental impacts and provide specific inputs to feasibility analysis.
- Impact assessment and prediction with respect to various environmental attributes i.e., land, air, water, noise, soil, socio-economic, ecological & biodiversity aspects of the project.

- Preparation of Implementable Environmental Management Plan with budgetary provisions and suggesting post project monitoring plan.

### 1.3 Need for Environmental Impact Assessment

Urban road developmental activities should be planned and executed after considering the potential environmental impacts. To minimize these adverse impacts that may be created by urban road development projects, the techniques of Environmental Impact Assessment (EIA) become necessary. Identification and assessment of potential environmental impacts should be an integral part of the project life cycle. It should commence early in the planning process of the project to enable a full consideration of alternatives and to avoid later delays and complications.

### 1.4 Project Proponent

The Government has enacted **Andhra Pradesh Capital Region Development Authority (AP CRDA) Act 2014** (Act No. 11 of 2014) and it got assent of the Governor of Andhra Pradesh on 29-12-2014 and it came into force w.e.f 30-12-2014. Section 3 of the Act enables the State Government to declare by Notification the "Capital Region" and "Capital City Area" for the State of Andhra Pradesh. Section-4 of the Act enables establishment of Capital Region Development Authority for planning, co-ordination, execution, supervision, financing, funding and for promoting and securing the planned development of the Capital Region and Capital city area for the state of Andhra Pradesh and for managing and supervising urban services in the new capital area and for the matters ancillary thereto. The Government notified 7068 $km^2$ area for Capital Region vide G.O.Ms.No.253 MA & UD (M2) Department dated 30.12.2014. The Master Plan for Capital city for the area of 217 $km^2$ and the Amaravati Development Corporation (ADC) has been formed for the development and implementation of Capital City Area. The AP CRDA has assigned the "Smart Integrated Infrastructure Master Plan & Detailed Project Reports for Phase-I Infrastructure works for / at Amaravati Capital City" to M/s. Aarvee Associates, Hyderabad and M/s. GIIC, China, vide agreement dated 09.09.2016.

### 1.5 Generic Structure of EIA report

In terms of the EIA notification of the MoEF&CC dated 14th September 2006, the generic structure of the EIA document shall be as under:

1. Introduction
2. Project Description

3. Approach & Methodology
4. Environmental Regulatory Framework
5. Analysis of Alternatives (Technology and Site)
6. Description of the Environment
7. Anticipated Environmental Impact & Mitigation Measures
8. Environmental Management Plan
9. Environmental Monitoring Plan
10. Environmental Cost Estimates
11. Summary & Conclusions
12. Disclosure of Consultants engaged

# Chapter 2
# PROJECT DESCRIPTION

## 2.0 Project Location

The proposed Amaravati City of Andhra Pradesh falls in Guntur district of Andhra Pradesh and on the right bank side of Krishna River. This is covered in 24 revenue villages falling in three mandals namely Thulluru, Tadepalli and Mangalagiri and part of Tadepalli municipality. The site is abutting the River Krishna on the west of Old National Highway from Prakasam Barrage to Y-junction at Mangalagiri. The nearest railway station is Krishna Canal Junction Railway Station near Tadepalli and the nearest airport is at Gannavaram. The existing land use of the site is consisting of – fallow developable land, village settlements and farm ponds etc. The proposed road network is predominantly of urban roads category within the area of proposed capital city area of 217.23 km$^2$. Project location map is given in Figure 2-1.

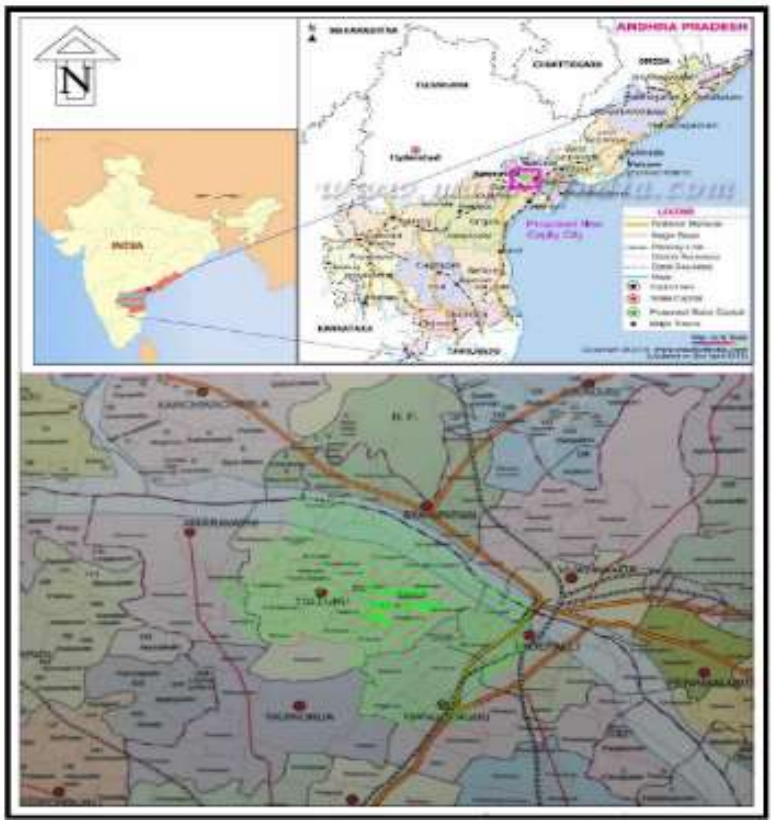



**Figure 2-1: Location Map showing the proposed new capital city**

## 2.1 Description of the Proposed Project

The grid network comprises roads designed and classified based on functions and capabilities. For classification of roads (as prescribed by the Urban and Regional Development Plan Formulation and Implementation Guidelines URDPFI 2014) were identified and used as the major classes of roads in the Master Plan are: Major Arterial Roads, Arterial Roads, Sub-arterial, Collector roads and Internal roads. Based on its classification, the Right of Way (RoW) and Length of the roads proposed in the project are given in Table 2-1.

**Table 2-1: Classification of Different types of roads**

| S. No | Type of Road | Nos. | RoW (m) | Length (km) |
|---|---|---|---|---|
| 1 | Major Arterial Roads | 3 | 60 | 44 |
| 2 | Arterial Roads | 17 | 50 | 107 |
| 3 | Sub-arterial Roads | 17 | 50 | 145 |
| 4 | Collector Roads | - | 25 | 277 |
| 5 | Internal Roads | - | 15.6/17 | 1100 |
| **Total length of Road Network** | | | | **1673** |

Unclassified roads such as collector, internal, local and access roads are not identified at Master Plan level, however detailed guidelines for local roads should be prepared by APCRDA to guide developers during development control. The proposed grid network will also be sub-categorized based on the level of social interaction, in line with international practice to create streets for people in urban settings. The different type of proposed roads is described below.

### 2.1.1 Major Arterial Roads

- The major arterial roads will provide circulation along the fringe of the city, therefore allowing through-traffic to bypass the Capital city Core.
- The downtown road will provide a traffic route from the major arterial road to the CBD
- Speeds along major arterial road are generally high to minimize travel time along the major arterial roads
- Major Industrial Zones to be located near the major arterial roads.

### 2.1.2 Arterial and Sub-arterial road network

- An arterial and sub-arterial network is developed to ensure mobility between the major areas within the City i.e. CBD, commercial zones, major townships and transport hubs.
- The arterial network also serves as the major transit corridors, especially for rapid transit systems.
- The sub-arterial network supports the arterial network, and is the primary access to township development zones.
- Infrastructure mains are to be located within or adjacent to the arterial network to ensure access to utilities.
- Traffic speeds along arterial roads should be maintained at 40-60 kmph.

### 2.1.3 Collector road network

- The collector road network is the main distributor of traffic at neighborhood level.
- Access to developments is to be gained from the collector roads.
- Access and Local roads are to be connected to the collector road network.
- Collector roads are to be generally designed for higher social interaction, and therefore speeds should be limited to no more than 40kmh, depending on context.
- Village Roads are to be integrated to the Collector Road network.

The proposed road hierarchy matrix is shown in Figure 2-2 below.

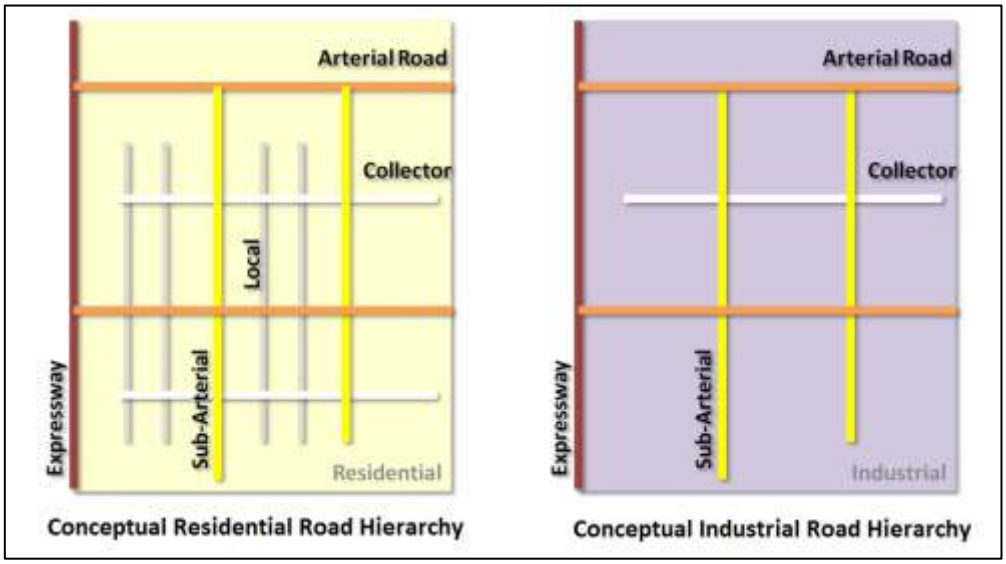



**Figure 2-2: Proposed road hierarchy matrix**

The details of the proposed major road network in Capital City area is given in Figure 2-4. Ten sub-arterial roads as outlined below are proposed to be taken up on priority to facilitate access to maximum number of existing villages as well as institutions and land pooling scheme layouts. LPS schemes layouts that are getting connected are: Nekkallu, Sakhamuru, Ainavolu, Penumaka, Navalluru, Buthalpudi, Krishnaiahpalem, Venkataiahpalem, Neerukonda, Velagapudi, Mandadam, Thulluru, Abbarajupalem, Anantavaram, Dondapadu etc. Table 2-2 shows the proposed 10 Roads+08 roads under ASCCDP Project are given below.

**Table 2-2: Details of the proposed road network under ASCCDP**

| S. No | Road ID | Type and RoW | Chainage (km) | Length (km) | Geo Co-ordinates | |
|---|---|---|---|---|---|---|
| | | | | | From | To |
| **10 Priority Roads** | | | | | | |
| 1 | E12 | Arterial Road– 50m | 0.000 to 6.79 | 6.79 | 16°27'33.43"N 80°29'57.57"E | 16°27'34.23"N 80°33'46.77"E |
| 2 | N16 | Sub Arterial Road – 50m | 0.000 to 8.777 | 8.777 | 16°28'49.82"N 80°26'41.04"E | 16°32'41.60"N 80°26'40.34"E |
| 3 | N14 | Sub Arterial Road – 50m | 0.000 to 8.272 | 8.272 | 16°29'9.78"N 80°27'51.77"E | 16°33'38.82"N 80°27'51.03"E |
| 4 | N9 | Sub Arterial Road – 50m | 0.000 to 13.168 | 13.168 | 16°29'9.08"N 80°25'14.91"E | 16°29'10.35"N 80°33'11.03"E |
| 5 | N4 | Sub Arterial Road – 50m | 0.000 to7.170 | 7.170 | 16°27'5.70"N 80°33'11.47"E | 16°30'47.13"N 80°33'26.20"E |
| 6 | E8 | Sub Arterial Road – 50m | 0.000 to 14.955 | 14.955 | 16°29'49.92"N 80°25'9.59"E | 16°29'51.17"N 80°32'50.01"E |
| 7 | E6 | Sub Arterial Road – 50m | 0.000 to 9.844 | 9.844 | 16°30'23.89"N 80°25'49.58"E | 16°30'58.92"N 80°30'49.04"E |
| 8 | N11 | Sub Arterial Road – 50m | 0.000 to 8.657 | 8.657 | 16°28'53.81"N 80°29'40.52"E | 16°33'35.93"N 80°29'39.70"E |
| 9 | E14 | Sub Arterial Road – 50m | 0.000 to 7.360 | 7.360 | 16°26'30.84"N 80°29'47.37"E | 16°26'11.87"N 80°33'47.39"E |
| 10 | E10 | Sub Arterial Road – 50m | 0.000 to 7.814 | 7.814 | 16°28'42.29"N 80°30'13.88"E | 16°29'5.63"N 80°34'22.04"E |
| **8 Roads (Phase II)** | | | | | | |
| 11 | E2 | Sub Arterial Road – 50m | 0.000 to 6.10 | 6.10 | 16°32'41.61"N 80°26'40.37"E | 16°33'18.36"N 80°29'39.76"E |
| 12 | E4 | Sub Arterial Road – 50m | 0.000 to 15.56 | 15.56 | 16°32'7.17"N 80°26'11.12"E | 16°30'2.77"N 80°34'21.91"E |
| 13 | E15 | Sub Arterial Road – 50m | 0.000 to 4.07 | 4.07 | 16°25'51.32"N 80°29'43.47"E | 16°25'51.60"N 80°31'25.07"E |
| 14 | N1 | Sub Arterial Road – 50m | 0.000 to | 3.67 | 16°28'23.50"N | 16°29'49.79"N |

| S. No | Road ID | Type and RoW | Chainage (km) | Length (km) | Geo Co-ordinates | |
|---|---|---|---|---|---|---|
| | | | | | From | To |
| | | | 3.67 | | 80°35'22.94"E | 80°35'49.40"E |
| 15 | N5 | Arterial Road – 50m | 0.000 to 2.06 | 2.06 | 16°25'52.41"N 80°32'55.83"E | 16°27'0.21"N 80°32'55.60"E |
| 16 | N2 | Sub Arterial Road – 50m | 0.000 to 2.13 | 2.13 | 16°29'5.24"N 80°34'22.08"E | 16°30'14.38"N 80°34'21.99"E |
| 17 | N7 | Sub Arterial Road – 50m | 0.000 to 12.24 | 12.24 | 16°25'17.54"N 80°32'0.70"E | 16°31'48.26"N 80°32'33.82"E |
| 18 | N18 | Sub Arterial Road – 50m | 0.000 to 2.30 | 2.30 | 16°29'8.90"N 80°25'30.02"E | 16°30'24.26"N 80°25'29.73"E |

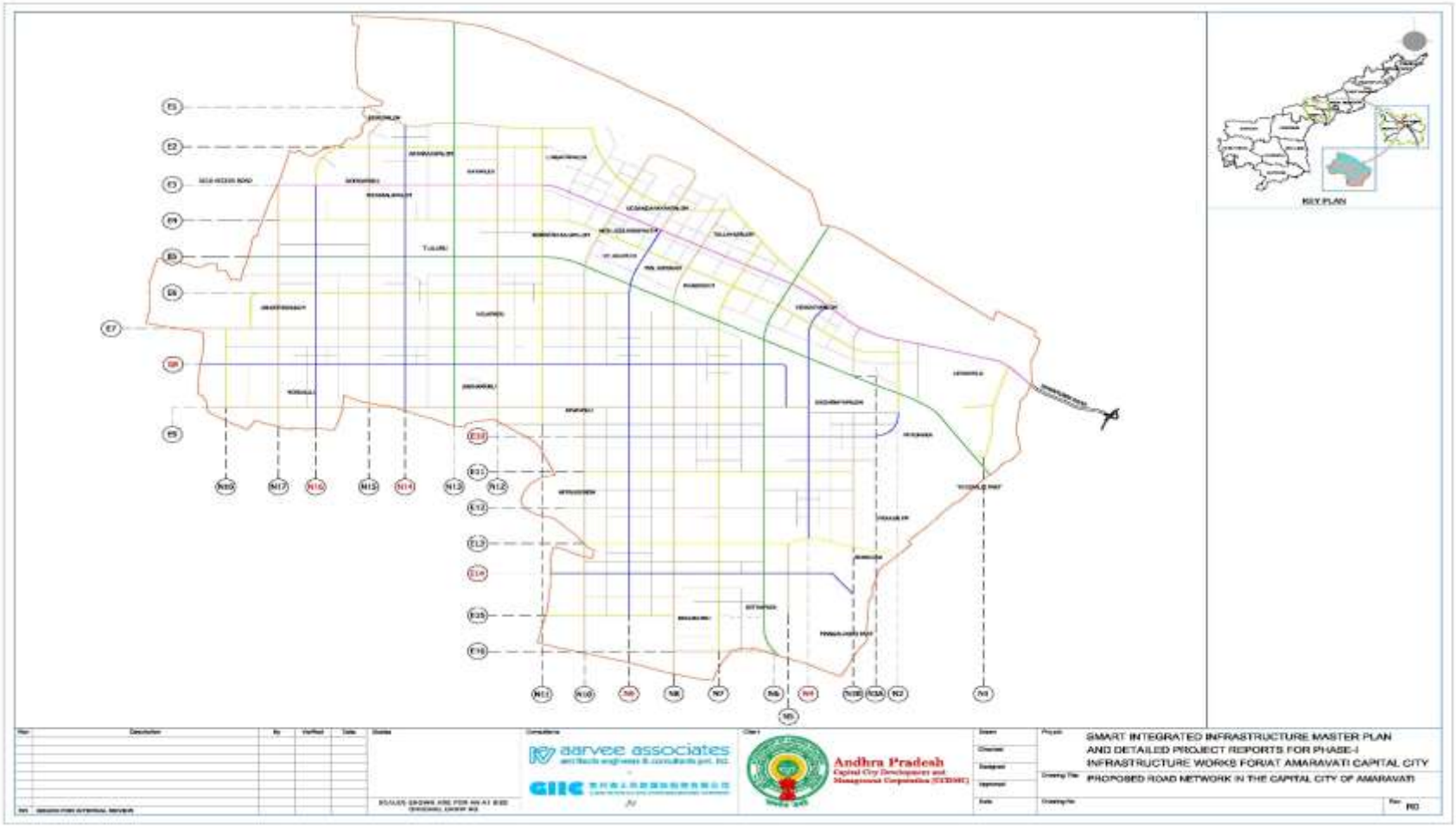



**Figure 2-3: Proposed Road network for the Capital city area of Amaravati**

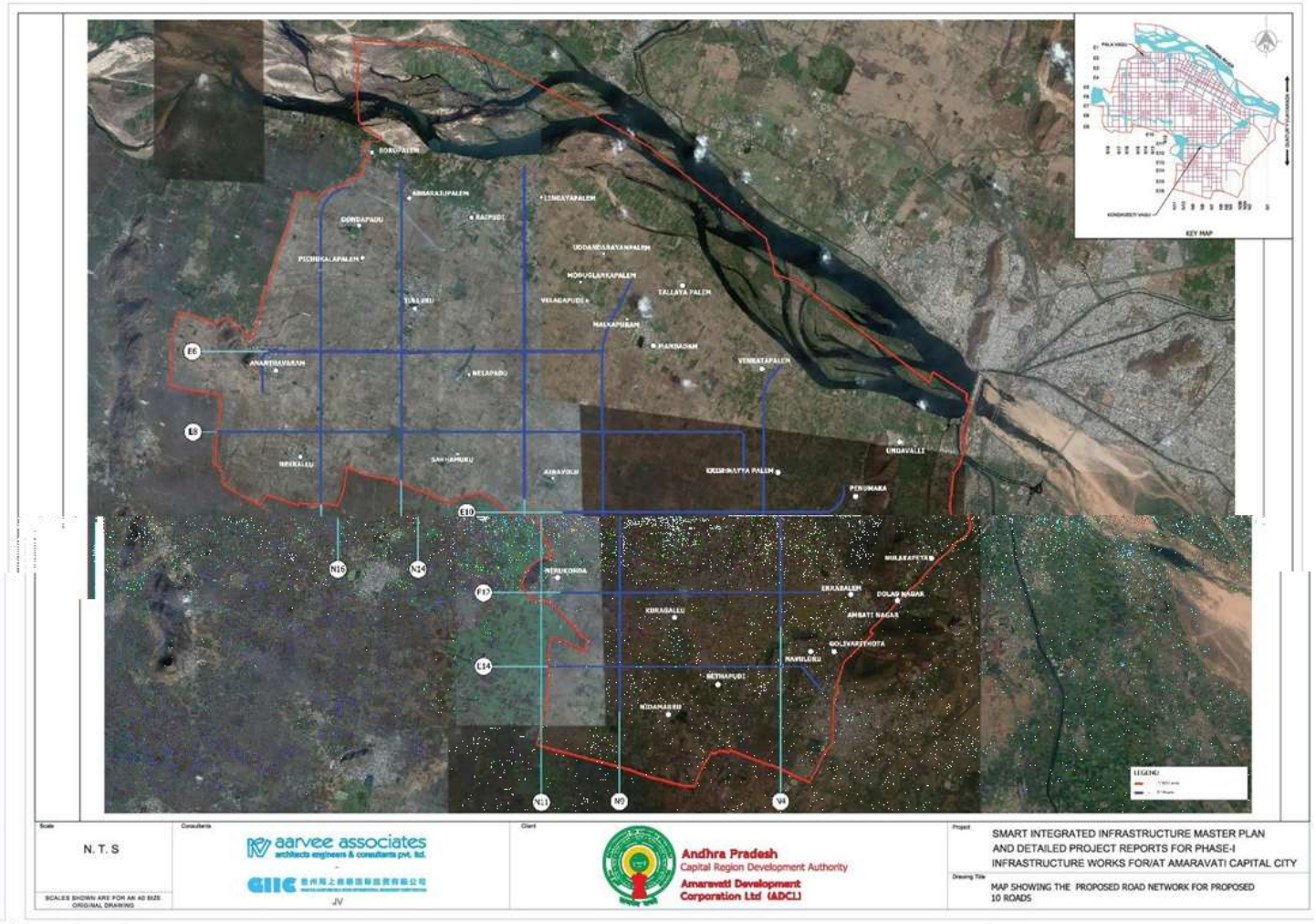



**Figure 2-4: Proposed 10 Roads in Capital City area of Amaravati**

### 2.1.4 Proposed Road Elements

Road elements for the proposed road cross sections need to cater for all users. In the major arterial roads and arterial roads, the cross-sections should cater for higher vehicular volume, whereas in the sub-arterial and collector roads, emphasis will be given to the public and non-motorized transport users, particularly pedestrians and cyclists, and bus and rapid transit riders. For these purposes, the road widths for the defined roads are set in the master plan. To do this, road design guidelines have been developed for use in the master plan. These guidelines may be further refined based on the local authority's requirements.

The roads are further classified into packages as shown in Table 2-3. The general features of the proposed roads are given in Table 2-4 and Table 2-5. Typical Cross Section for 4-lane sub-arterial road with BRT for construction in filling and partial cutting is given in Figures 2-5 & 2-6 respectively and without BRT for construction in filling and partial cutting is given in Figures 2-7 & 2-8 respectively.

**Table 2-3: Packages of the Proposed 10 Priority Roads**

| S. No | Package | Roads |
|---|---|---|
| 1 | Package-I | E8 |
| 2 | Package-II | N9 |
| 3 | Package-III | N4,N14 |
| 4 | Package-IV | E10,E14,N16 |
| 5 | Package-V | E6 |
| 6 | Package-VI | N11 & E12 |

**Table 2-4: General features of the Proposed 10 Priority Roads**

| Package | Road ID | Type of Road | Length (km) | TCS | No. of structures | Cost (Cr.) |
|---|---|---|---|---|---|---|
| Package-I | E8 | Sub-Arterial | 14.955 | 4-lane + 2 lane BRT | 3 Bridges & 17 Culverts | 329.20 |
| Package-II | N9 | Sub-Arterial | 13.168 | 4 lane + 2 lane BRT | 2 bridge & 17 Culverts | 358.67 |
| Package-III | N4 | Sub-Arterial | 7.170 | 4 lane | 2 bridges & 12 Culverts | 169.34 |
| | N14 | Sub-Arterial | 8.272 | 4 lane | 2 bridges & 7 Culverts | 152.96 |
| Package-IV | E10 | Sub-Arterial | 7.814 | 4 lane | 1 Bridge & 14 Culverts | 168.29 |
| | E14 | Sub-Arterial | 7.360 | 4 lane | 17 Culverts | 203.14 |
| | N16 | Sub-Arterial | 8.777 | 4 lane | 1 bridge & 12 Culverts | 136.51 |
| Package-V | E6 | Sub-arterial | 9.844 | 4-lane + 2-lane BRT | 4 Bridges & 19 Culverts | 161.09 |
| Package-VI | E12 | Sub-arterial | 6.790 | 4-lane + 2-lane BRT | 1 Bridge & 23 Culverts | 217.53 |
| | N11 | Sub-arterial | 8.657 | 4-lane + 2-lane BRT | 1 Bridge & 24 Culverts | 40.25 |

| Package | Road ID | Type of Road | Length (km) | TCS | No. of structures | Cost (Cr.) |
|---|---|---|---|---|---|---|
| **Total Length** | | | **92.807** | | **Total Cost (Cr.)** | **1936.98** |

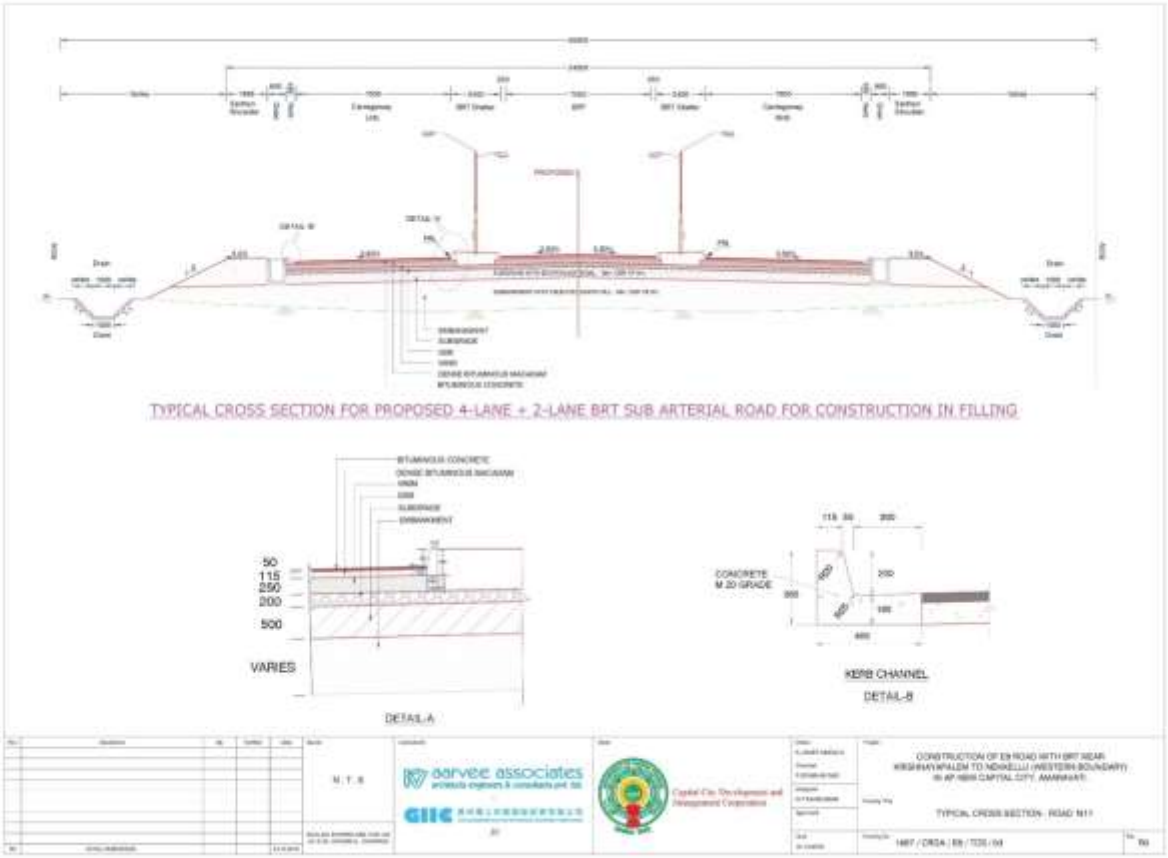



**Figure 2-5: TCS for proposed 4-Lane + 2-Lane BRT Sub-arterial road for construction in Filling**

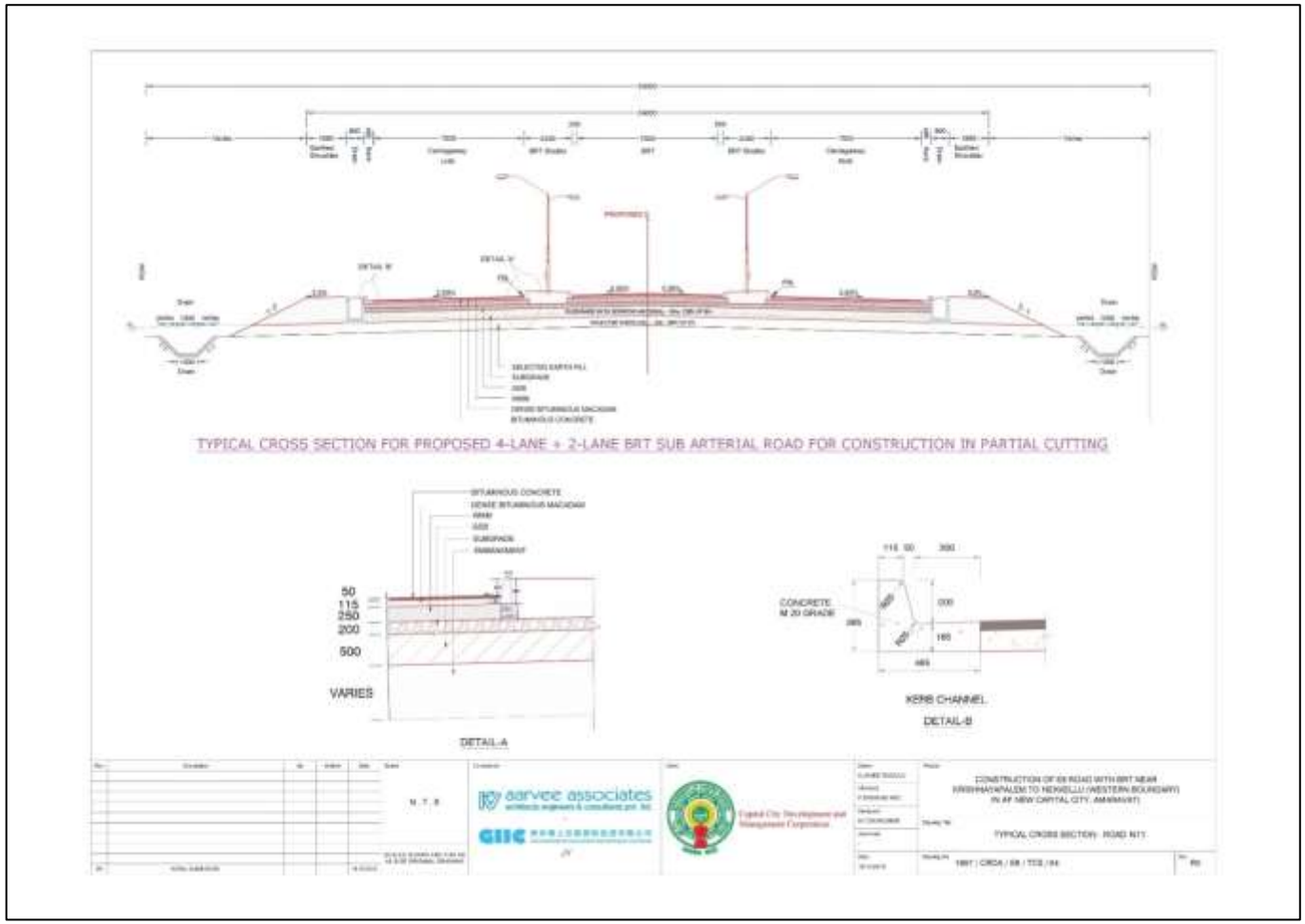



**Figure 2-6: TCS for proposed 4-Lane + 2-Lane BRT Sub-arterial road for construction in Partial Cutting**

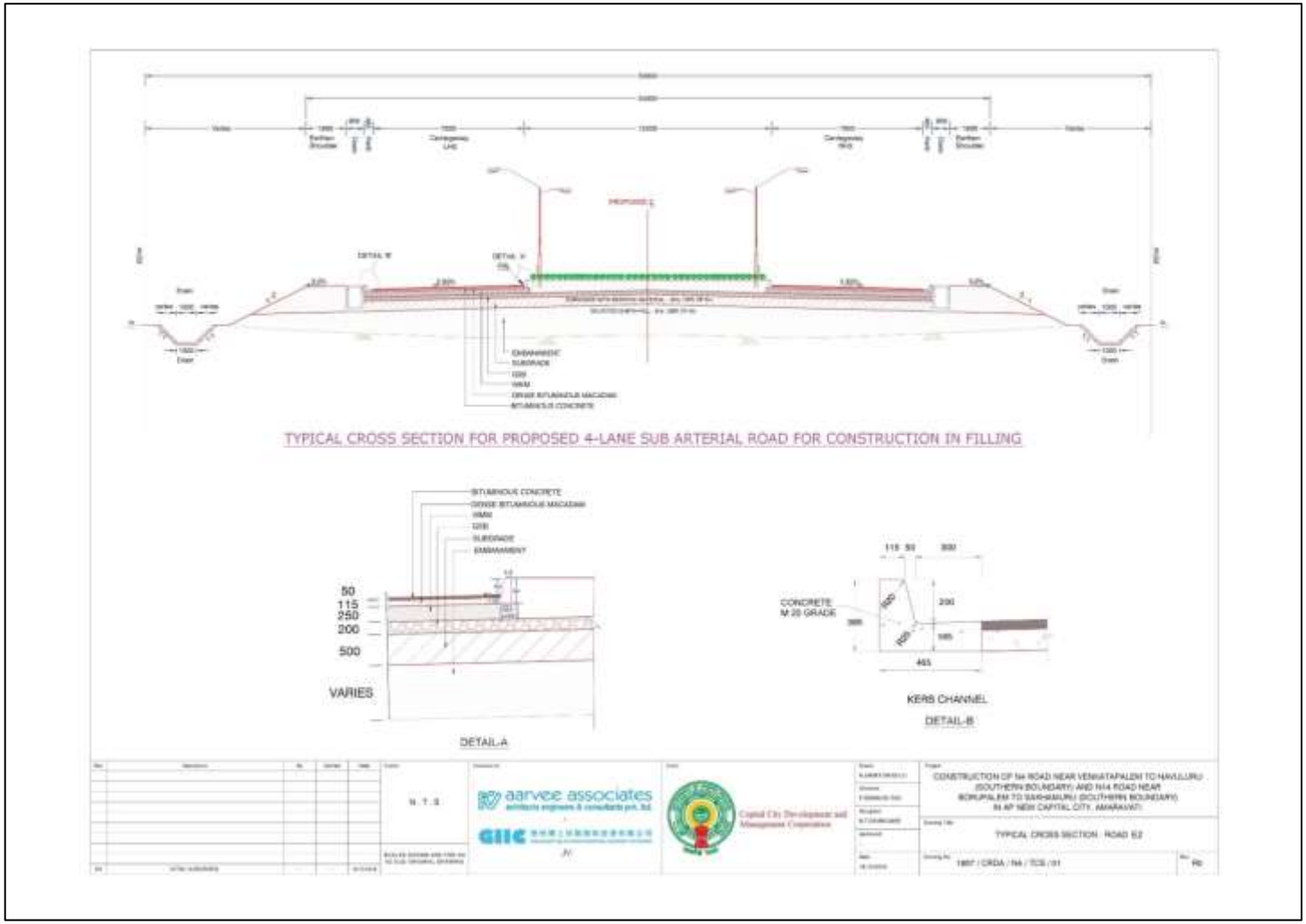



**Figure 2-7: TCS for proposed 4-Lane Sub-arterial road for construction in Filling**

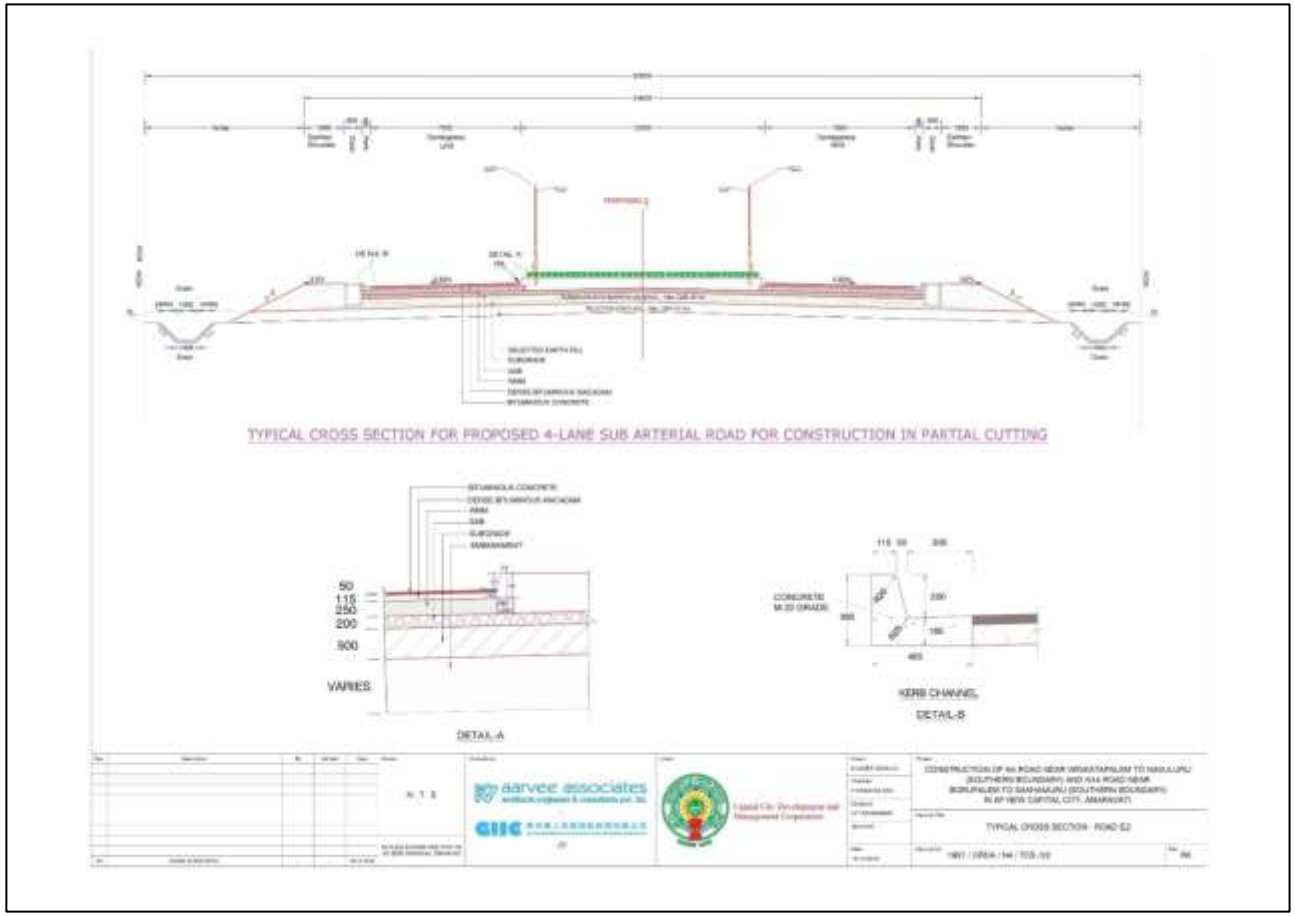



**Figure 2-8: TCS for proposed 4-Lane Sub-arterial road for construction in Partial Cutting**

## 2.2 Salient features of the Project Area and influence area

The new Capital city, Amaravati is almost a Greenfield site and is therefore lacking in infrastructure. Major investment in transportation and infrastructure is required in the coming years to prepare the site as the new Capital of Andhra Pradesh. The transportation and infrastructural requirements, planning intention and objectives have been identified in the master plan. This is to guide the future detailed studies that will be conducted to develop detailed transportation and infrastructure plans for the Capital City. These recommendations have been included in the land use master plan to reserve appropriate land space for infrastructure development. The environmental setting within 10 km radius of the project and other features are given in Table 2-5 & Table 2-6.

**Table 2-5: Environmental setting within sub-project influence area (10 km radius)**

| S. No | Particulars | Details |
|---|---|---|
| 1 | Latitude and Longitude | North East Coordinate- 16º30'30" N, 80º37' E South West Coordinate-16º29' N, 80º25' E North West Coordinate-16º31' N, 80º22'30" E South East Coordinate-16º24'30" N, 80º34' E |
| 2 | Elevation above Mean Sea Level | Varying from 18m to 260m |
| 3 | Nearest Highway | NH16 passing within the boundary of the sub-project influence area (SPIA) |
| 4 | Nearest Railway Station | Krishna Canal Junction Railway Station near Tadepalli, 1.26 km, East direction from N1 road |
| 5 | Nearest Airport | Gannavaram Airport 22 km, North-East Directoin |
| 6 | Nearest City | Vijayawada, 3 km North-East |
| 7 | Rivers | River Krishna on the northern fringes of the sub-project influence area, 160 m, North-East direction from N4 road |
| 8 | Hills/Valleys, Monuments | Tadepalli Hills, 1.40 km, East direction from N1 road |
| 9 | Archaeologically important places | The Rock cut Cave Temple, Undavalli and fort, 1650 m, North East direction from E10 road |
| 10 | National Parks/ Forest areas | No National Park within 10 km radius<br><br>Reserve Forests (R.F) are as under:<br><br>Tadepalli R.F, 1.37 km, North-East direction from E12 road |

| S. No | Particulars | Details |
|---|---|---|
| | | Mangalagiri R.F, 2.49 km, South-East direction from E12 road<br>Karlapudi R.F, 2.3 km, West direction from E8 road<br>Motadaka R.F, 4.71 km, South-West direction from N16 road<br>Kondapalli R.F, 6.18 km, North direction from N14 road |
| 11 | List of major industries in 10 km radius | Dr. Narla Tata Rao Thermal Power Plant, 4.10 km North-East direction. |
| 12 | Wildlife Sanctuary | None within 10 km radius |
| 13 | Core Biosphere reserve | None within 10 km radius |

**Table 2-6: Other features of the area**

| S. No | Parameter (s) | Description |
|---|---|---|
| 1 | Location of Project | Amaravati Capital City |
| 2 | Terrain | Plain/Rolling |
| 3 | Major Settlement along the Project Stretch | Modugulankapalem, Malkapuram, Lingayapalem, Abbarajupalem, Nelapadu, Penumaka, Velagapudi, Venkatapalem, Bethapudi, Neerukonda, Undavalli, Nekkallu, Sakhamuru, Krishnayapalem, Thullur, Navuluru, and Dondapadu |
| 4 | Rivers/ Streams/ Canals | Kondaveeti Vagu and Pala Vagu |
| 5 | Forest area and Sanctuaries | - |
| 6 | Length of the Existing Alignment | - |
| 7 | Existing Carriageway Width | - |
| 8 | Proposed Carriageway width | 14m carriageway with 7m BRT lane (2×2 Lane configuration of 7 m carriageway along with 2 lane BRT) |
| 9 | Administrative locations | Guntur District |
| 10 | State | Andhra Pradesh |

## 2.3 Study of existing amenities

The study has been conducted to know the existing amenities in the proposed project area. The Chainage wise features like terrain, land-use, nature of soil, location of water bodies, cross drainage structures have been recorded.

### 2.3.1 Terrain

Terrain is classified by the general slope of the project area across the roads alignment. The general topography of the area along the project corridor is a combination of plain and rolling terrain shown in Table 2-7. Figure 2-9 is showing the photographs of the terrain in the sub-project influence area.

**Table 2-7: Terrain Details**

| Type of Terrain | Percentage |
|---|---|
| Plain | 98% |
| Rolling | 2% |

**Figure 2-9: Terrain in the sub-project influence area**

### 2.3.2 Land Use

The proposed 10 priority roads pass through villages like Nekkallu, Sakhamuru, Ainavolu, Penumaka, Navalluru, Buthalpudi, Krishnaiahpalem, Venkataiahpalem, Neerukonda, Velagapudi, Mandadam, Thulluru, Abbarajupalem, Anantavaram, Dondapadu etc. Much of adjoining land is developable land and built up sections. There is no forest area involved in construction of the roads project. The type of land use pattern that exists along the project stretch in sub-project influence area is presented in Table 2-8.

**Table 2-8: Existing Land Use Distribution for Sub-Project Influence Area**

| S. No | Land Use | Capital City | | Proposed roads | |
|---|---|---|---|---|---|
| | | Area (Ha) | % | Area (Ha) | % |
| 1 | Developable Land | 16302.2 | 75 | 419.4 | 97.6 |
| 2 | Hills | 426.5 | 2 | 0.0 | 0.0 |
| 3 | Islands | 1750.9 | 8 | 0.0 | 0.0 |
| 4 | Village Settlements | 1449.4 | 7 | 5.1 | 1.2 |
| 5 | Water Bodies | 497.5 | 6 | 3.1 | 0.7 |
| 6 | River | 1277.7 | 2 | 1.9 | 0.4 |
| **Total** | | 21704.2 | 100.0 | 429.6 | 100 |

### 2.3.3 Villages and Towns

This Section passes through Modugulankapalem, Malkapuram, Lingayapalem, Abbarajupalem, Nelapadu, Penumaka, Ananthavaram, Velagapudi, Venkatapalem, Bethapudi, Neerukonda and Nidamarru etc. Further there are more number of villages and hamlets with less density along the project stretch and the list of villages, areas and population are given in Table 2-9. The photographs showing the view of the sub-project influence area village is given in Figure 2-10.

**Table 2-9: List of Villages, Areas and Population in the Study Area**

| S. No | Mandal | Village | Area in km$^2$ | Population |
|---|---|---|---|---|
| 1 | Thulluru | Lingayapalem including Hamlet Villages of Modugulankapalem | 14.49 | 1554 |
| 2 | | Uddandarayunipalem | | 1503 |
| 3 | | Malkapuram | | 1360 |
| 4 | | Velagapudi | 8.09 | 2688 |
| 5 | | Sakamuru | 6.58 | 1218 |
| 6 | | Nekkallu | 5.71 | 1908 |
| 7 | | Dondapadu | 1.56 | 2189 |
| 8 | | Nelapadu | 5.74 | 1028 |
| 9 | | Venkatapalem | 11.09 | 3732 |
| 10 | | Abbarajupalem | 5.86 | 490 |
| 11 | | Borupalem | | 1190 |
| 12 | Tadepalli | Penumaka | 8.85 | 7918 |
| 13 | Mangalagiri | Krishnayapalem | 6.34 | 1560 |
| 14 | | Bethapudi | 19.53 | 6883 |
| 15 | | Kuragallu including Hamlet villages of Neerukonda | 14.33 | 4340 |
| **Total** | | | **129.77** | **49148** |


**Figure 2-10: Photograph showing Thullur and Malkapuram Village**

## 2.4 Drainage Pattern

Capital city area is bound by several natural features mainly the Krishna River and seasonal streams, Kondapalli, Mangalagiri and Tadepalli reserve forest and hills. Existing terrain within the proposed Capital city is flat and gently slopes towards Northeast. All major and minor streams in this area originate either from South, Southwest or West, draining to Northeast and discharge finally in to River Krishna upstream of Prakasam Barrage.

Amaravati area is currently protected from the floods within the Krishna River by a flood bund along the right bank of river.

A typical drainage map of the Amaravati Capital City Region is given in Figure 2-11. Maps showing the drainage patterns of roads are attached separately in **Annexure-I**.

**Figure 2-11: Drainage map of Amaravati Capital City**

## 2.5 Traffic Study Analysis

An accurate estimate of the traffic that is likely to use the Project road is very important as it forms the basic input in planning, design, operation and financing.

### Transport Modelling Methodology

The traditional four-stage transportation planning process has been adopted for the study. The population and employment projected by "Detailed Master Plan of Capital city - Amaravati" and "Draft Perspective Plan - 2050 for APCRDA region" and the land use plans were the key inputs for the Transport Demand estimation carried out. The model exercise is carried out for different horizon years of 2020, 2025, 2035 and 2050 for establishing the road adequacy and also to identifying the demand corridors. The process includes trip generation, trip distribution, modal split and traffic assignment. Trip generation is the first stage of the travel modelling. The trip generation is used to predict the total number of trips generated and attracted to each zone of the study area. The generated trips from each zone are then distributed to other zones based on the choice of destination. This is called trip distribution which forms the second stage of travel modelling for which Gravity Model was adopted. Modal split is the third stage of the travel demand modelling. It is used to determine the mode chosen by various trips while travelling from one zone to other. Trip assignment is the final stage of transport modelling in which, the determined mode wise trips/vehicles are loaded on to the network. Thus, at the end of the four stages of the modelling process the estimated trips are distributed and assigned on the proposed road network to get link/section wise estimated mode-wise traffic. The overall modelling process was carried out using Cube software, which is a flexible and open platform for transportation and land-use modeling package. It's a proprietary of Citilabs, Inc., USA. Consultants' are equipped with the latest version 6.4.2 of Cube software.

The traffic figures predicted for the year 2050 at different proposed roads are given in Table 2-10 and the detailed traffic data can be found in **Annexure-VII.**

**Table 2-10:Traffic volume prediction for the year 2050**

| Package | Road ID: | Traffic Range (Total no. of vehicles) | |
|---|---|---|---|
| | | Min | Max |
| Package 1 | E8 | 14222 | 58819 |
| Package 2 | N9 | 5516 | 26418 |
| Package 3 | N4 | 15251 | 61544 |
| | N14 | 3801 | 17673 |
| Package 4 | E10 | 5287 | 41029 |
| | E14 | 7895 | 36549 |
| | N16 | 9345 | 21556 |
| Package 5 | E6 | 9088 | 36795 |
| Package 6 | N11 | 2912 | 18035 |
| | E12 | 4257 | 34433 |

## 2.6 Requirement of Natural Resources for the Project

The major requirement of the natural resources such as borrow earth, moorum, aggregates, sand, cement, HYDS bars, bitumen, water etc., for the construction of the 2/4/6-laning of the proposed road infrastructure in the sub-project influence area. The quantity of the resources requirement in the project is given in Table 2-10

Borrow earth, moorum, sand and aggregate shall be taken from operational licensed borrow areas and quarries located around nearby areas. Steel, cement, bitumen, emulsion etc., would be sourced from authorized locally available industries/vendors in/around Vijayawada. The water will be extracted from the nearest water bodies after getting formal approval from the concerned department for construction and workers camps purposes. The details of the borrow areas, Metal and Sand quarries in the sub-project influence area are allotted for AP CRDA by the Department of Mines & Geology, GoAP; and the masshaul diagram of the same can be found in **Annexure -II**. The details of the quarry map around the Amaravati Capital City Area are given in Figure 2-12. The allocation of borrow areas for APCRDA as per the quantities recommended in Table -2.11. List of borrow areas and metal quarries are given in **Annexure -II**.

**Table 2-11: Quantities of Natural Resources required for the proposed roads**

| S. No. | Construction Material | Quantity (Cum /Tones) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Package - I | Package -II | Package -III | | Package -IV | | | Package - V | Package -VI | |
| | | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | N11 | E12 |
| 1 | Borrow Earth (Cum) | 6,03,975 | 5,78,740 | 4,20,695 | 3,78,260 | 4,57,900 | 3,41,305 | 3,95,706 | 324658 | 287694 | 239786 |
| 2 | Moorum | - | - | - | - | - | - | - | 98 | 901 | 1682 |
| 3 | Aggregates (Cum) | 3,68,150 | 2,97,066 | 1,46,027 | 1,67,475 | 1,62,175 | 1,43,918 | 1,70,978 | 325934 | 257481 | 207330 |
| 4 | Sand (Cum) | 29,326 | 19,662 | 15,288 | 14,351 | 11,633 | 1,697 | 11,425 | 74101 | 36163 | 35428 |
| 5 | Cement (MT) | 16,300 | 11,845 | 9,455 | 8,002 | 7,000 | 727 | 6,382 | 38236 | 21946 | 15646 |
| 6 | HYSD Bars (MT) | 3,950 | 2,837 | 2,670 | 2,094 | 1,750 | 97 | 1,236 | 7982 | 4285 | 2768 |
| 7 | Bitumen (MT) | 6,203 | 5,097 | 2,000 | 2,367 | 2,325 | 2,118 | 2,484 | 4180 | 3576 | 2952 |
| 8 | Emulsion (MT) | 569 | 468 | 182 | 214 | 213 | 197 | 226 | 388 | 336 | 278 |
| 9 | Water (KL) | 10,000 | 8,000 | 6,500 | 5,500 | 4,500 | 1,000 | 4,000 | 91384 | 81333 | 67507 |

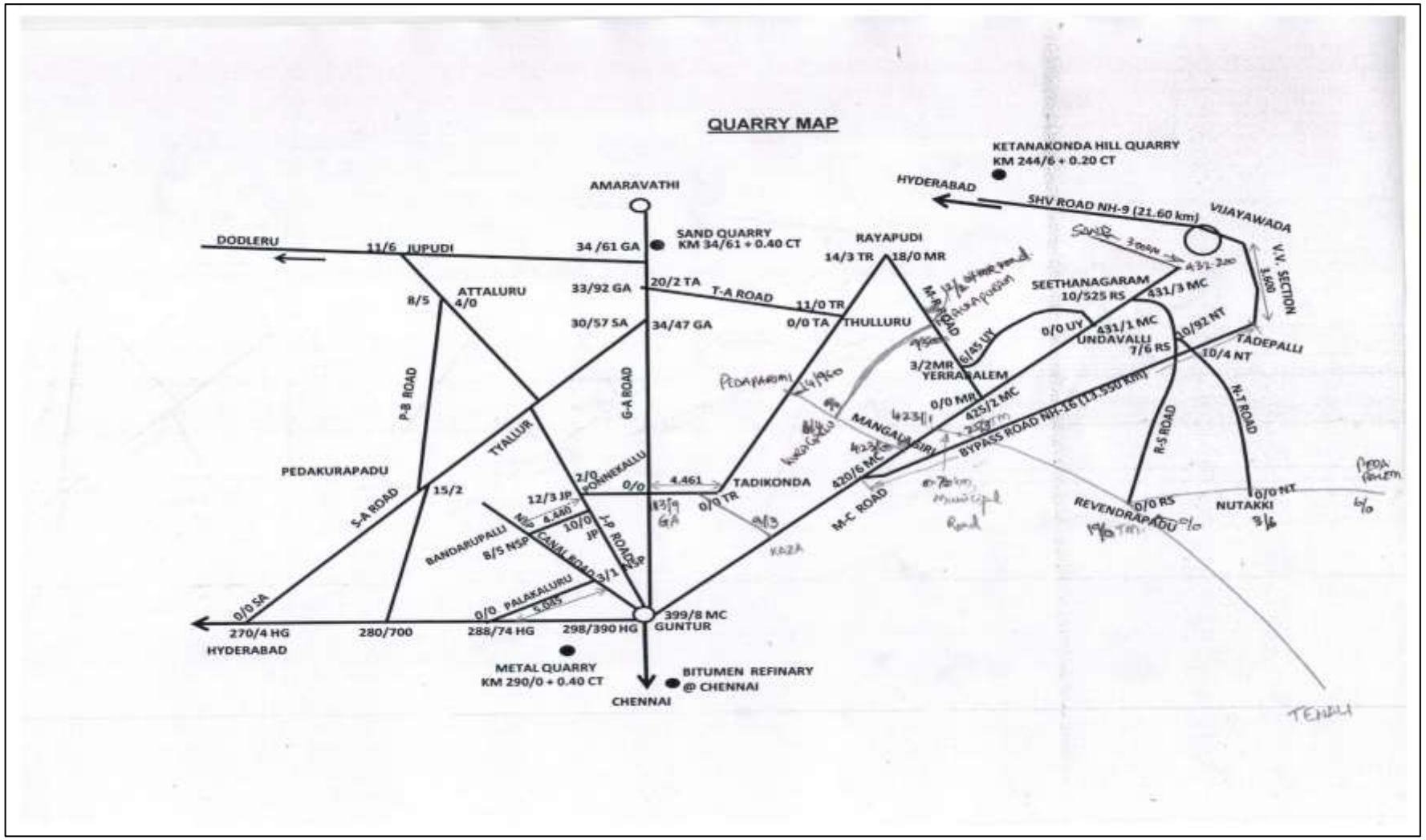



**Figure 2-12: Quarry map around Amaravati Capital City**

# Chapter 3
# APPROACH AND METHODOLOGY

## 3.0 Approach and Methodology

The approach for the preparation of EIA involves the following steps:

A project specific Environmental Assessment study has been carried out for proposed Smart Integrated Infrastructure Master Plan & Detailed Project Reports for Phase-I Infrastructure works for / at Amaravati Capital City in accordance with the Environmental and Social Management Framework (ESMF) developed for Roads & Highway Projects guidelines and Operational Manual of World Bank & guidelines of Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India.

The approach to carry out site specific EIA study was organized in four tasks and is based on the field investigations and reconnaissance surveys in the project area, collection, collation and analysis of secondary data and discussions with key stakeholders on the potential impacts of the project. Information on various environmental components were collected through survey oriented screening, collection of data using questionnaire, monitoring of air, water and soil quality and collection of secondary data.

The Screening exercise along the proposed roads pinpointed the environmental constraints. The sensitive receptors identified during the screening exercise were further assessed for their criticality and impacts jointly by teams of environmental specialist, social impact specialist, design engineers and surveyors. The proposed alignment has been examined in detail for any direct, indirect or impact on environmental characteristics during report preparation. A variety of mitigation measures have been included in road design to minimize the adverse effects of road widening on environmental components. During screening, the following screening process was used to assess the extent of potential impacts on different environmental components.

The analysis of location of environmental features with respect to the project alignment and extent of identified impacts due to project, reflect that most of the impacts are of low and medium extent and mainly related to construction activities which are mostly temporary in nature. Based on the environmental screening the project is Classified as Category-B project in accordance with World Bank's Policy (OP 4.01 Environmental Assessment) and therefore it warrants site specific Environmental Impact Assessment.

For Environmental Impact Assessment study, the task wise activities undertaken for screening process is presented below:

### 3.1 Sub-Project Influence Area

The direct Corridor of Impact (CoI) has been considered 20m on either side, beyond RoW of all type of the roads. The sub-project influence area (SPIA) is considered as 10 km on either side of the road, for Eco-sensitive areas, such as wildlife sanctuary, national parks, tiger reserves, notified wetlands, elephant corridors, etc. as notified by the MoEF & CC, New Delhi.

### 3.2 Task 1: Collection of Baseline Environmental Data

#### 3.2.1 Secondary Baseline Data

Secondary data of the project area has been collected from secondary sources like published literature from various government agencies, or institutions on physical, biological and social components of environment. The data were reviewed and verified for establishing existing environmental and ecological status within the project area. Following documents from different sources were consulted for collection of baseline environmental data. The source of secondary data is given in Table 3-1.

**Table 3-1: Sources of Secondary Data**

| S. No | Information | Source |
|---|---|---|
| 1 | Topo sheets, District Planning Maps etc. | Survey of India, GoI. |
| 2 | Meteorological Data for the year 1971 to 2000 | India Meteorological Department, Gannavaram. |
| 3 | Geological Data | Geological Survey of India |
| 4 | Reserved Forests, Protected Forests Wildlife Sanctuaries, Forests Statistics etc. | Forests Department, GoAP, MoEF&CC, New Delhi |
| 5 | Land-use Pattern | CRDA Master Plan |
| 6 | Wetland Atlas | MoEF & CC, New Delhi |
| 7 | Demographic Profile | District Statistics Handbook |
| 8 | Census of India | Census of India, GoI |

#### 3.2.2 Primary Baseline Data

The primary baseline information on different environmental components were collected through field survey. Field survey were carried out to collect information on the major environmental features such as settlement facilities, drainage pattern of the area, forest, trees within RoW of the alignment, water bodies, river crossing, sensitive receptors, air, water, noise and soil quality etc. and were studied in detail, which helped in identifying areas of concern along the stretch and critical issues. Consultation with the local officials and public were carried out also on the salient environmental features of the project area, etc.

Further primary samples surveys for the environmental components, such as air, surface water, noise and soil characteristics that are critical in the context of the project were carried out. The post-monsoon season monitoring was carried out in the months of October to November, 2016.

**Ambient Air Quality**: Ambient air monitoring stations were established at various locations along the project section accessing the ambient air quality in the project area. The air quality parameters considered for the study included Particulate Matter ($PM_{10}$), Particulate Matter ($PM_{2.5}$), Nitrogen oxides ($NO_x$), Sulphur dioxide ($SO_2$), and Carbon Monoxide (CO). The criteria for the selection of sampling sites were based on type of activity, residential, commercial, traffic congestion, urban centres, location of sensitive receptors etc. Monitoring was done 20-30 m away from the central line of the existing roads from the villages. 24 hourly monitoring was carried out twice in a week for one season.

**Water Quality**: Grab samples were collected from River Krishna and farm ponds/lakes in the study are of APCRDA to assess the surface water quality in the project area. Ground water samples were collected from handpumps. The water samples were tested for different physico-chemical parameters such as dissolved oxygen, total alkalinity, pH, conductivity, TDS, BOD, COD, etc. using standard methods (APHA, 1998). Bacteriological quality of the water was tested using the membrane filter method (APHA, 1998).

**Soil Quality**: The composite soil samples were collected from different locations in the study area. They were analyzed for relevant physico-chemical parameters using standard analytical methods (Allen, 1989; Anderson and Ingram, 1993; Rowell, 1994) to assess the soil quality of the area.

**Noise Level**: 24 hourly ambient noise level was measured using noise level meter at various key locations of study area during day and night time. The selection of sampling locations was based on land use & categorization of the study area. The noise levels have been expressed as an equivalent noise level (Leq), which is the measurement of sound pressure level as the logarithmic averaging time.

**Flora and Fauna Study**: A list of all macroscopic plants is prepared based on extensive field survey covering the entire project site or core area. If any species cannot be identified, photos of the plant and plant parts are taken and a field note is prepared on the plant for subsequent identification.

Quantitative data on frequency, density, dominance as percent cover etc are noted based on quadrants of 10 x 10 m in case of trees, 2 x 5 m in case of shrubs and 1 x 1 m in case of herbs. Cover is usually estimated by a modified line intercept method where the area occupied by each species is estimated as percentage of total length of a line transect either intercepted or over lain or under laid along with the transect.

Data from field study is recorded in the following table.

| **List of plant species found in the Project area** | | | | |
|---|---|---|---|---|
| Name of plant species | Local name or common name (if any) | Family | | |
| Frequency, density and dominance of different species of plants<br><br>(separate Table for each quadrant and transect will be maintained) | | | | |
| Name of plant species | Frequency (recorded as + or – only) | Density as number per quadrant | % cover based on line transects | |

| **Relative frequency (R.F), relative density (R.D), relative dominance (R.dom) and Importance value indices (IVI) of different species** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name of plant species | Frequency | | Density | | Dominance | | IVI |
| | % | R.F | % | R.D | % | R.Dom | |
| | | | | | | | |

Based on the IVI values, Shannon –Wiener Indices of Diversity was calculated.

Shannon – Wiener Indices of Diversity was calculated as the sum of $p^i$ value of each species multiplied by ln of $p^i$ using the following equation:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where, $p^i$ is calculated by dividing the IVI of a species by the total IVI of all species in the sampled community.

### 3.3 Task 2: Review of Policies, Regulations and Institutional Arrangements

A review of all applicable operational policies / directives of MoEF&CC, State government, the World Bank and environmental laws / regulations in India, were carried out in this task. In addition to the above, the following key environmental regulations / policies in India that may affect / influence the project environment both during preparation and implementation stages were also reviewed.

**World Bank Safeguards Policies:**

- OP 4.01: Environmental Assessment
- OP 4.04: Natural Habitats
- OP 4.36: Forests
- OP 4.09: Pest Management
- OP 4.12: Involuntary Resettlement
- OP 4.10: Indigenous Peoples
- OP 4.11: Physical Cultural Resources
- OP 4.37: Safety of Dams
- OP 7.50: Projects on International Waterways
- OP 7.60: Projects in Disputed Areas
- Environmental, Health and Safety (EHS) Guidelines

**Other Indian Rules & Regulation and Polices:**

- EIA Notification, 2006 and amendment thereafter
- Environment (Protection) Act, 1986
- Water (Prevention & Control) Act, 1974
- Air (Prevention & Control) Act 1981
- Forest (Conservation) Act, 1980
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989

- The Motor Vehicle Rule, 1983
- The Explosives Act, 1984

### 3.4 Task 3: Identification of Potential Environmental Impacts

Based on the baseline environmental profile of the project area and proposed improvement and project activities, impacts of the proposed project on various environmental components were identified. The impacts were also analyzed with respect to pre-construction, construction and operation phases and were categorized in terms of magnitude and significance.

The environmental impacts identified through the earlier tasks were used in the design formulation process to integrate environmental issues and for identification of suitable mitigation measures.

### 3.5 Task 4: Preparation of Environmental Management and Monitoring Plan

Based on the nature and type of environmental impacts anticipated, mitigation measures for preventing / minimizing the same were identified and an Environmental Management Plan has been formulated both for the project execution and operation phases. Monitoring requirements and institutional responsibilities for the implementation of the suggested management plan has also been identified as part of this task. The cost for implementing the proposed environmental mitigation measures has been worked out and presented in the report for necessary budgetary allocations as part of the project cost.

The methodology adopted is presented in the form of a Flow chart given in Figure -3.1.

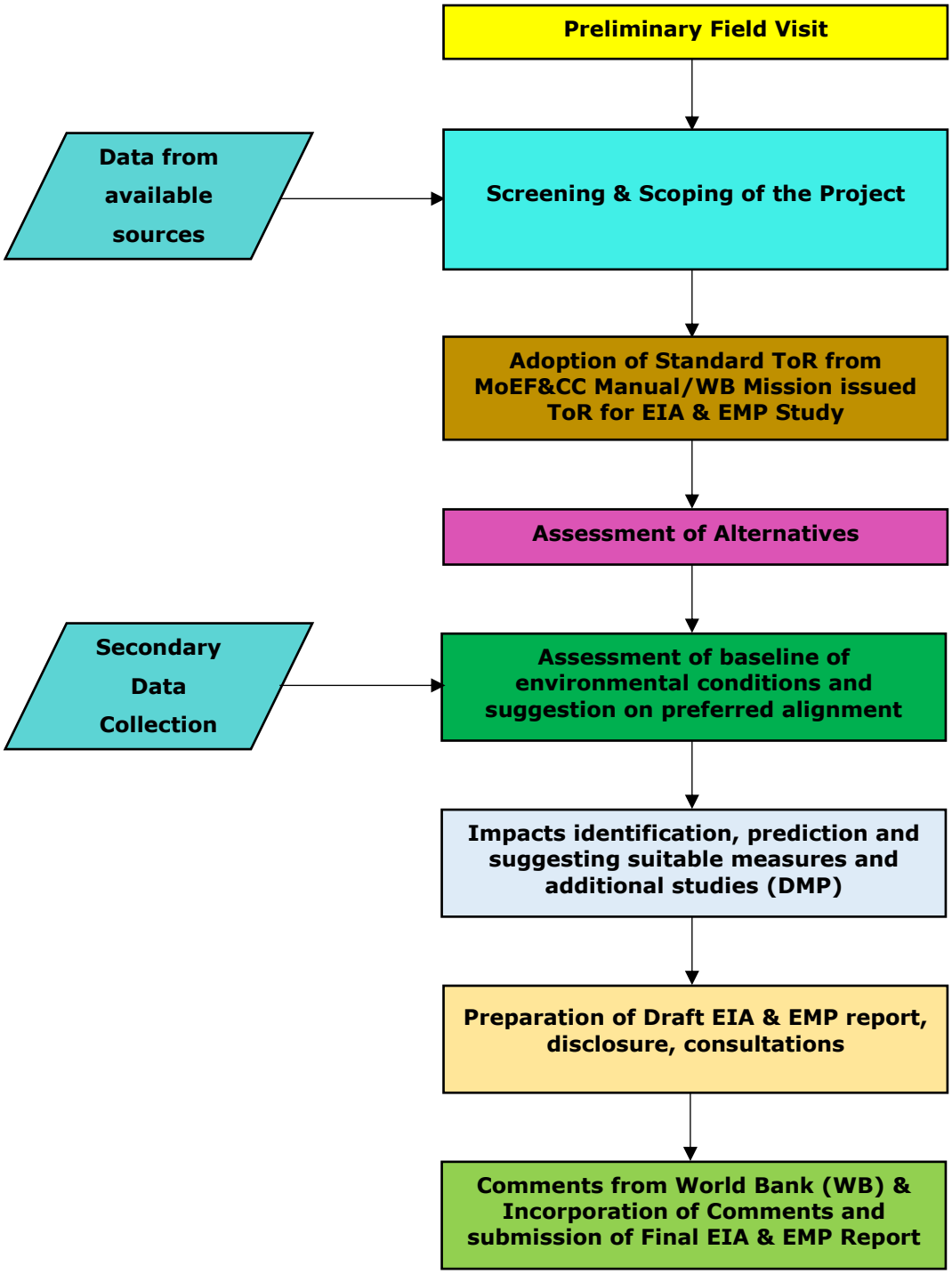



**Figure 3-1: Flow Chart showing the EIA Methodology**

# Chapter 4
# ENVIRONMENTAL REGULATORY FRAMEWORK

## 4.0 Environmental Regulatory Framework

The increase of environmental concerns has necessitated appropriate tools to protect the environment. India has developed a comprehensive regulatory framework to address environmental and social concerns in relation to development projects. Its wide-ranging enactments cover almost all major issues that need to be addressed in the course of development of infrastructure from a social and environmental perspective. The following section describes the institutional set-up and key legislation pertaining to environmental issues.

## 4.1 Institutional Framework

The Ministry of Environment, Forest and Climate Change (MoEF&CC) to serve as the focal point in the administrative structure for the planning, promotion and coordination of environmental and forestry programs. The Ministry of Environment and Forests (MoEF) has been renamed recently in the year 2014 as Ministry of Environment and Forest and Climate Change (MoEF&CC). The MoEF&CC has overall authority for the administration and implementation of government policies, laws and regulations related to the environment, including conservation, environmental assessment, sustainable development and pollution control. MoEF & CC identifies the need to enact new laws and amend existing environmental legislation when required, to continue to conserve and protect the environment. At the state level, the MoEF & CC authority is implemented by the Department of the Environment, Forests and Science & Technology.

In 1976, the 42$^{nd}$ Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. Thus, several laws related to environmental conservation were passed to strengthen existing legislation. Environment (Protection) Act, 1986 is the landmark legislation as it provides for the protection of environment and aims at plugging the loopholes in the other related acts.

The Government of India through specific legislation regulates the environmental management system in India. The Ministries / Statutory Bodies responsible for ensuring environmental compliance by project proponents include:

- The Ministry of Environment & Forests and Climate Change (MoEF&CC)
- Central Pollution Control Board (CPCB)
- Andhra Pradesh Pollution Control Board (APPCB)
- Department of Environment, Forests and Science & Technology in the States

### 4.2 Applicability of International, National, State and Local Environmental norms

The proposed Road network in the Capital City area is attracting various International, National, State, regional and World Bank environmental laws, rules and regulations. These regulations and rules are helpful in impact mitigation and improvement of the environment. The environmental assessment study will be carried out as per the requirement of the National/State/World Bank environmental guidelines. The applicability of the regulatory norms is given in Table 4-1.

**Table 4-1: Applicability of Environmental Regulatory Norms for Urban Roads**

| Project | Project Components | Applicability of Environmental Laws, Policies and Notifications | Remarks |
|---|---|---|---|
| Construction of Proposed 10 Roads in the Capital City area. | • Right of Way<br>• Land Acquisition<br>• Protected Social Forestry throughout the Right of Way (RoW)<br>• Quarries<br>• Borrow Areas<br>• Establishment of Hot Mix Plants and Batch Mix Plants<br>• Sensitive Locations (Schools, hospitals, etc.)<br>• Archaeological Sites | The Environment (Protection) Act, 1986 and further notifications issued under this Act. | Any act during implementation causing damage to environment<br><br>As per the Environment (Protection) Act (EP) 1986, ambient noise levels are to be maintained as stipulated by the Central Pollution Control Board (CPCB) for different categories of areas like, commercial, residential and silence zones, etc., during sub-project construction and operation. Section -3 (2) (iii & iv). |
| | | Water (Prevention and Control of Pollution) Cess Act, 1977 including Rules | Applicable to all activities, which discharge effluents because of process or operations. |
| | | Water (Prevention and Control of Pollution) Act, 1974 – as amended in 1978 & 1988. | Section 3 (2) (a) of the Act and Cess to the Govt. of India as per Table -I & II for consumption of water for domestic, commercial and industrial purposes. |

| Project | Project Components | Applicability of Environmental Laws, Policies and Notifications | Remarks |
|---|---|---|---|
| | | Forest (Conservation) Act, 1980 – as amended in 1988. | Applicable if the project involves any activities in the reserved forests, village forests, protected forests and other areas as declared by the state Government. Forest Conservation Act –Chapter –2.4 and Chapter –3.0. |
| | | The Ancient Monuments and Archaeological Sites and Remains Act, 1958, as amended in 2010.<br><br>Ancient Monuments and Archaeological Sites and Remains Rules, 1959. | Not applicable since The Rock cut Cave Temple, Undavalli is 1650 m, East direction from E10 road (closest 10 Priority road) |
| | | Wildlife Protection Act, 1972, amended thereof. The Wildlife (Protection) Rules, 1995. | The act prohibits picking, uprooting, damaging, destroying, acquiring any specified plant from any forest land.<br><br>It bans the use of injurious substances, chemicals, explosives that may cause injury or endanger any wildlife. |
| | | A. P. New Sand Policy, 2016<br><br>G.O.Ms.No.21 Dated: 19-01-2016<br><br>Read the following:<br><br>1) G.O.Ms.No.19, Ind. & Com. (M.II) Dept., Dt.15.01.2016.<br><br>2) G.O.Ms.No.20, Ind. & Com. (M.II) Dept., Dt.15.01.2016. | The act prohibits in-stream mining of sand. The maximum sale price of the sand shall be read as Rs.500/- per cubic metre in the State.<br><br>The Government reserves the right to allot any of the specified sand bearing area on nomination basis for consumption of sand in Government works such as Major Irrigation Projects, Capital Region Development and such other Public purposes on payment of the Seignior age fees, contribution fund to DMF and MERIT at applicable rates. |
| | | Coastal Regulation Zone (CRZ) Notification 1991 as amended till January 2011 | Not Applicable |
| | | The Hazardous Wastes (Management and Handling) Rules, 1989 and subsequent amendments thereof till date. | Materials such as heavy metals, toxic inorganic, oils, emulsions, spent chemicals and Metal-finishing wastes emanating during construction and operation shall be stored and disposed of as per the |

| Project | Project Components | Applicability of Environmental Laws, Policies and Notifications | Remarks |
|---|---|---|---|
| | | | Rules.<br><br>Rule 17, 18 & 19 of the Act. |
| | | The Public Liability Insurance Act, 1991. | Act enables the people to access legal aid to claim compensation in the event of an accident occurred while handling any hazardous substance. So, insurance needs to be taken up by the project implementing agencies or contractors.<br><br>PLI Act: Act 6 of 1991 as amended by Act 11 of 1992. |
| | | Ministry of Environment Forests & Climate Change (MoEF&CC) EIA Notification (New) issued on 14th September, 2006 and subsequent amendments thereof till date. | Not Applicable.<br><br>The EIA Report should be prepared as per the World Bank guidelines |
| | | World Bank Operational Directive and Operational Policies for Environmental Impact Assessment OP:4.01,<br><br>OP 4.04: Natural Habitats, OP 4.36: Forests, OP 4.11: Operational Policy on cultural property and OP 4.12: Involuntary Resettlement for roads & highways projects. | Applicable in preparation of Environmental assessment report, protection of cultural property, forest clearances etc. |
| | | Noise Pollution (Regulation and Control) Rules, 2000 | Applicable<br><br>Under Rule 3(1) & 4 (1) - Clause 2, 3 & 6. |
| | | Land Acquisition Act 1894<br><br>Land Acquisition Act 1989 &<br><br>RFCTLARR Act, 2013.<br><br>AP Capital City Land Pooling Scheme New Guidelines, The Andhra Pradesh Capital City Amaravati Land Pooling Scheme (Formulation and | Applicable.<br><br>To set out rules for the acquisition of land by Government. |

| Project | Project Components | Applicability of Environmental Laws, Policies and Notifications | Remarks |
|---|---|---|---|
| | | Implementation) Rules, 2015 – Amendment Notification. AP Municipal Administration & Urban Development (CRDA.2) Department G.O.MS.No. 41 Dated: 17-02-2016. | |
| | | Motor Vehicles Act, 1988<br><br>Rules of Road Regulations, 1989 | Applicable.<br><br>To enforce urban roads/highway codes during construction and operation. |

A brief description of relevant laws is given below:

**EIA Notification, 2006**

This is the Indian Government's Guidelines for environmental impact assessment governing all the development interventions that takes place within the boundaries of India. EIA notification was issued by Ministry of Environment, Forests and Climate Change (MoEF&CC) in 2006. Under this EIA Notification, the projects listed in Schedule-1 of the Notification require prior environmental clearance. The objective of the notification is to formulate a transparent, decentralized and efficient regulatory mechanism to:

- Incorporate necessary environmental safeguards at planning stage
- Involve stakeholders in the public consultation process
- Identify developmental projects based on impact potential instead of the investment criteria

As per EIA Notification, 2006 and amendment thereafter, the Expansion of State Highway does not require environmental clearance except for the State highways expansion project in hilly terrain (above 1000 m above mean sea level) and/or in eco-sensitive areas. As per Hon'ble Superme court's direction, 10 km radius from the boundary of wildlife sanctuary will be considered as eco-sensitive zone till the actual radius of the eco-sensitive zone around the wildlife sanctuary boundary is notified by the state government. The MDR and ODRs do not come in the purview of EIA Notification, 2006.

**Forest (Conservation) Act, 1980:**

The Forest Conservation Act, 1980 is a Central Act of Parliament with a view to provide for the conservation of forest and for matters connected therewith or ancillary or incidental thereto. The act extends to the whole of India except the state of Jammu and Kashmir. Section 2 of the act makes a provision of a prior approval of the Central Government necessary before a State Government or any other authority issues direction for dereservation of reserved forests (which have been reserved under the Indian Forest Act 1927), use of forest land for non – forest purpose, assigning forest land by way of lease or otherwise to any private person or to any authority, corporation, agency or any other organization not owned, managed or controlled by the government and clear felling of naturally grown trees. The term "forest land" mentioned in Section 2 of the Act refers to reserved forest, protected forest or any area recorded as forest in the government records. Lands which are notified under section4 of the Indian Forest Act would also come within the purview of the Forest Conservation Act 1980.

Submission of the proposals seeking approval of the Central Government under section 2 of the Act. -

(1) Every user agency, who wants to use any forest land for non-forest purposes shall make his proposal in the appropriate Form appended to these rules, i.e. Form A for proposals seeking first time approval under the Act and Form B for proposals seeking renewal of leases where approval of the Central Government under the Act had already been obtained earlier, to the concerned nodal officer authorized in this behalf by the State Government, along with requisite information and documents, complete in all respects, well in advance of taking up any non-forest activity on the forest land.

(2) Every State Government or other authority, after having received the proposal under sub-rule (1) and after being satisfied that the proposal requires prior approval under section 2 of the Act, shall send the proposal to the Central Government in the appropriate forms, within ninety days of the receipt of the proposal from the user agency for proposals seeking first time approval under the Act and within sixty days for proposals seeking renewal of leases where approval of the Central Government under the Act had already been obtained earlier: Provided that all proposals involving clearing naturally grown trees in forest land or portion thereof for the purpose of using it for re-afforestation shall be sent in the form of Working Plan or Management Plan.

(3) The proposal referred to in sub-rule (2) above, involving forest land of more than forty hectare shall be sent by the State Government to the Secretary to the Government

of India, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi-110 003, with a copy of the proposal (with complete enclosures) to the concerned Regional Office.

(4) The proposal referred to in sub-rule (2) above, involving forest land up to forty hectares shall be sent to the Chief Conservator of Forests or Conservator of Forests of the concerned Regional Office of the Ministry of Environment and Forests.

(5) The proposal referred to in sub-rule (2) above, involving clearing of naturally grown trees in forest land or portion thereof for the purpose of using it for reafforestation shall be sent to the Chief Conservator of Forests or Conservator of Forests of the concerned Regional Office of the Ministry of Environment and Forests.

**Committee to advice on proposals received by the Central Government. -**

(1) The Central Government shall refer every proposal, complete in all respects, received by it under sub-rule (3) of rule 6 including site inspection report, wherever required, to the Committee for its advice thereon.

(2) The Committee shall have due regard to all or any of the following matters while tendering its advice on the proposals referred to it under sub-rule (1), namely: - a. Whether the forests land proposed to be used for non-forest purpose forms part of a nature reserve, national park wildlife sanctuary, biosphere reserve or forms part of the habitat or any endangered or threatened species of flora and fauna or of an area lying in severely eroded catchment; b. Whether the use of any forest land is for agricultural purposes or for the rehabilitation of persons displaced from their residences by reason of any river valley or hydro-electric project; c. Whether the State Government or the other authority has certified that it has considered all other alternatives and that no other alternatives in the circumstances are feasible and that the required area is the minimum needed for the purpose; and d. Whether the State Government or the other authority undertakes to provide at its cost for the acquisition of land of an equivalent area and afforestation thereof.

(3) While tendering the advice, the Committee may also suggest any conditions or restrictions on the use of any forest land for any non-forest purpose, which in its opinion, would minimize adverse environmental impact.

**Wild Life Protection Act, 1972**:

The Wildlife Act was passed in 1972 to protect the wildlife and their habitats. The habitat destruction due to agriculture, industries, urbanization and other human activities had led to the erosion of the country's wildlife.

The major activities and provisions in the act can be summed up as follows:

1. It defines the wildlife related terminology.

2. Enactment of an All India Wildlife Protection Act (1972).

3. It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc.

4. Becoming a party to the Convention of International Trade in Endangered Species of Fauna and Flora (CITES, 1976).

5. Launching a "national component of UNESCO's 'Man and Biosphere Programme' (1971).

6. Under the Act, comprehensive listing of endangered wildlife species was done for the first time and prohibition of hunting of the endangered species was mentioned.

7. Protection to some endangered plants.

8. The Act provides for setting up of National Parks, Wildlife Sanctuaries etc.

9. The Act provides for the constitution of Central Zoo Authority.

10. There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.

11. The act imposes a ban on the trade or commerce in scheduled animals.

12. It provides for legal powers to officers and punishment to offenders.

13. It provides for captive breeding programme for endangered species. Several Conservation Projects for individual endangered species like Lion (1972), Tiger (1973),

Crocodile (1974) and Brown antlered Deer (1981) were stated under this Act. The Act is adopted by all states in India except J & K, which has its own Act.

**The Water (Prevention and Control of Pollution) Act, 1974:**

The act resulted in the establishment of the Central and State Level Pollution Control Boards whose responsibilities include managing water quality and effluent standards, as well as monitoring water quality, prosecuting offenders and issuing licenses for construction and operation of any facility. This will include generation of liquid effluent during construction of road from civil engineering activities or from domestic activities in workers' colony. There are specific penalties for violation, which include imprisonment for responsible officials.

**The Air (Prevention and Control of Pollution) Act, 1981:**

The act empowers Central and State Pollution Control Boards for managing air quality and emission standards, as well as monitoring air quality, prosecuting offenders and issuing licenses for construction and operation of any facility. Air quality includes noise level standards. There are specific penalties for violation, which include imprisonment for responsible officials. This act has notified National Ambient Air Quality Standard for different regions e.g. Industrial, Residential and Sensitive. Air quality during construction and operation phases will be guided by this specific act.

**Environment (Protection) Act, 1986:**

This act was passed as an overall comprehensive act "for protection and improvement of environment" Under this act rules have been specified for discharge/emission of effluents and different standards for environmental quality. These include Ambient Noise Standard, Emission from Motor Vehicles, Mass Emission standard for Petrol Driven Vehicles, General Effluent Standards etc. especially important for road project.

**Fly ash Notification, 2016:**

As per the Notification No. S.O. 763 (E), dated 14.09.1999 and its amendment thereafter on 27.08.2003 and notification S.O. 2804 (E) dated 3rd November 2009 by Ministry of Environment and Forests, it is mandatory to use fly ash within a radius of 300 km of Thermal Power Plant. No agency, person or organization shall within a radius of 300 km of Thermal Power Plant undertake construction or approve design for construction of roads of flyover embankments in contravention of the guidelines/ specification issued by the Indian Road Congress (IRC) as contained in IRC specification

No. SP: 58: 2001. Any deviation from this direction can only be agreed to technical reasons if the same is approved by Chief Engineer (Design) or Engineer-in-chief of the concerned agency or organization or on production of certificate of "Pond ash not available" from the Thermal Power Plant(s) located within 100 kilometers of the site construction. This certificate shall be provided by TPP within two working days from the date of making request for fly ash.

Soil required for top or side cover of embankment of roads or flyovers shall be excavated from the embankment site and it is not possible to do so, only the minimum quantity of the soil required for the purpose shall be excavated from soil borrow area. In either case, the topsoil should be kept or stored separately. Voids created due to soil borrow area shall be filled up with ash with proper compaction and covered with top soil kept separately as mentioned above.

No agency, person or organization shall within a radius of 100 kilometers of coal or lignite based Thermal Power Plant allow reclamation and compaction of low lying areas with soil. Only Pond ash shall be used for compaction. They shall also ensure that such reclamation and compaction is done in accordance with the bye-laws, regulation and specification laid down by Authorities.

All agencies undertaking construction of roads or fly over bridges including Ministry of Shipping Road Transport and Highways (MoSRTH), National Highways Authority of India (NHAI), Central Public Works Department (CPWD), State Public Works Department and other State Government Agencies, shall within three months from the 1st day of September 2003 make provision in their documents, schedules of approved materials and rates as well as technical documents; including those related to soil borrow area or pits.

Make necessary specifications/guidelines for road or fly over embankments that are not covered by the specification laid down by the Indian Road Congress (IRC).

### 4.3 World Bank Safeguard Policies

#### Environmental Assessment – OP 4.01 Requirements

Operational Policy 4.01 (OP 4.01) is one of the ten safeguard policies of the World Bank, which provides the Environmental Assessment (EA) guidance for the lending operations. The OP 4.01 requires the borrower to screen projects upstream in the project cycle for potential impacts. Thereafter, an appropriate EA approach to assess, minimize, enhance and mitigate potentially adverse impacts is selected depending on nature and scale of

project. The EA needs to be integrated in the project development process such that timely measures can be applied to address identified impacts. The policy requires consultation with affected groups and NGOs to recognize community concerns and the need to address the same as part of EA.

**Cultural Property – OP 4.11 Requirements:**

The World Bank's Operational Policy Note 4.11 aims at preserving and avoiding the elimination of structures having archaeological (prehistoric), paleontological, historical, religious and unique natural values. Projects that could significantly damage non-replicable cultural properties are declined for funding and the Bank will in turn assist protection and enhancement of cultural properties encountered in the project rather than leaving that protection to chance.

**Natural Habitats – OP 4.04 Requirements:**

Operational Policy 4.04 sets out the World Bank's policy on supporting and emphasizing the precautionary approach to natural resource management and ensuring opportunities for environmentally sustainable development. As per this policy, projects that involve significant conversion or degradation of critical natural habitats are not supported by the Bank. Projects involving non-critical habitats are supported if no alternatives are available and if acceptable mitigation measures are in place.

**Forests – OP 4.36 Requirements:**

OP 4.36 sets out specific policy on protection of forests through consideration of forest related impacts of all investment operations, ensuring restrictions for operations affecting critical forest conservation areas, and improving commercial forest practice through use of modern certification systems. The policy requires consultation with local people, the private sector and other stakeholders in forest area.

**Involuntary Resettlement – OP 4.12:**

This policy describes Bank policy and procedures on involuntary resettlement as well as the conditions the borrowers are expected to meet in operations involving resettlement. The objective of the Bank's policy is to ensure that populations displaced by a project also benefit from the project and that livelihood and standards of living are improved, or at, least restored to earlier levels.

**Indigenous People – OP 4.10 Requirements:**

The World Bank policy on indigenous peoples, **OP/BP 4.10, Indigenous Peoples**, underscores the need for Borrowers and Bank staff to identify indigenous peoples,

consult with them, ensure that they participate in, and benefit from Bank-funded operations in a culturally appropriate way- and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated.

As per the World Bank's Environmental Safeguard policy, the project coordinating entity or implementing institution carries out Environmental Assessment (EA) during the preparation of each proposed sub-project as per country requirements and the requirements of this policy. The Bank appraises and recommends to strengthen the capabilities of the coordinating entity or the implementing institution to (a) screen sub-projects, (b) obtain the necessary expertise to carry out EA, (c) review all findings and results of EA for individual sub-projects, (d) ensure implementation of mitigation measures (including, where applicable, an EMP), and (e) monitor environmental conditions during project implementation. If the Bank is not satisfied that adequate capacity exists for carrying out EA, all Category A sub-projects and, as appropriate, Category B sub-projects including any EA reports are subject to prior review and approval by the Bank.

The purpose of conducting an environmental assessment (EA) is to identify environmental and social consequences of the proposed sub-projects or components, to:

- Ensure the identification of potential environmental issues and social concerns early in the implementation of a proposed project to incorporate necessary safeguards in project design to prevent potential adverse impacts by determining appropriate mitigation and compensation measures;
- Minimize risks and enhance positive impacts/benefits;
- Avoid delays and extra costs which may subsequently arise due to unanticipated environmental problems;
- Identify the potential for maximizing environmental resources management and socio-economic benefits to local communities within the scope of the subproject.
- The EA should cover physical-chemical, biological, socio-economic and cultural issues that are likely to arise during upgrading and widening of roads safety risks and appurtenance structures and associated activities as appropriate.

The World Bank has classified the type of projects into following categories depending on the extent of the impact on environment:

**(i) Category A**: A proposed project is classified as Category A, if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. Such project requires full EIA study.

**(ii) Category B**: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas—including wetlands, forests, grasslands, and other natural habitats—are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects.

**(iii) Category C**: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

**(iv) Category FI:** A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

Thus, for Category-A project detail Environmental Assessment would be required. For the project requiring Environmental Clearance from the MoEF&CC, detailed Environmental Impact Assessment would be required in accordance with the Environmental Impact Assessment Notification, 2006 and amended thereafter. For Category-B projects site specific EA is required and a generic environmental management plan (EMP) would be required to be prepared for such project. For Category C projects, no study beyond environmental screening is required.

### 4.4 Statutory Clearance for Borrow area and Stone quarry

Mining of minor minerals such as sand, gravel, clay, marble and other stones will not be allowed in the country without the approval of the Central government. The Hon'ble Supreme Court, vide its order dated 27.02.2012 in I.A.No.12-13 of 2011 in SLP (C) No.19628-19629 of 2009 titled Deepak Kumar etc. Vs. State of Haryana & Ors. has inter alia ordered that leases of minor mineral including their renewal for an area less than 5 ha be granted by the State / Union Territory only after getting environment clearance (EC) from the Ministry of Environment, Forests and Climate Change (MoEF&CC). In order to ensure compliance of the aforesaid order of the Hon'ble Supreme Court, MoEF&CC issued an OM No.L-11011/47/2011-IA.II(M) dated 18.05.2012 stating inter alia that all

mining projects of minor minerals including their renewal, irrespective of the size of the lease would require prior EC and that the projects of minor minerals with lease area less than 5 ha would be treated as Category "B" as defined in EIA Notification, 2006 and will be considered by the respective State Environment Impact Assessment Authorities (SEIAAs) notified by MoEF&CC and following the procedure prescribed under the EIA Notification, 2006. The mining projects having more than 5 Ha of lease area will be categorized as Category A project and will be appraised by Central Committee of MoEF&CC.

Regarding the borrow area for ordinary soil, the Contractor should obtain environmental clearance from State Environmental Impact Assessment Authority (SEIAA) of MoEF&CC in compliance to the Supreme Court's order and MoEF&CC conditions vide their circular no. L-11011/47/2011-IA. II(M) dated 20th June, 2013. If the area of a borrow area is less than 5 Ha, then this will be treated as Category-B-2 Project and will be appraised and approved based of only Form-1. No EIA study will be required for such area. However, if the size of the borrow area is more than 5 Ha then it will be categorized as "Category-B1" and therefore will require EIA study, based on which the SEIAA will give clearance for the same.

### 4.5 Applicability of Clearances

#### 4.5.1 Environmental Clearance

As the sub-project consists of only urban roads it doesn't need to comply with Environmental Impact Assessment (EIA) Notification issued on 14th September 2006 (amended) by the MOEF, Govt., of India and as per the amended Notification of the MoEF on 22nd August 2013 on Highway projects.

However, the proposed roads sub-project needs to get approvals from Andhra Pradesh Pollution Control Board (APPCB) are i.e., No Objection Certificates (NOC), Consent for Establishment (CFE) and Consent for Operation (CFO) for establishment and operation of Hot mix plants, batch mix plants, quarries etc. during the construction phase of the project.

The MoEF&CC, Government of India, Notification of 14th September 2006 and its amendment enlist projects in Schedule that proposed Green Field Capital of Amaravati has already got Environmental Clearance for the entire project from State Level Environmental Impact Assessment Authority (SEIAA), Andhra Pradesh in vide order no. SEIAA/AP/GTN-151/2015, Dated:09.10.2015. No specific clearance is required for roads sub-project in the Amaravati Capital City area. According to MoEF&CC, EIA Notification, the

sub-arterial roads are neither falling under Category -A nor Category -B hence, Environmental Clearance is not required. As per the World Bank Safe Guard policy, the project is classified as Category "A". Hence, EIA/EMP report is prepared duly adopting the both national and WB norms.

The EC conditions pertaining to the 10 Priority roads are compiled and given in Table - 4.2.

**Table 4-2: EC conditions pertaining to the proposed Roads**

| S. No. | Applicable EC Condition | Compliance | Remarks |
|---|---|---|---|
| 1 | All roads should have rain water drains connected separately to the treatment facility of the zone. (Point -12 of Water Environment under Specific Conditions) | Provided storm water drains either side of Right of Way | Storm water drains included in package however they will be taken up as sub-project subsequently |
| 2 | Proponent shall ensure construction of rain water harvesting structures and also promote rain water storage use system by considering heavy rains in the area. Proponent shall make these as mandatory by incorporating in the Bye-laws of APCRDA & CA (Point -06 of Water Environment under Specific Conditions) | 53, 51, 60 & 95 nos. of RWH Pits are proposed either side of the road at an interval of 500m for Package –I, Package –II, Package –III and Package –IV 38 & 59 nos. of RWH Pits are proposed either side of the road at an interval of 500m for Package -V, Package -VI | Section - 7.3.13 of EA & EMP report |
| 3 | The proponent shall give priority for walking, cycling and integrated public transport system for laying of the roads and usage of cleaner fuels and plying of fuel efficient vehicles on the road. (Point -01 of Air Environment under Specific Conditions) | 3m Sidewalk, 3m Cycle Track and 7m BRT are proposed in Typical Cross Section for 4 – Lane + 2 – Lane BRT sub-arterial roads | Section -2.2 of EA & EMP report |
| 4 | The proponent shall ensure that all utility lines (Electricity, telephone, cable, water supply, sewerage, drainage etc.) shall be laid below the ground. Duct shall be provided along and across the roads to lay the utility lines. Major truck (water / sewerage) lines are to be laid along the utility corridor. (Point -10 of Air Environment under Specific Conditions). | All utility lines including ICT, Gas, F&I and WS are proposed to be laid below the Sidewalk and Cycle Track segments on either side of the 10 Priority Roads | Section -2.2 of EA & EMP report |
| 5 | All construction activities by the proponent should ensure that the activities do not alter or do not adversely affect the water bodies and their ecology (Point -02 of Ecology under Specific Conditions). | The project affects about 0.13% of water spread area or .02% of the capital city area. Enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala | Section - 7.3.6.1 |

| S. No. | Applicable EC Condition | Compliance | Remarks |
|---|---|---|---|
| | | vagu, other streams etc. As such the proposed water spread area in the capital city will increase by 197%. | |

### 4.5.2 Forest Clearances

Forest (Conservation) Act, 1980 (amended in 1988) enacted by Government of India, restricts the diversion of forests for use of non-forest purposes. As per the Act, State Government requires prior approval of GoI for the use of forest land for non-forest purposes (means the breaking up or clearing of any forest land) or for assigning lease to any private person or agency not controlled by Government. The Forest (Conservation) Rules, 2003 issued under this Act, provide specific procedures to be followed for conversion of forest land for non-forest purposes.

The forest land conversion will follow the "Guidelines for Diversion of Forest Lands for Non-Forest Purpose" under Forest (Conservation) Act, 1980. Compensatory afforestation is one of the most important conditions stipulated for diversion of forest land.

Cutting of trees in non-forest land, irrespective of land ownership, also requires permission from the State Forest Department. Afforestation to the extent of two trees per each tree felled is mandatory.

There are no forest areas involved in the construction of roads in the Amaravati Capital City Area. Hence, no Forest Clearance is required.

### 4.5.3 Other Permissions/ Clearances

The project implementing agency will ensure the following clearances before initiating the works.

- Permission from I& CADD for new and widening cases and to draw water during the construction period.
- All the borrow areas, quarries, sand mines proposed to be utilized in the project shall get the permissions from respective departments /owners.
- Permission for breaking or shifting of public utilities like sewer lines or water pipe lines from water supply and sewerage boards.

- Permission and clearance from electricity board for shifting/ moving of streetlights transformers, electric poles during construction of roads or fly over or pedestrian ways or any other likely sub projects.

# Chapter 5
# ANALYSIS OF ALTERNATIVES

## 5.0 Analysis of Alternatives

The concept of alternative can be defined as a possible course of action, in place of another, that would meet the same purpose and need. Alternative analysis in EA is designed to bring environmental and social considerations into the "upstream" stages of development planning—project identification and earlier—as well as the later stages of site selection, design and implementation.

The alignments of the proposed 10 Priority roads in the Amaravati capital city was finalized in the masterplan stage itself considering techno-economic feasibility and addressing the environmental and social issues of concern. The master plan was prepared and finalised by M/s. Surbana Jurong which was notified on Feb 23, 2016. The summary of the social and environmental considerations in finalization of proposed roads are:

**Social Aspects :**

- Integration of Villages: The alignments of the roads were finalized considering maximum connectivity to the villages in the Capital City Region viz Nekkallu, Sakhamuru, Ainavolu, Penumaka, Navalluru, Buthalpudi, Krishnaiahpalem, Venkataiahpalem, Neerukonda, Velagapudi, Mandadam, Thulluru, Abbarajupalem, Anantavaram, Dondapadu etc.
- The alignments of the roads were finalized considering that maximum right of way (RoW) of the roads lies in government owned lands and lands acquired through land pooling scheme.
- These roads are also connecting proposed Government Complexes, statup areas, knowledge hubs, recreational hubs, electronic city etc.
- The Amaravati Master Plan envisages a grid network of roads for providing both internal connectivity as well as connectivity to highways (NH-5 & NH-9)/ transport corridors to the wider core & extended regions of AP CRDA.
- The roads passing through the existing village settlements in the draft master plan were affecting a total of around 3578 structures; as a result the draft was modified after the period of objections/suggestions. The number of affected structures in the settlements reduced to about 589 by slightly realigning 5 North-South sub-arterial roads and 2 of East-West sub-arterial roads without affecting

the objective of perfectly straight arterial roads as well as a true North alignment for all sub arterial roads within the capital city.

- A total of 4740 objections/suggestions were received from various sources such as grama sabhas, e-mail communication, post and by hand. All the objections/ suggestions received were carefully evaluated by a technical committee constituted for this purpose. The three major categories of objections/ suggestions related to:
    1. Demand for demarcating boundaries of village settlement areas within which land pooling will be exempted with the exception of master plan infrastructure requirements, and
    2. Demand to identify the exact survey numbers where lands will be returned in each village and also to avoid locating such returnable residential/ commercial plots on low lying areas especially in villages of Borupalem, Neerukonda, and Navuluru. As per request of people the returnable lands are changed from low lying areas near streams/ water spread areas to other areas.

**Environmental Aspects**

- Various environmental considerations were taken while fixing the alignments during the masterplan stage. Due care was taken to avoid maximum number of trees and ponds falling in the RoW.There are about 1743 nos. of plants and 78 nos. of farm ponds avoided in the corridor of impact of the project in the proposed 10 roads.
- As per the Ancient Monuments & Archaeological Sites and Remains Act, 1958, as amended in 2010. Due care has been taken during master plan stage by consiering the minimum distance of 200m away from the Rock cut cave temple, Undavalli. Hence, there is no impact on Rock Cut Cave temple is envisaged due to proposed 10 roads project.
- Based on historical information and projections carried out there is a concern regarding flooding of parts of the Capital City on account of flash floods in Kondaveeti Vagu. Engineering interventions for flood mitigation are planned to address this issue.Proposed 10 roads Finished Road Levels (FRLs) are compared with proposed High Flood Levels (HFLs) of seasonal streams such as Kondaveeti vagu and Pala vagu. The details of the same are:

- The Eastern roads such as E8 & E10 roads are crossing Kondaveeti vagu near Nekkallu & Krishnayapalem. The FRL of E8 is +39.7 to +39.8m whereas the HFL of the vagu is +33.3 to +35.6m. The FRL of E10 is +21.90 to +22.0m whereas the HFL of the vagu is +15.3m.
- The Northern roads such as N4, N9, N11, N14 & N16 roads are crossing Kondaveeti vagu & Pala vagu near Krishnayapalem, Neerukonda, Velagapudi, Kondamraju palem, Sakhamuru, Abbaraju palem, Nekkallu and Borupalem. The FRL of N4 Road is +21.30 to +22.0m whereas the HFL of the vagu is +15.3 to +35.6m. The FRL of N9 is +22.00 m whereas the HFL of the vagu is +16.40m. The FRL of N11 is +22.00 m whereas the HFL of the vagu is +16.60m. The FRL of N14 is +23.70 m whereas the HFL of the vagu is +16.70m. The FRL of N16 is +31.30 m whereas the HFL of the vagu is +29.0m.

Overall, all the proposed roads are found to be located above proposed HFLs of the Kondaveeti vagu and Pala vagu. Hence, no issue of the flood impact is envisaged in the project.

- Ten roads are designed in such a way that there will be a very minimal impact on existing water bodies, rivers etc.

Several existing villages are present in the capital city area; Extreme care has been taken during the masterplan stage to avoid the intersection of the road alignment through the villages and minimal damage to existing environment. The various villages which are intersecting with the proposed 10 Priority roads alignment are given in the Table 5-1

**Table 5-1: Package wise roads intersecting the villages**

| S. No | Package | Road ID | Name of Intersecting Villages |
|---|---|---|---|
| 1 | Package -I | E8 | - |
| 2 | Package -II | N9 | - |
| 3 | Package -III | N4 | Venkatapalem |
| 4 | | N14 | Thulluru, Abbarajupalem |
| 5 | Package -IV | E10 | - |
| 6 | | E14 | Nowluru |
| 7 | | N16 | - |
| 8 | Package V | E6 | Ananthavaram, Thullur |

| | | | |
|---|---|---|---|
| 9 | Package-VI | E12 | - |
| 10 | | N11 | Lingayapalem |

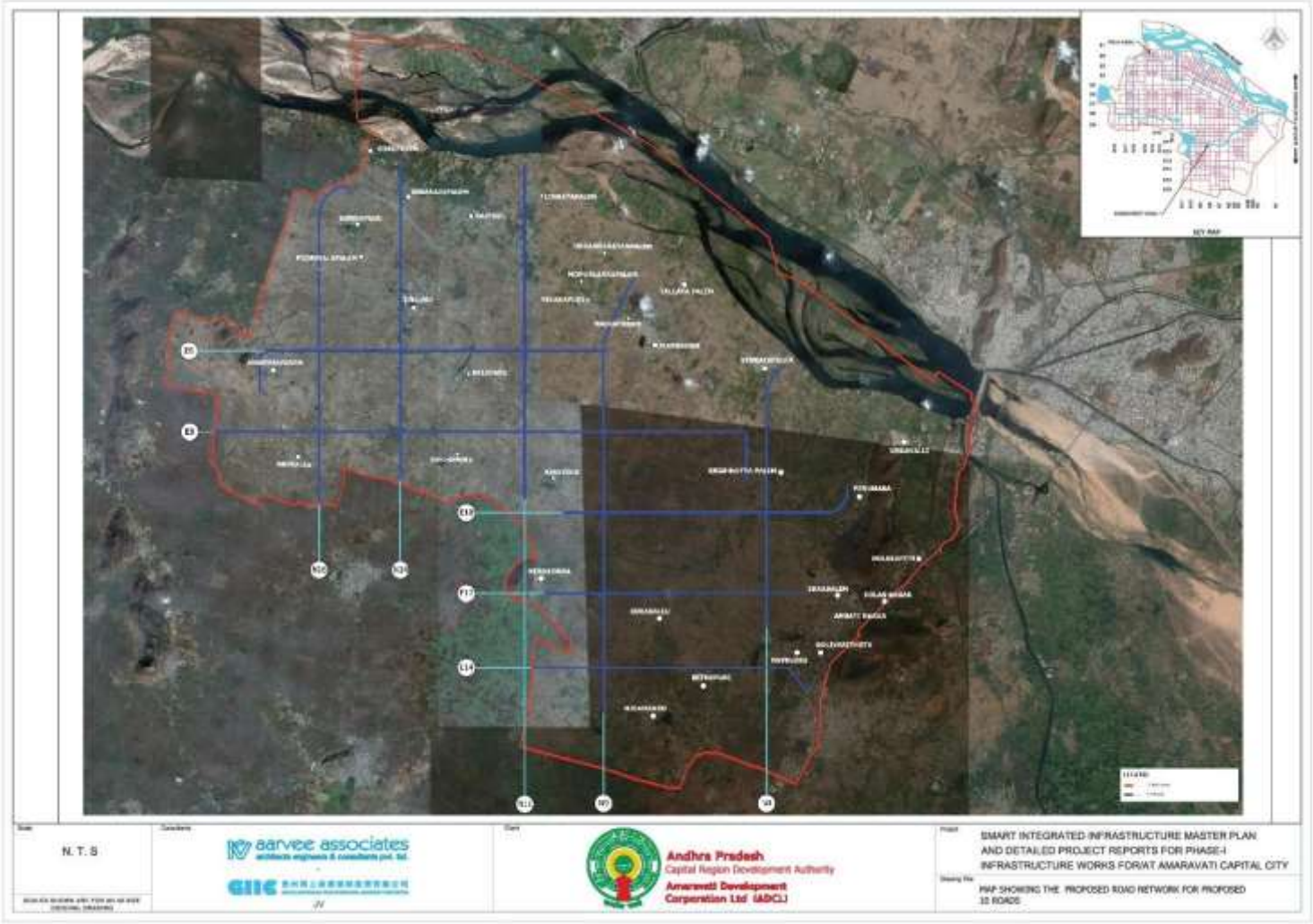



**Figure 5-1: Proposed 10 Priority roads network in the capital city of Amaravati**

# Chapter 6
# DESCRIPTION OF THE ENVIRONMENT

## 6.0 Description of the Environment

This chapter provides an overall description of the existing environmental status in the sub-project influence area. Studies were conducted to generate baseline data within a 10 Km radius along the proposed project on micro – meteorology, air quality, ground and surface water quality, noise levels, land environment including soil quality, geomorphology, land-use pattern, forest cover, biological environment and socio-economic status of the population, etc. From these inputs, possible significant impacts are identified. Impacts are quantified and an appropriate Environmental Management Plan is prepared to manage and mitigate these impacts.

As a primary requirement of EIA process, the EIA report has been prepared based on the standard ToR given in the "EIA and EMP for Roads Sub-projects" by MoEF & CC and World Bank. For the study area, primary Environmental baseline data was collected by M/s. Aarvee Associates, Hyderabad during October & November 2016 through M/s. Vison Labs, Hyderabad (A laboratory Recognized by Ministry of Environment & Forests, Government of India, S.O. 1680 (E), Dated 02.07.2014 and NABL), which was engaged for the field study of air, water, noise, soil etc. The basic site & its environs are analyzed during the field study to know the pre-existing status of the study area and the same is described below.

## 6.1 Site and its Environs

The reconnaissance survey and subsequent field studies are carried out in the study area and the major aspects were emphasized with respect to the geography, geology & soil, hydro-geology, river basins, forests & wildlife sanctuaries, transportation, socio-economic aspects, industries, and climatological conditions of the sub-project influence area are collected and analyzed. The details of the same are given below:

### 6.1.1 Geographical features

This section contains a detailed description on existing environment of the proposed project area including physical and biological environment in the study area. The project area passes through Guntur district in Andhra Pradesh.

**Guntur district:** Guntur is one of the 9 Coastal districts of Andhra Pradesh. It is located between 15° 18'and 16° 50' North latitude and 70° 10'and 80° 55'East longitude. It is bounded by Krishna & Nalgonda districts on the North, by Prakasam and Mahabubnagar districts on the West, by Prakasam district on the South and by Krishna district, and the

Bay of Bengal on the East. The district has a coastline of 42 km. The total geographical area of the district is 11328 $km^2$. Guntur district lies at an elevation of 33m from sea level. The district is mainly plain, with a few hill ranges. The average rainfall in the district is 830mm during South-West monsoon.

Guntur district is divided into 3 Revenue divisions: Guntur, Tenali and Narsaraopeta. The district is divided into 57 Mandals and 729 revenue villages The Ethipothala water falls near Macherla, Kottappakonda shrine, Amaravati stupas, Nagarjunasagar dam, Managalgiri temple etc are the major centres of tourist attraction. Krishna is the main river, which traverses 250 km in the district, irrigating an area of nearly 5 lakh Ha. Chandravanka, Naguleru and Gundlakamma are the 3 major rivulets.

### 6.1.2 Geology & Soil Characteristics

**Geology:**

The area is underlain by various geological formations of different age groups ranging from Archaean to Recent. The Archaean basement complex comprising the granite-gneisses, Schists, Khondalites, Charnockites and basic dykes of dolerites form the predominant rock types in the central part. The fringe of the Archaeans in the central part is represented by Cuddapah basin, namely Nallamalai group of Upper Cuddapahs. In a sequential order, the younger Kurnools occurring in the Cuddapahs and those in the western parts of the district are thrust over by the Cuddapahs and these in turn by the Archaean granite-gneisses. The Upper Gondwana group of sandstones and shales out crop are seen at Guntur. The youngest rock types of the district appear to be of Mio-Pliocene age followed by the Alluvial deposits of Recent to Sub-Recent age.

**Soil:**

The soils in general are very fertile and they are broadly classified as Black cotton, Red loamy and sandy loamy. Black cotton area is in 70%, Red loamy in 24% and sandy loamy in about 6% of the area in the district.

### 6.1.3 Minerals

Guntur district has deposits of limestone, clay, quartz, copper, and lead. Lime stone is abundantly available in Pidiuguralla, Macherla, Pondugula and Tadipalli areas. Copper deposits are found at Agnigundala. Napa stones are found in abundance in various places in this district.

### 6.1.4 Hydro-geology

Guntur District: Ground water occurs in the granites, gneisses, schists, charnockites and Khondalites of Archaean age in the weathered to semi-weathered portions under water

table and semi-confined conditions. In general, the thickness of weathered zone varies from 10 to 30m and the fractured zones extend from 30 to 50m bgl. The fracture porosity decreases with depth and appears negligible below 50m. The Open wells constructed in the hard rock area generally vary in depth from 10 to 15m. The depth to water table varies from 4 to 10m. The yields range from 30 to 80 cubic meters per day. The bore wells constructed in the hard rock range in depth from 50 to 120m and the yields vary from 3,000 to 10,000 liters per hour. Dug wells are feasible in Guntur Mandal, bore wells are not feasible in these areas due to shallow basement. The sandstones of Upper Gondwanas at Chebrolu Mandal, are good water bearing, open wells and tube wells are feasible in these rocks, Ground water occurs under confined conditions and the potential aquifer exist down to 60 to 70m only followed by thick clay. Open wells are feasible and can be constructed to a depth of 10 to 12m in the villages of Suddapally, Narakodur, Chebrolu, Gundavaram etc.

The chemical quality of groundwater exhibits considerable variations from place to place. It is observed from the data in pre-monsoon period (May-2008) that the EC value ranges from 700 to 7780 µs/cm, TDS from 480 to 4979- ppm, pH from 7.65 to 8.95, Cl from 60 to 1850 ppm, F from 0.1 to 2.16 ppm, and NO3 up to 463 ppm. The quality of groundwater is generally suitable for both drinking as well as for irrigation purposes in study area. Similarly, Fluoride contamination is well known in Mandal and in localized pockets of Nuzendla, pedakurapadu and Krosuru mandals. (Source: Dynamic Ground Water Resources of Guntur District, 2008-09, APGD).

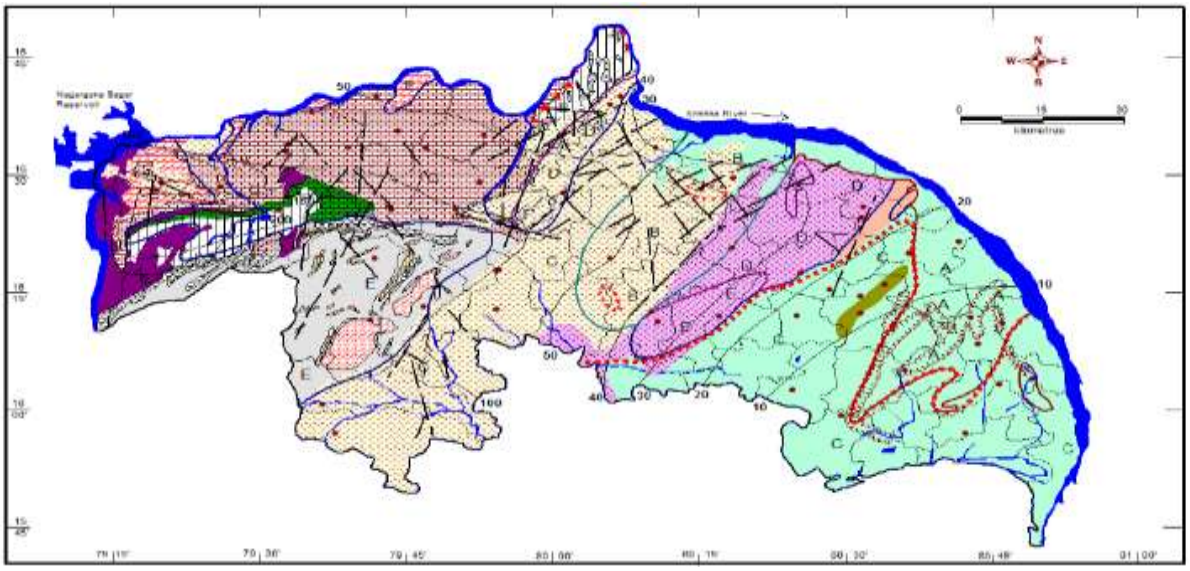


**Figure 6-1:Hydro-geology map of Guntur District, Andhra Pradesh**
Source: Ground Water Brochure, Guntur District, September 2013

The hydro-geological map of Guntur district was collected from "Ground Water Brochure, Guntur District, prepared by Central Ground Water Board, September 2013" and the same thing is given in Figure 6-1.

### 6.1.5 River basins, Flood and Cyclones

**Krishna river system:**

Krishna, the second largest river in the state, flows 780 km from Mahabaleshwar in Maharashtra before entering Andhra Pradesh. The main tributaries are Koyna, Bhima, Ghataprabha, Mallaprabha, Tungabhadra, Yerla, Warna and Dudhganga in combined Andhra Pradesh State. The river gets most of its water from Western Ghats. The catchment area of the river is 2,58,818 $km^2$, of which 29.45% is in combined Andhra Pradesh. Most part of this basin comprises rolling and undulating country except the western border which is formed by an unbroken line of ranges of the Western Ghats. The important soil types found in the basin are black soils, red soils, laterite and lateritic soils, alluvium, mixed soils, red and black soils and saline and alkaline soils.

An average annual surface water potential of 78.1 $km^3$ has been assessed in this basin. Out of this, 58.0 $km^3$ is utilizable water. Culturable area in the basin is about 203,000 $km^2$, which is 10.4% of the total culturable area of the country.

**Floods occurred to River Krishna:**

In 2009 October, heavy floods occurred, isolating 350 villages and leaving millions homeless, which is believed to be first occurrence in 1000 years. The flood resulted in heavy damage to Kurnool, Mahabubnagar, Guntur, Krishna and Nalgonda Districts. The entire city of Kurnool was immersed in approximately 10 feet (3.0 m) water for nearly 3 days. Water inflow of 1,110,000 cu ft/s (31,000$m^3$/s) was recorded at the Prakasam Barrage, which surpassed the previous record of 1,080,000 cu ft./s (31,000 m3 /s) recorded in the year 1903. The map showing the Vagu/Stream High Flood Level (HFL) vs Finished Road Level (FRL) of the proposed roads is given in Figure -6.2 (attached separately due to space constraint). Details of Vagu/Stream High Flood Level (HFL) vs Finished Road Level (FRL) of the proposed Roads are given in Table -6.1. Chainage of road along the vagu is highlighted in 'green' whereas chainage of road across the vagu is highlighted in 'yellow' in Table -6.1.

**Table 6-1: Details of Vagu/Stream High Flood Level (HFL) vs Finished Road Level (FRL) of the Proposed roads package wise.**

| Road ID | Chainage of the road along/across the vagu in m | Median edge level (FRL) of road in m | Vagu section | Chainage of vagu section in m | HFL of vagu section in m | Remarks |
|---|---|---|---|---|---|---|
| **Package-I** | | | | | | |
| E8 | 7900 | 23.767 | | 15400 | 17.63 | No inundation is anticipated on the road along the vagu since FRL > HFL |
| E8 | 8100 | 24.165 | | 15600 | 17.75 | |
| E8 | 8200 | 23.958 | | 15800 | 18.14 | |
| E8 | 8400 | 23.544 | | 16000 | 18.81 | |
| E8 | 8600 | 23.911 | | 16200 | 19.32 | |
| E8 | 8800 | 25.059 | | 16400 | 19.80 | |
| E8 | 9000 | 26.175 | | 16600 | 20.20 | |
| E8 | 9100 | 26.301 | | 16800 | 20.50 | |
| E8 | 9200 | 26.090 | | 17000 | 20.73 | |
| E8 | 9400 | 25.656 | | 17200 | 20.87 | |
| E8 | 9500 | 25.456 | | 17400 | 21.04 | |
| E8 | 9700 | 26.215 | | 17600 | 21.26 | |
| E8 | 9800 | 26.804 | | 17800 | 21.57 | |
| E8 | 10000 | 27.983 | | 18000 | 22.17 | |
| E8 | 10200 | 28.714 | | 18200 | 22.78 | |
| E8 | 10400 | 28.350 | | 18400 | 23.75 | |
| E8 | 10600 | 28.953 | | 18600 | 24.56 | |
| E8 | 10800 | 30.798 | | 18800 | 24.90 | |
| E8 | 11000 | 32.644 | | 19000 | 25.18 | |
| E8 | 11100 | 33.566 | | 19200 | 25.38 | |
| E8 | 11300 | 35.411 | | 19400 | 25.52 | |
| E8 | 11500 | 36.398 | | 19600 | 25.67 | |
| E8 | 11700 | 35.482 | | 19800 | 25.82 | |
| E8 | 11900 | 34.201 | | 20000 | 25.98 | |
| E8 | 12100 | 34.529 | | 20200 | 26.28 | |
| E8 | 12300 | 35.000 | | 20400 | 27.24 | |
| E8 | 12500 | 35.025 | | 20600 | 28.00 | |

| Road ID | Chainage of the road along/across the vagu in m | Median edge level (FRL) of road in m | Vagu section | Chainage of vagu section in m | HFL of vagu section in m | Remarks |
|---|---|---|---|---|---|---|
| E8 | 12700 | 36.124 | | 20800 | 29.54 | |
| E8 | 12900 | 38.156 | | 21000 | 30.24 | |
| E8 | 13050 | 39.500 | | 21200 | 30.51 | |
| E8 | 13250 | 39.617 | | 21400 | 30.73 | |
| E8 | 13450 | 38.774 | | 21600 | 30.93 | |
| E8 | 13650 | 38.130 | | 21800 | 31.15 | |
| E8 | 13900 | 39.768 | | 22000 | 33.33 | No inundation is anticipated on the road across vagu since FRL > HFL |
| E8 | 14050 | 39.837 | | 22200 | 34.58 | |
| E8 | 14200 | 39.844 | | 22400 | 35.64 | |
| **Package-II** | | | | | | |
| N9 | 9100 | 22.000 | Kondaveeti vagu from Krishnayapalem To Neerukonda | 10400 | 15.30 | |
| N9 | 9100 | 22.000 | | 10600 | 15.40 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N9 | 9100 | 22.000 | | 10800 | 15.40 | |
| N9 | 9100 | 22.000 | | 11000 | 15.40 | |
| N9 | 9100 | 22.000 | | 11200 | 15.40 | |
| N9 | 2500 | 22.000 | Pala vagu (Navigable) | 6000 | 16.30 | |
| N9 | 2550 | 22.000 | | 6200 | 16.40 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N9 | 2550 | 22.000 | | 6400 | 16.40 | |
| N9 | 2550 | 22.000 | | 6600 | 16.40 | |
| N9 | 2600 | 21.998 | | 6800 | 16.50 | |
| **Package-III** | | | | | | |
| N4 | 3700 | 20.717 | Kondaveeti vagu from Krishnayapalem to Neerukonda | 5200 | 15.30 | |
| N4 | 3800 | 21.685 | | 5400 | 15.30 | |
| N4 | 3900 | 22.000 | | 5600 | 15.30 | No inundation is anticipated on the road across vagu |
| N4 | 4000 | 22.000 | | 5800 | 15.30 | |

| Road ID | Chainage of the road along/across the vagu in m | Median edge level (FRL) of road in m | Vagu section | Chainage of vagu section in m | HFL of vagu section in m | Remarks |
|---|---|---|---|---|---|---|
| | | | | | | since FRL > HFL |
| N4 | 4100 | 22.000 | | 6000 | 15.30 | |
| N4 | 4200 | 21.987 | | 6200 | 15.30 | |
| N4 | 2800 | 21.235 | Pala vagu (Navigable) | 400 | 15.50 | |
| N4 | 2700 | 21.973 | | 600 | 15.60 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N4 | 2500 | 22.000 | | 800 | 15.60 | |
| N4 | 2350 | 21.554 | | 1000 | 15.60 | |
| N4 | 2200 | 20.259 | | 1200 | 15.60 | |
| N4 | 2000 | 20.307 | | 1400 | 15.65 | |
| N14 | 7300 | 23.730 | Kondaveeti vagu from Shakamuru to Ananthavaram | 18000 | 22.17 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N14 | 7300 | 23.730 | | 18200 | 22.78 | |
| N14 | 7300 | 23.730 | | 18400 | 23.75 | |
| N14 | 600 | 23.700 | Pala vagu (Non-navigable) | 13800 | 16.70 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N14 | 500 | 23.700 | | 14000 | 16.70 | |
| N14 | 480 | 23.700 | | 14200 | 16.70 | |
| N14 | 460 | 23.700 | | 14400 | 16.80 | |
| **Package - IV** | | | | | | |
| E10 | 1700 | 19.943 | Kondaveeti vagu from Krishnayapalem to Neerukonda | 4800 | 15.30 | |
| E10 | 1900 | 19.543 | | 5000 | 15.30 | |
| E10 | 2100 | 19.143 | | 5200 | 15.30 | |
| E10 | 2200 | 19.279 | | 5400 | 15.30 | |
| E10 | 2400 | 21.390 | | 5600 | 15.30 | |
| E10 | 2600 | 22.000 | | 5800 | 15.30 | No inundation is anticipated on the road across vagu since FRL > HFL |
| E10 | 2750 | 22.000 | | 6000 | 15.30 | |
| E10 | 2900 | 22.000 | | 6200 | 15.30 | |
| E10 | 3100 | 22.000 | | 6400 | 15.30 | |
| E10 | 3200 | 21.942 | | 6600 | 15.30 | |

| Road ID | Chainage of the road along/across the vagu in m | Median edge level (FRL) of road in m | Vagu section | Chainage of vagu section in m | HFL of vagu section in m | Remarks |
|---|---|---|---|---|---|---|
| E10 | 3400 | 20.570 | | 6800 | 15.30 | |
| E10 | 3600 | 20.593 | | 7000 | 15.30 | |
| E10 | 3700 | 20.427 | | 7200 | 15.30 | |
| E10 | 3800 | 20.107 | | 7400 | 15.30 | |
| E10 | 3900 | 19.784 | | 7600 | 15.30 | |
| E14 | - | - | - | - | - | - |
| N16 | 7460 | 31.007 | Kondaveeti vagu from Shakamuru to Ananthavaram | 20000 | 28.00 | |
| N16 | 7380 | 31.341 | | 20200 | 29.00 | No inundation is anticipated on the road across vagu since FRL > HFL |
| N16 | 7280 | 31.341 | | 20400 | 30.00 | |
| N16 | 7240 | 31.370 | | 20600 | 31.00 | |
| N16 | 0 | 23.190 | Pala vagu (Non-navigable) | 15200 | 18.30 | No inundation is anticipated on the road along the vagu since FRL > HFL |
| N16 | 150 | 23.510 | | 15400 | 18.80 | |
| N16 | 300 | 23.791 | | 15600 | 19.90 | |
| N16 | 500 | 24.133 | | 15800 | 19.90 | |
| N16 | 640 | 23.938 | | 16000 | 19.90 | |
| N16 | 800 | 23.604 | | 16200 | 19.90 | |
| N16 | 900 | 23.405 | | 16400 | 19.90 | |
| **Package -V** | | | | | | |
| E6 | - | - | | - | - | |
| **Package-VI** | | | | | | |
| E12 | - | - | - | - | - | - |
| N11 | 3200 | 22.000 | Pala Vagu (Navigable) | 8400 | 16.60 | No inundation is anticipated Since FRL > HFL |
| N11 | 3220 | 22.000 | | 8600 | 16.60 | |
| N11 | 3240 | 22.000 | | 8800 | 16.65 | |
| N11 | 3240 | 22.000 | | 9000 | 16.65 | |
| N11 | 3240 | 22.000 | | 9200 | 16.70 | |

| Road ID | Chainage of the road along/across the vagu in m | Median edge level (FRL) of road in m | Vagu section | Chainage of vagu section in m | HFL of vagu section in m | Remarks |
|---|---|---|---|---|---|---|
| N11 | 3240 | 22.000 | | 9300 | 16.70 | |

**Figure 6-2: Map showing the Vagu/Stream High Flood Level (HFL) vs Finished Road Level (FRL) of 10 Priority Roads**

**Cyclones:**

The state of Andhra Pradesh experienced 71 cyclones during 1892-1997, each time with colossal damage. Between 1892 and 1977, 56 cyclones affected the seven coastal districts. The district wise figures are given in the following Table which indicates that Nellore, Krishna and Srikakulam districts had more number of cyclones. The frequency of occurrence of Cyclone and storms in AP are given in Table 6-2.

**Table 6-2: Frequency of occurrence of Cyclone and Storms in AP**

| S.No. | District | No. of Cyclones and Storms in Coastal AP |
|---|---|---|
| 1 | Srikakulam | 4 & 10 |
| 2 | Vizianagaram | - |
| 3 | Visakhapatnam | 3 & 7 |
| 4 | East Godavari | 4 & 11 |
| 5 | West Godavari | -- |
| 6 | **Krishna** | **8** & 13 |
| 7 | **Guntur*** | **1** & 2 |
| 8 | Prakasam | 2 & 4 |

Source: Disaster Management Department, Govt. of AP

Note: 1. The figures in bold indicate severe cyclones 2. *: Study Districts

### 6.1.6 Industries

The District has 38 Large and Medium Industries in the sectors based on Lime Stone, Granite, Sand etc. with an investment of Rs 653 Crores. The Deccan Cements Ltd, Sri Chakra Cements and KCP Cements are some of the predominant industries. There are 11 Industrial Estates, 4 Autonagars and 2 Shopping Complexes in the District.

### 6.1.7 Transportation

The study district is having a good transport system in the State of Andhra Pradesh. These are connected to all the major cities across the country through various major and local highways, railways, waterways and air. There is a couple of major highways. State Highways and MDRs, Panchayat roads etc. Common modes of road transport within the cities /towns are city buses, cars and auto-rickshaws etc.

### 6.1.8 Infrastructure

The study area has well-developed and extensive infrastructural facilities in place. The power supply position is good and almost all the villages in study district are electrified. The districts head quarter Guntur have facilities like housing, hospital, drinking water facility, school and technical education, universities, medical college, etc. Emergency

medical care and firefighting facilities are also available at all Tehsils headquarters along the proposed project corridor.

### 6.1.9 Seismic Details of the Area

As per the seismic hazard map of India updated in 2000 by the Bureau of Indian Standards (BIS), the study district Guntur lies in Zone -III. As classified in BIS map, Zone -V indicates the most seismically active region, while zone -II is the least seismically active region. However, the sub-project influence area falls in 'low to medium damage risk zone' region only.

### 6.1.10 Archeological Sites/Places of Tourist Interest

**The Rock Cut Cave Temple, Undavalli:**

The Rock Cut Cave Temple, Undavalli, a monolithic example of Indian rock-cut architecture and one of the finest testimonials to ancient vishwakarma sthapathis, are in the village of Undavalli in Tadepalle Mandal in the Guntur District, and near the southern bank of the Krishna River in the state of Andhra Pradesh, India. The caves are located 6 km south west from Vijayawada, 22 km north east of Guntur City of Andhra Pradesh. The Rock cut Cave Temple, Undavalli are 1650 m, North East direction from E10 (nearest in 10 Roads) and is shown in Figure -6.3. As per "The Ancient Monuments and Archaeological Sites and Remains Act, 1958, as amended in 2010", the construction activities should be 200m away from the ASI site. Since the proposed roads are away from 200m of the site, no impact on Rock Cut Cave Temple is envisaged.

**Figure 6-3 : The Rock cut Cave Temple, Undavalli in the sub-project influence area**

During the baseline study, no artefacts have been identified in the corridor of impact as per the discussions with the local people.

### 6.1.11 Sources of Irrigation and Cropping Pattern

The major crops grown in the sub-project influence area are paddy, chilli, cotton, red gram, black gram, among pulses, cereals like jowar and maize, sorghum, jute, fodder grass, subabul and commercial crops like turmeric, guar gum. The district has 2 major and 1 medium irrigation projects: the Nagarjunasagar Right Bank Canal Command (NSRCCA), Krishna Western Delta (KWD) Canal System and Guntur Channels Scheme. The total area irrigated by all sources in the district is 4,30,806 ha which works out to be 23.33% of the total area of the district. Out of this about 3,56,328 ha (82.71%) is irrigated through canal network and 1.94% through lift irrigation. 14% area is irrigated through tube wells and filter points and the rest 1.35% area is irrigated through tanks, farm ponds and other sources.

## 6.2 Meteorology of the study area

### 6.2.1 Climatic Conditions

Meteorological data was compiled from Indian Meteorological Department (IMD), for Gannavaram station, which is located within the sub-project influence area. The climatological data was compiled for a period of 30 years (1971 – 2000). Data on tropical storms and cyclones were compiled from IMD for a period of more than 100 years. The whole year is divided into four seasons as given in Table-6.3.

**Table 6-3 : Seasons of the study area**

| Season | Months | Characteristics |
|---|---|---|
| Summer | March-Mid of June | Hottest part of the year, occurrence of dust storms. |
| South-west monsoon | Mid of June-September | Characterized by predominantly SW winds. Generally strong and persistent winds prevail. |
| Post monsoon | October-November | Characterized by predominantly NE winds. Fair weather with the variable winds. |
| Winter | December-February | Cool season of the year |

**Temperature:** The cold weather commences towards the end of November when the temperature begins to fall in Gannavaram is observed as the coldest month, with the mean daily maximum temperature at 30.0°C and the mean daily minimum at 18.4°C. The period from March to May is the hottest month with the mean daily maximum temperature at 44.6°C and a mean daily minimum at 19.6°C. With the advance of south–west & north-east monsoon by about mid of June there is an appreciable drop in temperatures. By about 3rd week of November, when the monsoon withdraws, the day temperature begins to increase slightly but the night temperatures decreases steadily. After November both day and night temperatures decrease rapidly.

**Humidity:** The relative humidity observed is high generally during the south-west & north-east monsoon season (64-82%). The air is generally dry during the rest of the

year, the remaining part of the year being the summer season the humidity is ranging between 52 -75%.

**Winds:** In Gannavaram winds are light to moderate with some strengthening in the period from May to August (8.6 – 11.0 Km/Hr) and the winds are blowing west and south-west. During the post- monsoon and cold season, winds blow mostly from the east or north-east. By March, south westerly's and westerlies started blowing and continue during the rest of summer. The south west monsoon season winds are mostly from directions between south-west and North West.

**Cloudiness:** During the south – west monsoon season the sky is heavily clouded to overcast (3.8–6.5 Oktas). There is rapid decrease of cloudiness during the post-monsoon season. For the rest of the year, the sky is mostly clear or lightly clouded.

**Rainfall:** The rainfall in Gannavaram in general increases from the south-west towards the north east. About 69.5% of annual rainfall is received during the south-west monsoon season. July being the peak rainy month with 189 mm, the variation in the Annual rainfall from year is almost compatible with the base levels. The Annual rainfall of the Gannavaram station is observed as 921mm.

The climatological data for Gannavaram station was compiled for a period of 30 years (1971 – 2000) and presented in Table-6.4.

## Table 6-4 : Climatological Table for Gannavaram Station (1971 – 2000)

| Month | | Station level pressure | Air temperature | | | | | | | | | | | | Rain fall | | | | | | Mean wind speed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | | | | | | Extremes | | | | Humidity | | Cloud amount | | Monthly total | No. of rainy days | Total in wettest month with year | Total in driest month with year | Heaviest rainfall in 24 years | Date and year | |
| | | | Dry blue | Wet blue | Daily max | Daily min | Highest in the month | Lowest in the city | highest | Date and year | lowest | Date and year | Relative humidity | Vapour pressure | All clouds | Low clouds | | | | | | | |
| | | hpa | $^0$c | $^0$c | $^0$c | $^0$c | $^0$c | $^0$c | $^0$c | | $^0$c | | % | hpa | | | mm | | mm | mm | mm | | kmph |
| Jan | I | 1013.4 | 22.3 | 20.2 | 30.0 | 18.4 | 32.5 | 15.4 | 35.9 | 22 | 11.1 | 7 | 81 | 22.0 | 2.1 | 0.9 | 0.8 | 0.3 | 59.1 | 0.0 | 47.5 | 2 | 6.3 |
| | II | 1009.4 | 27.5 | 21.3 | | | | | | 1990 | | 1992 | 55 | 20.5 | 2.3 | 1.0 | | | 1985 | | | 1985 | |
| Feb | I | 1011.6 | 24.3 | 22.1 | 32.7 | 20.5 | 35.7 | 17.6 | 37.8 | 14 | 14.4 | 22 | 81 | 24.9 | 2.5 | 1.5 | 9.2 | 0.6 | 66.9 | 0.0 | 45.7 | 1 6 | 6.9 |
| | II | 1007.8 | 30.0 | 22.7 | | | | | | 1954 | | 1993 | 52 | 21.8 | 2.0 | 1.2 | | | 1994 | | | 1972 | |
| Mar | I | 1009.9 | 26.7 | 24.1 | 35.7 | 22.6 | 38.7 | 19.6 | 43.3 | 29 | 17.0 | 1 | 79 | 28.0 | 3.1 | 2.2 | 9.7 | 0.7 | 138.8 | 0.0 | 76.4 | 1 9 | 7.3 |
| | II | 1005.6 | 32.7 | 23.9 | | | | | | 1953 | | 1976 | 46 | 22.7 | 1.5 | 0.6 | | | 1967 | | | 1967 | |
| Apr | I | 1002.5 | 29.7 | 26.3 | 37.8 | 25.5 | 41.5 | 22.4 | 44.5 | 24 | 19.4 | 21 | 75 | 31.5 | 4.4 | 3.4 | 17.1 | 1.1 | 83.8 | 0.0 | 77.5 | 2 5 | 8.8 |
| | II | 1003.5 | 34.8 | 25.8 | | | | | | 1985 | | 1971 | 47 | 26.1 | 2.6 | 1.1 | | | 1971 | | | 1953 | |
| May | I | 998.9 | 31.7 | 26.7 | 40.0 | 27.4 | 44.6 | 22.7 | 47.6 | 23 | 19.4 | 1 | 67 | 31.2 | 4.4 | 2.3 | 44.3 | 2.4 | 411.0 | 0.5 | 210.0 | 1 0 | 9.8 |
| | II | 1000.9 | 36.8 | 26.5 | | | | | | 1966 | | 1997 | 45 | 26.7 | 3.8 | 1.5 | | | 1969 | 1978 | | 1990 | |
| Jun | I | 996.9 | 30.5 | 25.5 | 37.4 | 27.0 | 42.6 | 22.9 | 46.7 | 11 | 21.5 | 25 | 66 | 28.6 | 5.8 | 1.8 | 118.7 | 6.8 | 300.7 | 15.4 | 156.9 | 1 6 | 11.0 |
| | II | 1001.5 | 35.0 | 26.1 | | | | | | 1953 | | 1957 | 49 | 26.6 | 6.0 | 2.6 | | | 1957 | 1976 | | 1996 | |
| Jul | I | 998.1 | 28.1 | 25.4 | 33.7 | 25.3 | 37.8 | 22.8 | 41.0 | 7 | 21.4 | 13 | 79 | 30.2 | 6.3 | 2.1 | 189.2 | 11.9 | 588.2 | 47.4 | 211.3 | 2 3 | 9.2 |
| | II | 1002.3 | 31.6 | 26.1 | | | | | | 1966 | | 1993 | 64 | 29.4 | 6.5 | 2.8 | | | 1988 | 1971 | | 1989 | |
| Aug | I | 998.9 | 27.8 | 25.2 | 32.7 | 25.1 | 36.0 | 22.8 | 38.3 | 7 | 21.4 | 9 | 81 | 30.1 | 6.3 | 2.2 | 174.3 | 10.6 | 392.4 | 10.0 | 95.0 | 1 2 | 8.6 |
| | II | | 30.6 | 26.0 | | | | | | 1971 | | 1992 | 69 | 29.9 | 6.4 | 2.7 | | | 1978 | 1993 | | 1986 | |
| Sep | I | 1004.8 | | 25.8 | 33.0 | 25.0 | 36.2 | 2 2.5 | 38.6 | 4 | 18.2 | 6 | 82 | 3 1.3 | 5.6 | 2.2 | 158.3 | 8.4 | 483.2 | 11.4 | 143.3 | 27 | 6.1 |
| | II | 1001.2 | | 26.3 | | | | | | 1972 | | 19 57 | 73 | 31.1 | 6.1 | 2.6 | | | 19 64 | 2000 | | 19 54 | |
| Oct | I | 1008.0 | | 24.9 | 3 2.1 | 23.8 | 34.8 | 21.0 | 37.9 | 15 | 17.6 | 24 | 8 1 | 29.6 | 4.4 | 1.8 | 129.3 | 7.1 | 419.7 | 0.0 | 200.6 | 16 | 5.7 |
| | II | 1004.7 | | 25.4 | | | | | | 1980 | | 1967 | 76 | 29.8 | 5.2 | 2.3 | | | 1969 | | | 19 95 | |
| Nov | I | 1011.0 | | 22.3 | 31.0 | 21.4 | 33.2 | 17.7 | 35.2 | 20 | 14.6 | 30 | 75 | 24.5 | 3.4 | 1.1 | 59.7 | 3.1 | 247.7 | 0.0 | 148.3 | 20 | 7.0 |
| | II | 1007.8 | | 23.0 | | | | | | 1979 | | 1970 | 65 | 24.4 | 4.2 | 1.7 | | | 1994 | | | 19 77 | |
| Dec | I | 1013.6 | | 20.1 | 29.9 | 19.1 | 31.8 | 16.0 | 34.2 | 14 | 13.0 | 14 | 7 5 | 21.3 | 2.6 | 0.7 | 11.0 | 0.8 | 93.4 | 0.0 | 71.7 | 2 | 6.6 |
| | II | 1010.0 | | 21.1 | | | | | | 1965 | | 1970 | 57 | 20.4 | 3.2 | 1.1 | | | 1985 | | | 20 00 | |
| Annual | I | 1007.4 | 27.1 | 24.0 | 33.8 | 23.4 | 45.1 | 14.7 | 47.6 | 23 | 11.1 | 7 | 77 | 27.8 | 4.2 | 1.8 | 921.5 | 53.6 | 1488.9 | 621.7 | 211.3 | 23 | 7.8 |
| Total or Mean | II | 1003.5 | 31.0 | 24.5 | | | | | 5 | 1966 | 1 | 1992 | 58 | 25.8 | 4.2 | 1.8 | | | 1956 | 1979 | 7 | 1989 | |
| No. of Years | III | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 51 | | 51 | | 30 | 30 | 30 | 30 | 29 | 29 | 49 | 49 | 49 | | 30 |

Source: IMD, Gannavaram

## 6.3 Air Environment

### Methodology

In assessing the environmental impact, collection and interpretation of baseline data is of prime importance. The primary data for the study period were collected 24 hourly twice in a week for October-November 2016 as per national guidelines. The criteria followed for selecting the AAQM stations is recommended by IS: 5182 and CPCB.

They are:

- The sampling station had free exposure so that it did not collect air from stagnant pockets.
- It was not obstructed by large structures including hills.
- The sampling point was not directly influenced by any local source of emission.
- It was located at a minimum height of 1.5m from the ground level.

**Monitoring and analytical procedure:**

Ambient air quality was monitored for the presence of contaminants existing in the air. To evaluate and quantify the air pollution problem, measurements were carried out for various air pollutants mentioned above. This data was used not only to evaluate the air quality in the study area but also as the basis to develop programs aiming at preventing the spread of pollutants leading to a risk to human health and general environment. Fine Dust Samplers (FDS) were used for ambient air sampling of selected parameters. The method for the selected parameters are based on the methods recommended by IS: 5182.

**Selection of monitoring parameters:** The parameters selected for analyzing ambient air quality status were Sulphur dioxide ($SO_2$), Nitrogen dioxide ($NO_2$), Respirable Particulate Matter ($PM_{10}$), Fine Particulate Matter ($PM_{2.5}$), Carbon Monoxide (CO).

### 6.3.1 Air Environment for Package -I

#### 6.3.1.1 Primary Data

After a preliminary reconnaissance of the study region and taking into account the meteorological, topographic conditions (predominant wind directions, wind speed) and considering the spatial relationship of various land uses in accordance with the BIS Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study region, Air Quality monitoring was carried out at two (02) locations in Package -I (E8). The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.5 and are shown in Figure-6.4

**Table 6-5 Ambient Air Quality Monitoring Stations in Package -I**

| Station Number | Station |
|---|---|
| AAQI-1 | Nekkallu |
| AAQI-2 | Sakhamuru |

**Figure 6-4 AAQ Monitoring stations installed at Nekkallu and Sakhamuru**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at two (02) monitored locations are presented in Table -6.6. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF.

**Table 6-6 Ambient air quality during study period in Package -I**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **PM $_{10}$ (µg/m$^3$)** | | | | | |
| Nekkallu | 42.6 | 48.3 | 45.5 | 100 | 50 |
| Sakhamuru | 38.5 | 42.5 | 40.5 | 100 | 50 |
| **PM $_{2.5}$ (µg/m$^3$)** | | | | | |
| Nekkallu | 18.8 | 21.6 | 20.2 | 60 | 25 |
| Sakhamuru | 16.0 | 18.3 | 17.2 | 60 | 25 |
| **$SO_2$ (µg/m$^3$)** | | | | | |
| Nekkallu | 5.0 | 5.6 | 5.3 | 80 | 20 |
| Sakhamuru | 4.8 | 5.2 | 5.0 | 80 | 20 |
| **$NO_2$ (µg/m$^3$)** | | | | | |
| Nekkallu | 15.4 | 16.1 | 15.8 | 80 | 40 |
| Sakhamuru | 14.2 | 15.0 | 14.6 | 80 | 40 |
| **CO (mg/m$^3$)** | | | | | |
| Nekkallu | <1.00 | <1.00 | <1.00 | 4 | - |
| Sakhamuru | <1.00 | <1.00 | <1.00 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 38.5 – 48.3 µg/m$^3$ as against the CPCB standard of 100 µg/m$^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was recorded at Sakhamuru.
- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 16.0 – 21.6 µg/m$^3$ as against the CPCB standard of 60 µg/m$^3$ for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was found at Sakhamuru.
- The Sulfur dioxide values were observed in the range between 4.8 – 5.6 µg/m$^3$ against the CPCB standard of 80 µg/m$^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

The maximum value was recorded at Nekkallu and minimum value was found at Sakhamuru.

- The Dioxides of Nitrogen (NO2) values were observed in the range between 14.2 – 16.1 µg/m$^3$ against the CPCB standard of 80 µg/m$^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Nekkallu and minimum value was recorded at Sakhamuru.
- The carbon monoxide (CO) levels observed were <1.0 mg/m$^3$ as against the CPCB standard of 4mg/m$^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS/WB-EHS standards/Guidelines for the study period in Package -I. In general, the ambient air quality in the Package -I is satisfactory.

The graph of $PM_{10}$ & $PM_{2.5}$ and $SO_2$ & $NO_2$ are shown in the Figures -6.5 & 6.6.

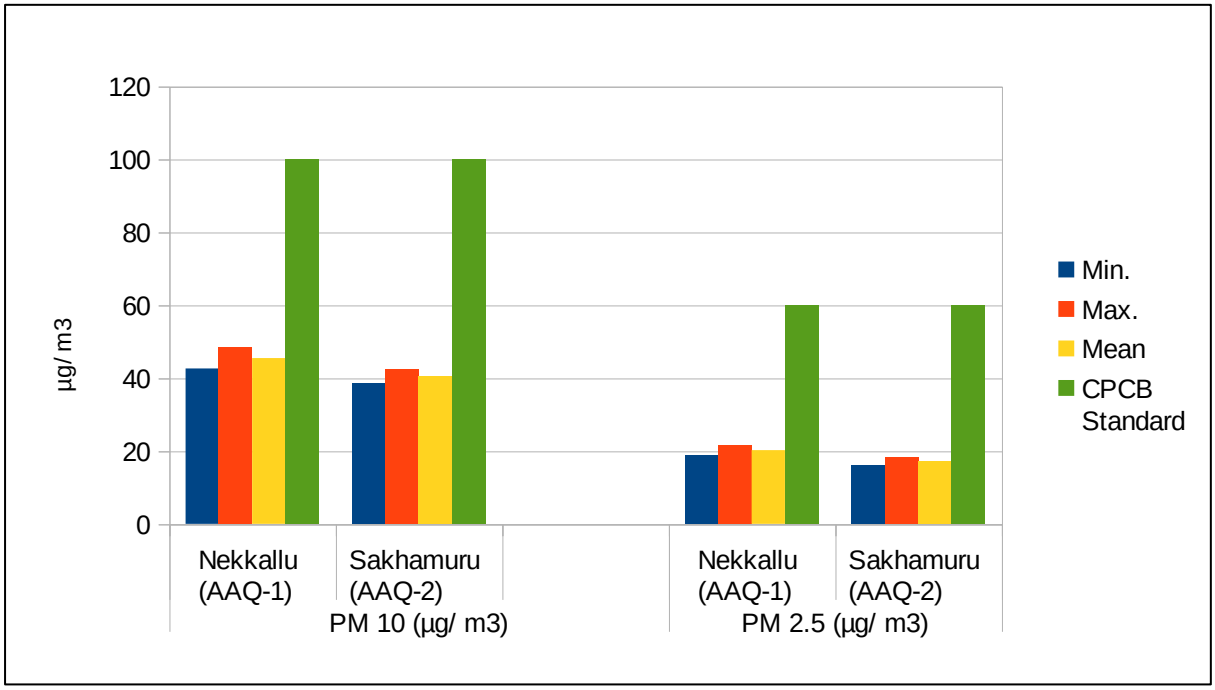



**Figure 6-5 Graph Showing the $PM_{10}$ & $PM_{2.5}$ Concentrations in the Study Area**

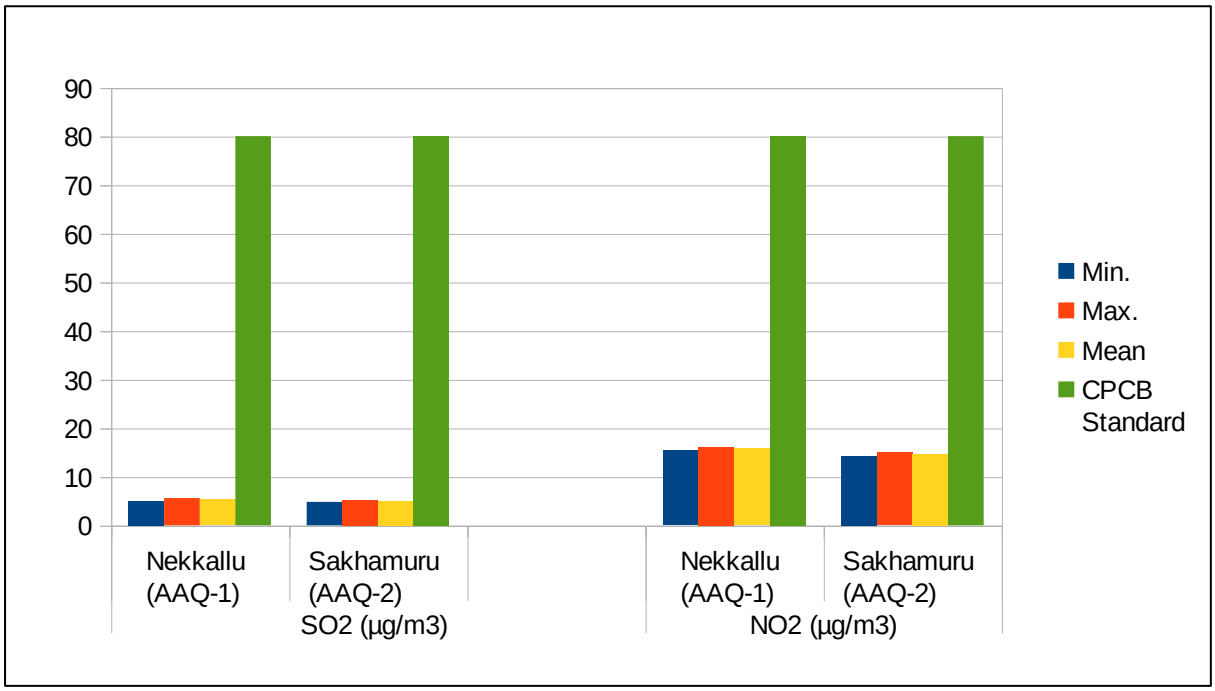



**Figure 6-6 Graph Showing the $SO_2$ & $NO_2$ Concentrations in the Study Area**

### 6.3.1.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons are as follows for Package -I.

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 48 – 52 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Nekkallu and minimum value was recorded at Sakhamuru. The values were found to be well within the standard similar to primary data.
- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 26.0 – 29.0 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. The maximum value was recorded at Sakhamuru and minimum value was found at Nekkallu unlike the trend in primary data. The values were found to be well within the standard similar to primary data.
- The Sulfur dioxide values were observed in the range between 16 – 18 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Sakhamuru and minimum value was found at

Nekkallu unlike the trend in primary data. The values were found to be well within the standard as compared to primary data.

- The Dioxides of Nitrogen (NO2) values were observed in the range between 27 – 29 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Sakhamuru and minimum value was found at Nekkallu unlike the trend in primary data. The values were found to be well within the standard as compared to primary data.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS standards for the study period in Package -I. In general, the ambient air quality in the Package -I is satisfactory.

### 6.3.2 Air Environment for Package -II

#### 6.3.2.1 Primary Data

After a preliminary reconnaissance of the study region and taking into account the meteorological, topographic conditions (predominant wind directions, wind speed) and considering the spatial relationship of various land uses in accordance with the BIS Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study region, Air Quality monitoring was carried out at two (02) locations in Package -II (N9). The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.7 and are shown in Figure-6.7.

**Table 6-7 Ambient Air Quality Monitoring Stations in Package -II**

| Station Number | Station |
|---|---|
| AAQII-1 | Malkapuram |
| AAQII-2 | Velgapudi |

**Figure 6-7 AAQ Monitoring stations installed at Malkapuram and Velgapudi**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at two (02) monitored locations in Package -II are presented in Table -6.8. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF.

**Table 6-8 Ambient air quality during study period in Package -II**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **$PM_{10}$ (µg/m³)** | | | | | |
| Malkapuram | 58.2 | 62.6 | 60.4 | 100 | 50 |
| Velgapudi | 53.6 | 56.4 | 55.0 | 100 | 50 |
| **$PM_{2.5}$ (µg/m³)** | | | | | |
| Malkapuram | 23.4 | 26.0 | 24.7 | 60 | 25 |
| Velgapudi | 19.8 | 21.5 | 20.7 | 60 | 25 |
| **$SO_2$ (µg/m³)** | | | | | |
| Malkapuram | 7.1 | 7.8 | 7.5 | 80 | 20 |
| Velgapudi | 6.0 | 6.4 | 6.2 | 80 | 20 |
| **$NO_2$ (µg/m³)** | | | | | |
| Malkapuram | 22.4 | 24.2 | 23.3 | 80 | 40 |
| Velgapudi | 19.5 | 20.1 | 19.8 | 80 | 40 |
| **CO (mg/m³)** | | | | | |
| Malkapuram | <1.00 | <1.00 | <1.00 | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| Velgapudi | <1.00 | <1.00 | <1.00 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 53.6 – 62.6 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was recorded at Velagapudi.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 19.8 – 26.0 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was found at Velagapudi.
- The Sulfur dioxide values were observed in the range between 6.0 – 7.8 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was found at Velagapudi.
- The Dioxides of Nitrogen (NO2) values were observed in the range between 19.5 – 24.2 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Malkapuram and minimum value was recorded at Velagapudi.
- The carbon monoxide (CO) levels observed were <1.0 mg/$m^3$ as against the CPCB standard of 4mg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS/WB-EHS standards/Guidelines for the study period in Package -II. In general, the ambient air quality in the Package -II is satisfactory.

The graph of $PM_{10}$ & $PM_{2.5}$ and $SO_2$ & $NO_2$ are shown in the Figures -6.8 & 6.9.

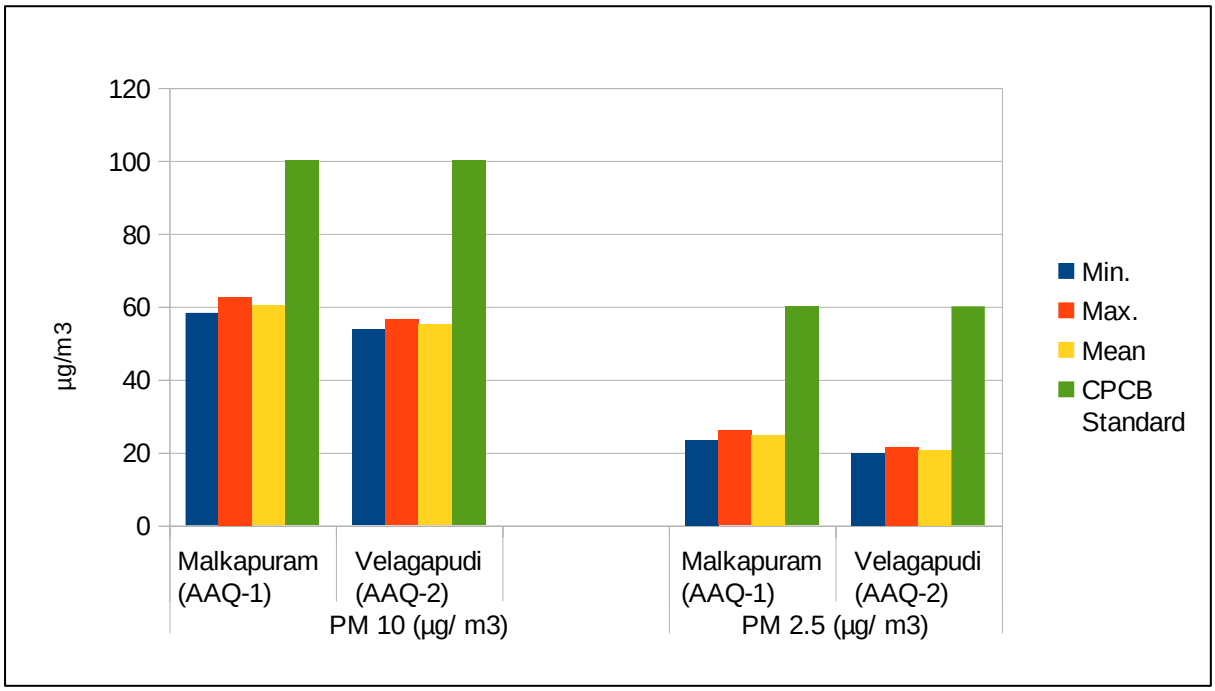



**Figure 6-8 Graph Showing the $PM_{10}$ & $PM_{2.5}$ Concentrations in the Package –II**

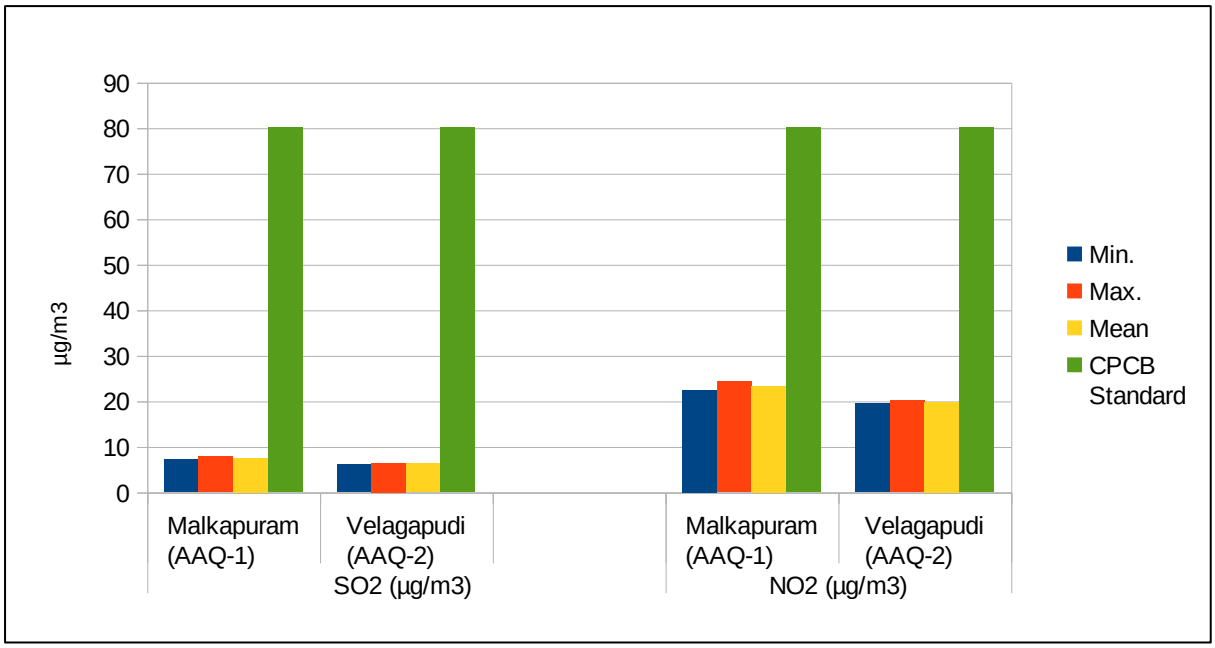



**Figure 6-9 Graph Showing the $SO_2$ & $NO_2$ Concentrations in the Package -II**

### 6.3.3 Air Environment for Package -III

#### 6.3.3.1 Primary Data

After a preliminary reconnaissance of the study region and taking into account the meteorological, topographic conditions (predominant wind directions, wind speed) and considering the spatial relationship of various land uses in accordance with the BIS Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study region, Air Quality monitoring was carried out at four (04) locations in Package -III. The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.9 and are shown in Figure-6.10.

**Table 6-9 Ambient Air Quality Monitoring Stations in Package -III**

| Station Number | Station |
|---|---|
| AAQIII-1 | Venkatapalem |
| AAQIII-2 | Krishnayapalem |
| AAQIII-3 | Thullur |
| AAQIII-4 | Abbarajupalem |

**Figure 6-10 AAQ Monitoring stations installed at Venkatapalem and Thullur**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at four (04) monitored locations in Package -III are presented in Table -6.10. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF.

**Table 6-10 Ambient air quality during study period in Package -III**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **PM $_{10}$ (µg/m$^3$)** | | | | | |
| Venkatapalem | 50.3 | 54.9 | 52.6 | 100 | 50 |
| Krishnayapalem | 43.4 | 46.2 | 44.8 | 100 | 50 |
| Thullur | 64.2 | 68.3 | 66.25 | 100 | 50 |
| Abbarajupalem | 48.5 | 52.4 | 50.45 | 100 | 50 |
| **PM $_{2.5}$ (µg/m$^3$)** | | | | | |
| Venkatapalem | 20.5 | 23.2 | 21.85 | 60 | 25 |
| Krishnayapalem | 19.6 | 20.1 | 19.85 | 60 | 25 |
| Thullur | 25.7 | 28.4 | 27.05 | 60 | 25 |
| Abbarajupalem | 20.0 | 22.3 | 21.15 | 60 | 25 |
| **$SO_2$ (µg/m$^3$)** | | | | | |
| Venkatapalem | 5.4 | 6.0 | 5.7 | 80 | 20 |
| Krishnayapalem | 5.0 | 5.4 | 5.2 | 80 | 20 |
| Thullur | 7.8 | 8.0 | 7.9 | 80 | 20 |
| Abbarajupalem | 5.1 | 5.5 | 5.3 | 80 | 20 |
| **$NO_2$ (µg/m$^3$)** | | | | | |
| Venkatapalem | 17.0 | 18.2 | 17.6 | 80 | 40 |
| Krishnayapalem | 17.5 | 18.9 | 18.2 | 80 | 40 |
| Thullur | 22.0 | 24.4 | 23.2 | 80 | 40 |
| Abbarajupalem | 16.2 | 17.0 | 16.6 | 80 | 40 |
| **CO (mg/m$^3$)** | | | | | |
| Venkatapalem | <1.0 | <1.0 | <1.0 | 4 | - |
| Krishnayapalem | <1.0 | <1.0 | <1.0 | 4 | - |
| Thullur | <1.0 | <1.0 | <1.0 | 4 | - |
| Abbarajupalem | <1.0 | <1.0 | <1.0 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 43.4 – 68.3 µg/m$^3$ as against the CPCB standard of 100 µg/m$^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was recorded at Krishnayapalem.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 19.6 – 28.4 µg/m$^3$ as against the CPCB standard of 60 µg/m$^3$ for residential/industrial

category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was found at Krishnayapalem.

- The Sulfur dioxide values were observed in the range between 5.0 – 8.0 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was found at Krishnayapalem.
- The Dioxides of Nitrogen (NO2) values were observed in the range between 16.2 – 24.4 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Thullur and minimum value was recorded at Abbarajupalem.
- The carbon monoxide (CO) levels observed were <1.0 mg/$m^3$ as against the CPCB standard of 4mg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS standards for the study period in Package -III. When compared with WB-EHS guidelines, $PM_{10}$ and $PM_{2.5}$ values are found to be slightly higher side. In general, the ambient air quality in the study area is satisfactory.

The graph of $PM_{10}$ & $PM_{2.5}$ and $SO_2$ & $NO_2$ are shown in the Figures -6.11 & 6.12.

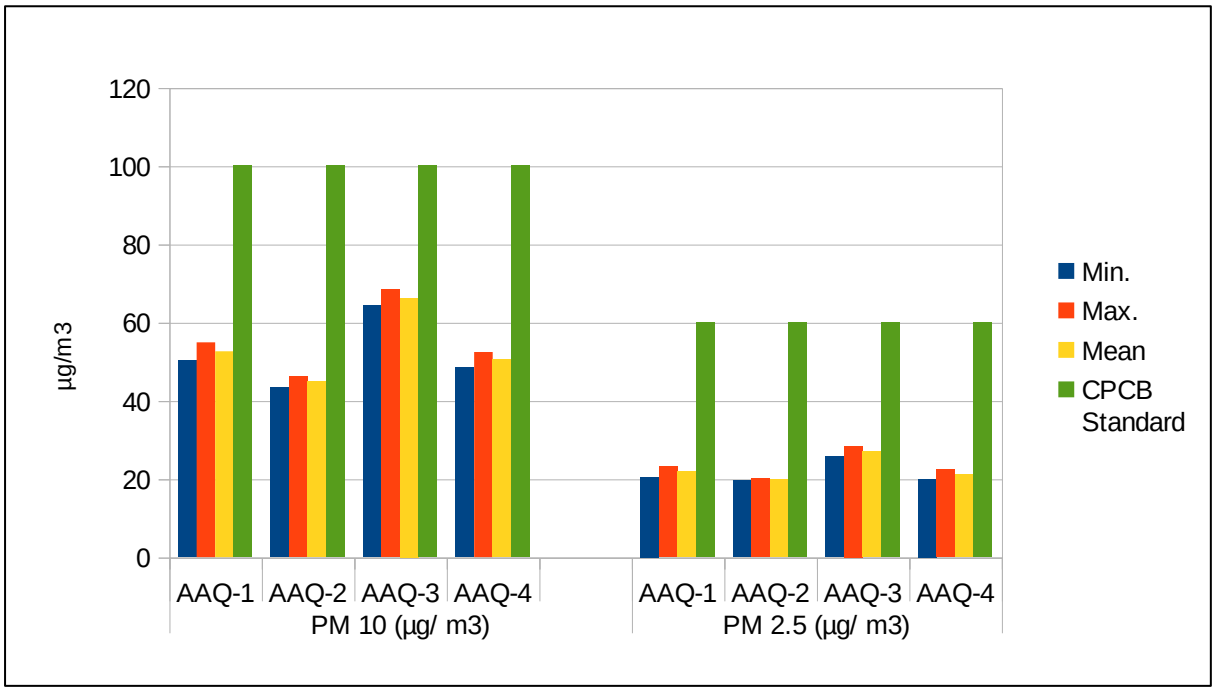



**Figure 6-11 Graph Showing the $PM_{10}$ & $PM_{2.5}$ Concentrations in the Package – III**

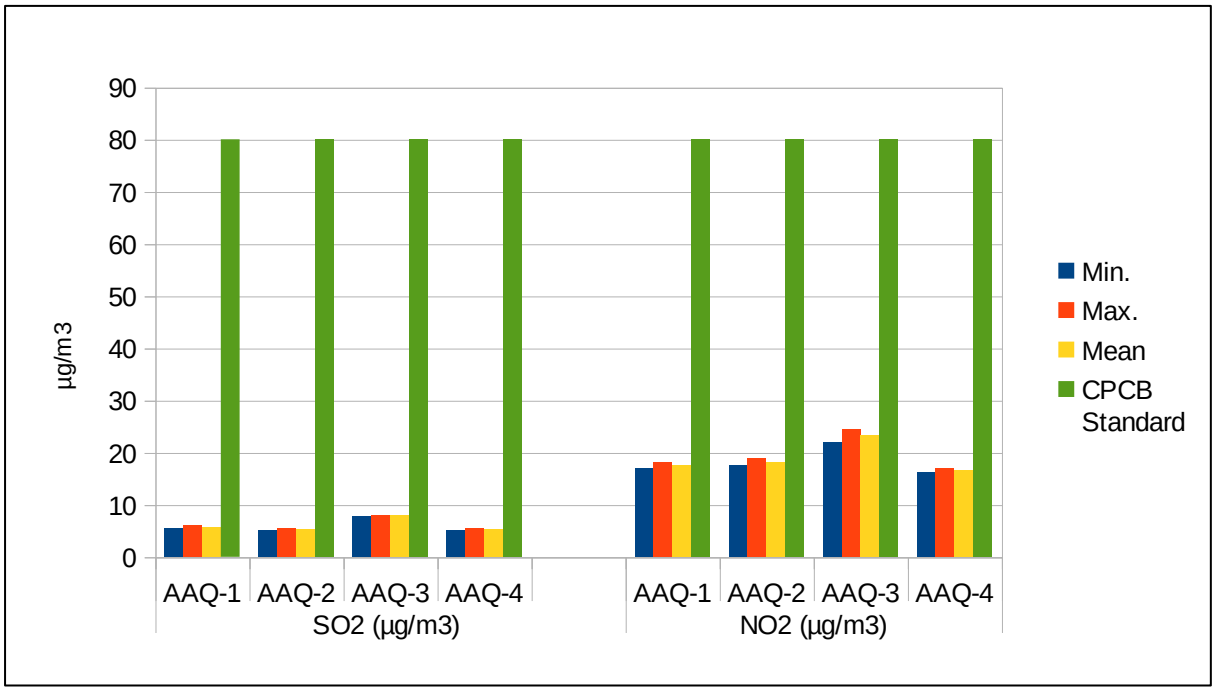



**Figure 6-12 Graph Showing the $SO_2$ & $NO_2$ Concentrations in the Package -III**

#### 6.3.3.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons for Thullur, Venkatapalem and Abbarajupalem are as follows for Package -III.

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 46 – 60 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Thullur and minimum value was recorded at Abbarajupalem. The values were found to be well within the standard similar to primary data.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 27.0 – 43.0 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. The maximum value was recorded at Thullur and minimum value was found at Abbarajupalem. The values were found to be well within the standard similar to primary data.
- The Sulfur dioxide values were observed in the range between 15 – 23 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Thullur and minimum value was found at Abbarajupalem. The values were found to be well within the standard as compared to primary data.
- The Dioxides of Nitrogen (NO2) values were observed in the range between 26 – 42 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Thullur and minimum value was found at Abbarajupalem. The values were found to be well within the standard as compared to primary data.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS standards for the study period in Package -III. In general, the ambient air quality in the Package -III is satisfactory.

### 6.3.4 Air Environment for Package -IV

#### 6.3.4.1 Primary Data

After a preliminary reconnaissance of the study region and taking into account the meteorological, topographic conditions (predominant wind directions, wind speed) and considering the spatial relationship of various land uses in accordance with the BIS

Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study region, Air Quality monitoring was carried out at six (06) locations in Package -IV. The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.11 and are shown in Figure-6.13.

**Table 6-11 Ambient Air Quality Monitoring Stations in Package -IV**

| Station Number | Station |
|---|---|
| AAQIV-1 | Krishnayapalem |
| AAQIV-2 | Penumaka |
| AAQIV-3 | Navuluru |
| AAQIV-4 | Bethapudi |
| AAQIV-5 | Nekkallu |
| AAQIV-6 | Dondapadu |

**Figure 6-13 : AAQ Monitoring stations installed at Dondapadu and Navuluru**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at six (06) monitored locations in Package -IV are presented in Table -6.12. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF.

**Table 6-12 Ambient air quality during study period in Package - IV**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **PM $_{10}$ (µg/m$^3$)** | | | | | |
| Krishnayapalem | 43.4 | 46.2 | 44.8 | 100 | 50 |
| Penumaka | 50.3 | 54.5 | 52.4 | 100 | 50 |
| Navuluru | 51.6 | 54.2 | 52.9 | 100 | 50 |
| Bethapudi | 52.4 | 56.8 | 54.6 | 100 | 50 |
| Nekkallu | 42.6 | 48.3 | 45.5 | 100 | 50 |
| Dondapadu | 51.4 | 56.1 | 53.8 | 100 | 50 |
| **PM $_{2.5}$ (µg/m$^3$)** | | | | | |
| Krishnayapalem | 19.6 | 20.1 | 19.9 | 60 | 25 |
| Penumaka | 22.4 | 24.8 | 23.6 | 60 | 25 |
| Navuluru | 19.2 | 22.8 | 21.0 | 60 | 25 |
| Bethapudi | 19.3 | 23.7 | 21.5 | 60 | 25 |
| Nekkallu | 18.8 | 21.6 | 20.2 | 60 | 25 |
| Dondapadu | 20.8 | 22.3 | 21.6 | 60 | 25 |
| **$SO_2$ (µg/m$^3$)** | | | | | |
| Krishnayapalem | 5.0 | 5.4 | 5.2 | 80 | 20 |
| Penumaka | 5.8 | 6.2 | 6.0 | 80 | 20 |
| Navuluru | 5.6 | 6.0 | 5.8 | 80 | 20 |
| Bethapudi | 6.0 | 6.5 | 6.3 | 80 | 20 |
| Nekkallu | 5.0 | 5.6 | 5.3 | 80 | 20 |
| Dondapadu | 5.8 | 6.0 | 5.9 | 80 | 20 |
| **$NO_2$ (µg/m$^3$)** | | | | | |
| Krishnayapalem | 17.5 | 18.9 | 18.2 | 80 | 40 |
| Penumaka | 16.8 | 17.5 | 17.2 | 80 | 40 |
| Navuluru | 15.8 | 16.2 | 16.0 | 80 | 40 |
| Bethapudi | 17.4 | 18.4 | 17.9 | 80 | 40 |
| Nekkallu | 15.4 | 16.1 | 15.8 | 80 | 40 |
| Dondapadu | 18.0 | 18.5 | 18.3 | 80 | 40 |
| **CO (mg/m$^3$)** | | | | | |
| Krishnayapalem | <1.0 | <1.0 | <1.0 | 4 | - |
| Penumaka | <1.0 | <1.0 | <1.0 | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| Navuluru | <1.0 | <1.0 | <1.0 | 4 | - |
| Bethapudi | <1.0 | <1.0 | <1.0 | 4 | - |
| Nekkallu | <1.0 | <1.0 | <1.0 | 4 | - |
| Dondapadu | <1.0 | <1.0 | <1.0 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 42.6 – 56.8 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Bethapudi and minimum value was recorded at Nekkallu.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 18.8 – 24.8 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Penumaka and minimum value was found at Nekkallu.
- The Sulfur dioxide values were observed in the range between 5.0 – 6.5 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Bethapudi and minimum value was found at Nekkallu and Krishnayapalem.
- The Dioxides of Nitrogen (NO2) values were observed in the range between 15.4 – 18.9 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Krishnayapalem and minimum value was recorded at Nekkallu.
- The carbon monoxide (CO) levels observed were <1.0 mg/$m^3$ as against the CPCB standard of 4mg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS standards for the study period in Package -IV. When compared with WB-EHS guidelines.

PM10 values are found to be slightly on the higher side. In general, the ambient air quality in the Package -IV is satisfactory.

The graph of $PM_{10}$ & $PM_{2.5}$ and $SO_2$ & $NO_2$ are shown in the Figures -6.14 & 6.15.

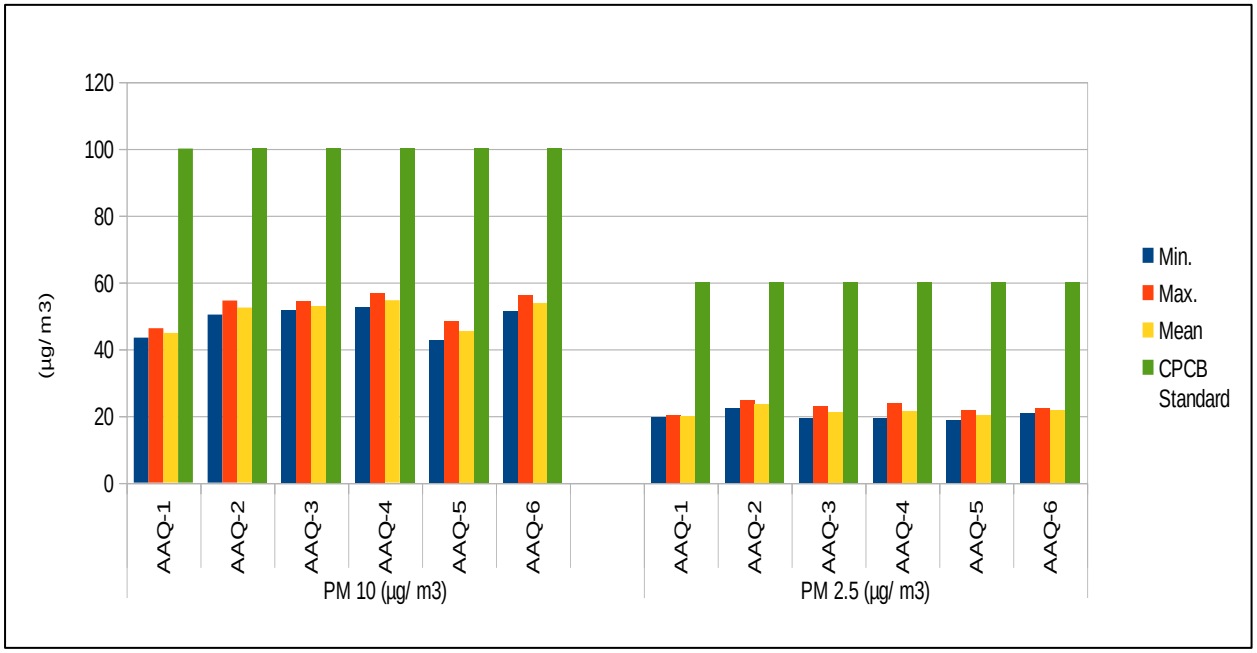



**Figure 6-14 Graph Showing the PM10 & PM 2.5 Concentrations in Package –IV**

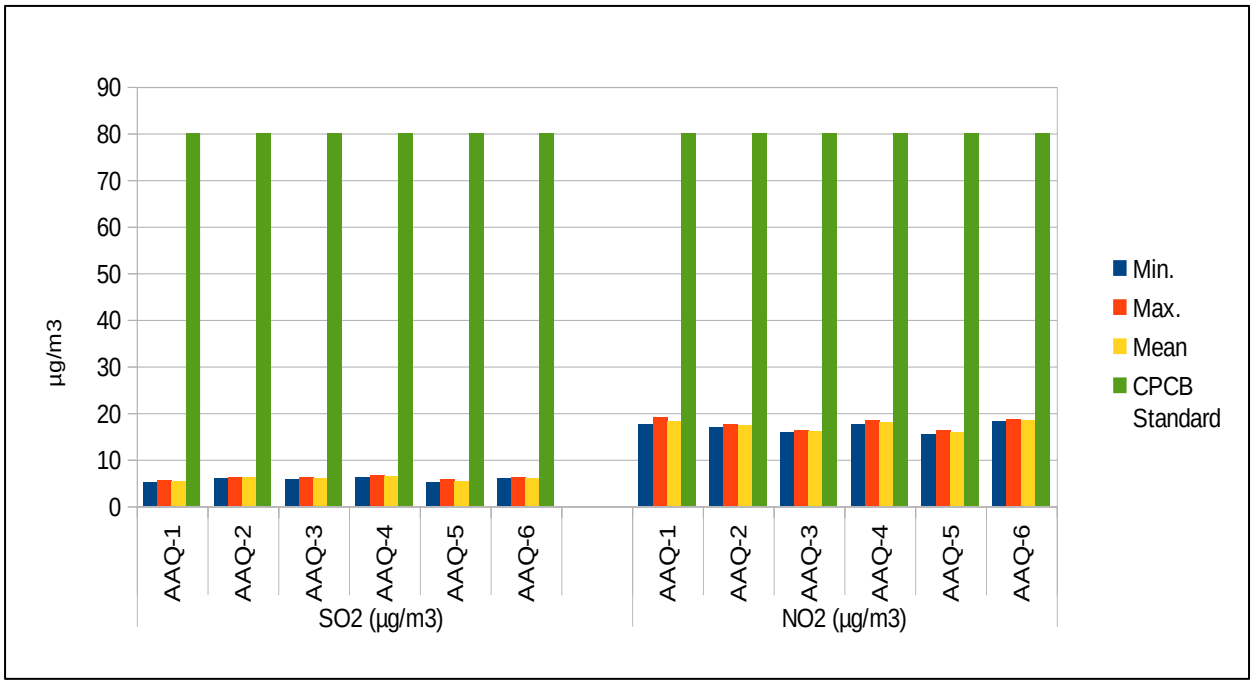



**Figure 6-15 Graph Showing the $SO_2$ & $NO_2$ Concentrations in the Package –IV**

#### 6.3.4.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons for the villages Navuluru and Nekkallu are as follows for Package -IV.

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 49 – 52 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Navuluru and minimum value was recorded at Nekkallu. The values were found to be well within the standard similar to primary data.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 26.0 – 28.0 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. The maximum value was recorded at Nekkallu and minimum value was found at Navuluru. The values were found to be well within the standard similar to primary data.
- The Sulfur dioxide values were observed in the range between 15 – 16 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Navuluru and minimum value was found at Nekkallu. The values were found to be well within the standard similar to primary data.
- The Dioxides of Nitrogen (NO2) values were observed in the range between 27 – 28 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The maximum value was recorded at Navuluru and minimum value was found at Nekkallu. The values were found to be well within the standard similar to primary data.

As a whole, the gaseous concentrations at all the locations are well below the NAAQS standards for the study period in Package -IV. In general, the ambient air quality in the Package -IV is satisfactory.

### 6.3.5 Air Environment for Package -V
#### 6.3.5.1 Primary Data

After a preliminary reconnaissance of the study area and taking into account the meteorological, topographic conditions (predominant wind directions, wind speed) and

considering the spatial relationship of various land uses in accordance with the BIS Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study area, Air Quality monitoring was carried out at two (2) locations in Package -V (E6). The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.13.

**Table 6-13: Ambient Air Quality Monitoring Stations in Package -V**

| Station Number | Station |
|---|---|
| AAQV-1 | Nelapadu |
| AAQV-2 | Ananthavaram |

**Figure 6-16: AAQ Monitoring stations installed at Nelapadu and Ananthavaram**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at eight (08) monitored locations are presented in Table-6.14. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF&CC.

**Table 6-14: Ambient air quality during study period in Package -V**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **PM $_{10}$ (µg/m$^3$)** | | | | | |
| Nelapadu | 40.0 | 45.1 | 42.6 | 100 | 50 |
| Ananthavaram | 40.5 | 45.2 | 42.9 | 100 | 50 |
| **PM $_{2.5}$ (µg/m$^3$)** | | | | | |
| Nelapadu | 16.2 | 18.1 | 17.2 | 60 | 25 |

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| Ananthavaram | 17.5 | 20.17 | 18.8 | 60 | 25 |
| **$SO_2$ (µg/m³)** | | | | | |
| Nelapadu | 5.1 | 5.6 | 5.4 | 80 | 20 |
| Ananthavaram | 5.4 | 5.9 | 5.7 | 80 | 20 |
| **$NO_2$ (µg/m³)** | | | | | |
| Nelapadu | 15.3 | 16.1 | 15.7 | 80 | 40 |
| Ananthavaram | 16.5 | 17.2 | 16.9 | 80 | 40 |
| **CO (mg/m³)** | | | | | |
| Nelapadu | <1 | <1 | <1 | 4 | - |
| Ananthavaram | <1 | <1 | <1 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 40.0 – 45.2 µg/m³ as against the CPCB standard of 100 µg/m³ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 16.2 – 20.17 µg/m³ as against the CPCB standard of 60 µg/m³ for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was found at Nelapadu.

- The Sulfur dioxide values were observed in the range between 5.1 – 5.9 µg/m³ against the CPCB standard of 80 µg/m³ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.

- The Nitrogen dioxide (NO2) values were observed in the range between 15.3 – 17.2 µg/m³ against the CPCB standard of 80 µg/m³ for residential / industrial category. The values were found to be well within the stipulated standards for all

the locations The maximum value was recorded at Ananthavaram and minimum value was recorded at Nelapadu.

- The carbon monoxide (CO) levels observed were <1.0 mg/$m^3$ as against the CPCB standard of 4mg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

The gaseous concentrations at all the locations are well below the NAAQS/WB-EHS standards/Guidelines for the study period in Package -V. In general, the ambient air quality in the Package -V is satisfactory. The graphs of $PM_{10}$ , PM $_{2.5}$, $SO_2$ & $NO_2$ concentrations in the study area are shown in the Figures -6.17 to 6.18.

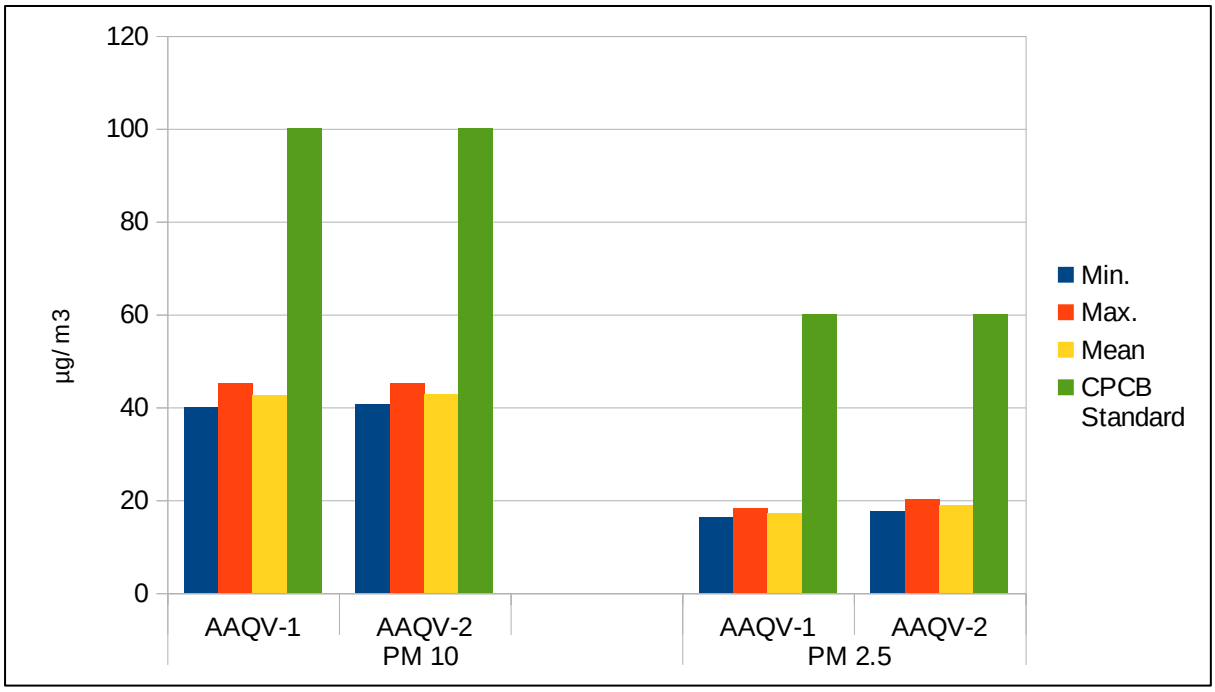



**Figure 6-17 : Graph Showing the $PM_{10}$ & PM $_{2.5}$ concentrations in the Study Area**

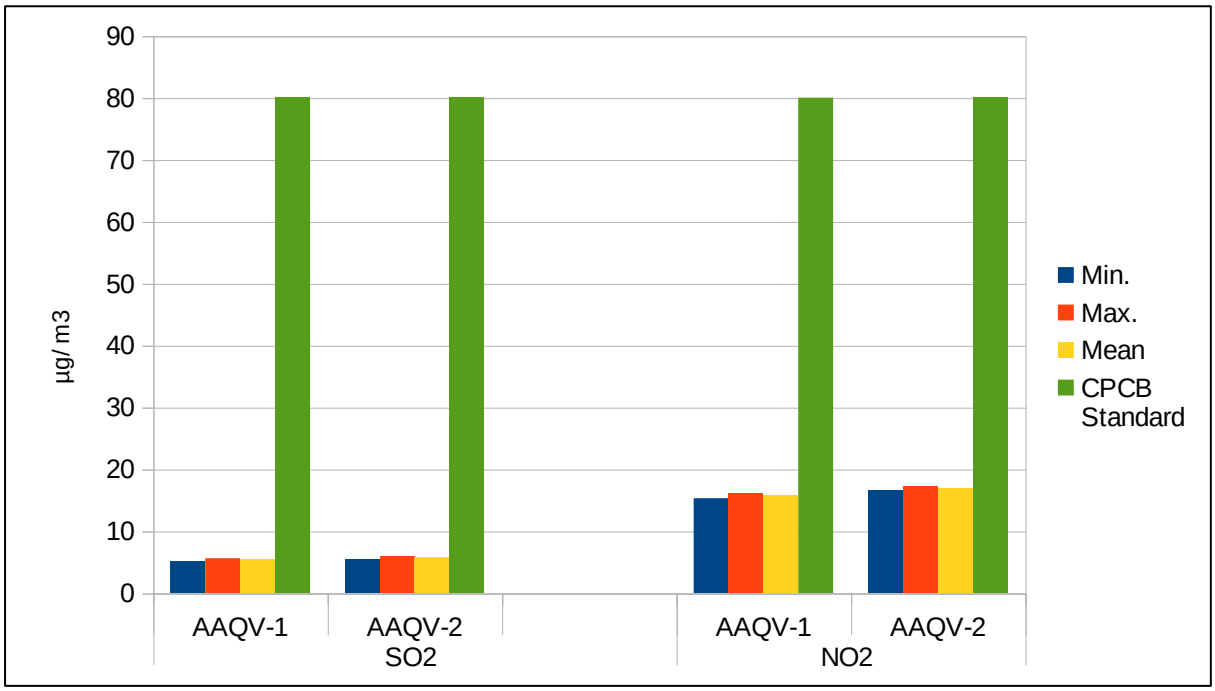



**Figure 6-18 : Graph Showing the $SO_2$ & $NO_2$ Concentrations in the Study Area**

### 6.3.6 Air Environment for Package -VI

#### 6.3.2.1 Primary Data

After a preliminary reconnaissance of the study area and considering the meteorological, topographic conditions (predominant wind directions, wind speed) and considering the spatial relationship of various land uses in accordance with the BIS Guidelines (IS: 5182 (part-14)-1985) and details on existing activities in the study area, Air Quality monitoring was carried out at seven (05) locations in Package -VI (N11, E12). The study was carried out during the month of November 2016. Ambient Air Quality Monitoring (AAQM) locations are given in Table -6.15.

**Table 6-15 : Ambient Air Quality Monitoring Stations in Package -VI**

| Station Number | Station |
|---|---|
| AAQVI-1 | Ainavolu |
| AAQVI-2 | Lingayapalem |
| AAQVI-3 | Neerukonda |
| AAQVI-4 | Kuragallu |
| AAQVI-5 | Yerrabalem |

**Figure 6-19 : AAQ Monitoring stations installed at Kuragullu and Yerrabalem**

**Data analysis**

The observed concentrations of various pollutants at all the sampling stations were processed. The existing baseline levels obtained during the study period at five (05) monitored locations in Package -VI are presented in Table: 6-16. The recorded concentrations are compared with the National Ambient Air Quality Standards as notified on 16.11.2009 by MoEF&CC.

**Table 6-16 : Ambient air quality during study period in Package -VI**

| Location/Category | Result | | | CPCB Standard | WB-EHS Guidelines |
|---|---|---|---|---|---|
| | Min | Max | Mean | | |
| **PM $_{10}$ (µg/m$^3$)** | | | | | |
| Ainavolu | 46.3 | 50.1 | 48.2 | 100 | 50 |
| Lingayapalem | 40.5 | 43.8 | 42.2 | 100 | 50 |
| Neerukonda | 34.6 | 36.7 | 35.7 | 100 | 50 |
| Kuragallu | 48.5 | 50.3 | 49.4 | 100 | 50 |
| Yerrabalem | 40.3 | 48.5 | 44.4 | 100 | 50 |
| **PM $_{2.5}$ (µg/m$^3$)** | | | | | |
| Ainavolu | 17.1 | 20.6 | 18.9 | 60 | 25 |
| Lingayapalem | 16.4 | 19.6 | 18 | 60 | 25 |
| Neerukonda | 14 | 16.2 | 15.1 | 60 | 25 |
| Kuragallu | 18.5 | 21 | 19.8 | 60 | 25 |
| Yerrabalem | 17.5 | 20.8 | 19.2 | 60 | 25 |
| **SO2 (µg/m3)** | | | | | |
| Ainavolu | 5 | 5.4 | 5.2 | 80 | 20 |
| Lingayapalem | 4.8 | 5.3 | 5.1 | 80 | 20 |
| Neerukonda | 4.2 | 4.5 | 4.4 | 80 | 20 |

| | | | | | |
|---|---|---|---|---|---|
| Kuragallu | 6.1 | 6.8 | 6.5 | 80 | 20 |
| Yerrabalem | 5 | 5.8 | 5.4 | 80 | 20 |
| **NO2 (µg/m3)** | | | | | |
| Ainavolu | 15.8 | 16.3 | 16.1 | 80 | 40 |
| Lingayapalem | 15 | 16.1 | 15.6 | 80 | 40 |
| Neerukonda | 13.2 | 14.8 | 14 | 80 | 40 |
| Kuragallu | 18.4 | 19.3 | 18.9 | 80 | 40 |
| Yerrabalem | 15.2 | 16.4 | 15.8 | 80 | 40 |
| **CO (mg/m3)** | | | | | |
| Ainavolu | <1 | <1 | <1 | 4 | |
| Lingayapalem | <1 | <1 | <1 | 4 | - |
| Neerukonda | <1 | <1 | <1 | 4 | - |
| Kuragallu | <1 | <1 | <1 | 4 | - |
| Yerrabalem | <1 | <1 | <1 | 4 | - |

As can be seen from the above Table:

- The Respirable Particulate Matter ($PM_{10}$) values observed in the range between 34.6 – 50.3 µg/$m^3$ as against the CPCB standard of 100 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was recorded at Nerukonda

- The Fine Particulate Matter ($PM_{2.5}$) values were found in the range between 14.0 – 20.8 µg/$m^3$ as against the CPCB standard of 60 µg/$m^3$ for residential/industrial category. All the values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Yerrabalem and minimum value was found at Neerukonda.

- The Sulfur dioxide values were observed in the range between 4.2-6.8 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was found at Neerukonda.

- The Dioxides of Nitrogen (NO2) values were observed in the range between 13.2-19.3 µg/$m^3$ against the CPCB standard of 80 µg/$m^3$ for residential / industrial

category. The values were found to be well within the stipulated standards for all the locations. The maximum value was recorded at Kurugallu and minimum value was recorded at Neerukonda.

- The carbon monoxide (CO) levels observed were <1.0 mg/$m^3$ as against the CPCB standard of 4mg/$m^3$ for residential / industrial category. The values were found to be well within the stipulated standards for all the locations.

The gaseous concentrations at all the locations are well below the NAAQS/WB-EHS standards/Guidelines for the study period in Package -VI. In general, the ambient air quality in the Package -VI is satisfactory.The graph of $PM_{10}$ , $PM_{2.5}$ $SO_2$ & $NO_2$ Concentrations in the study area are shown in the Figures -6.20 & 6.21.

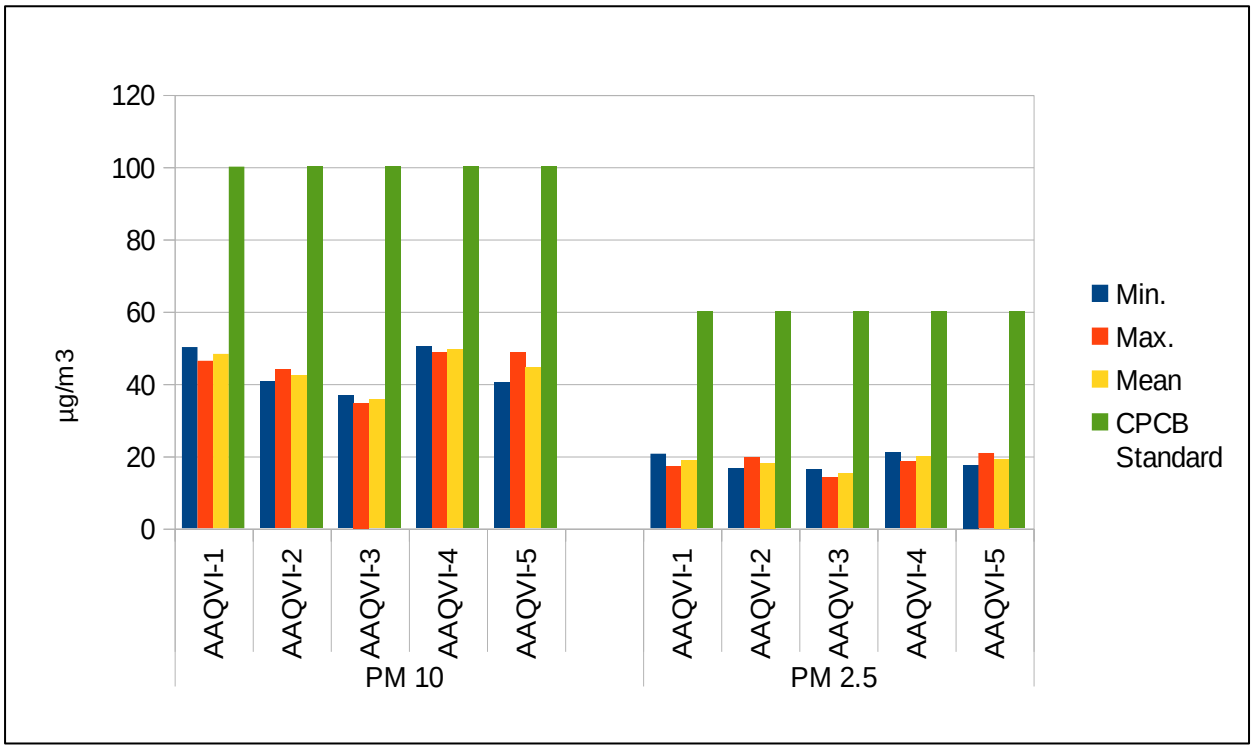



**Figure 6-20: : Graph Showing the $PM_{10}$ & $PM_{2.5}$ Concentrations in the Package -VI**

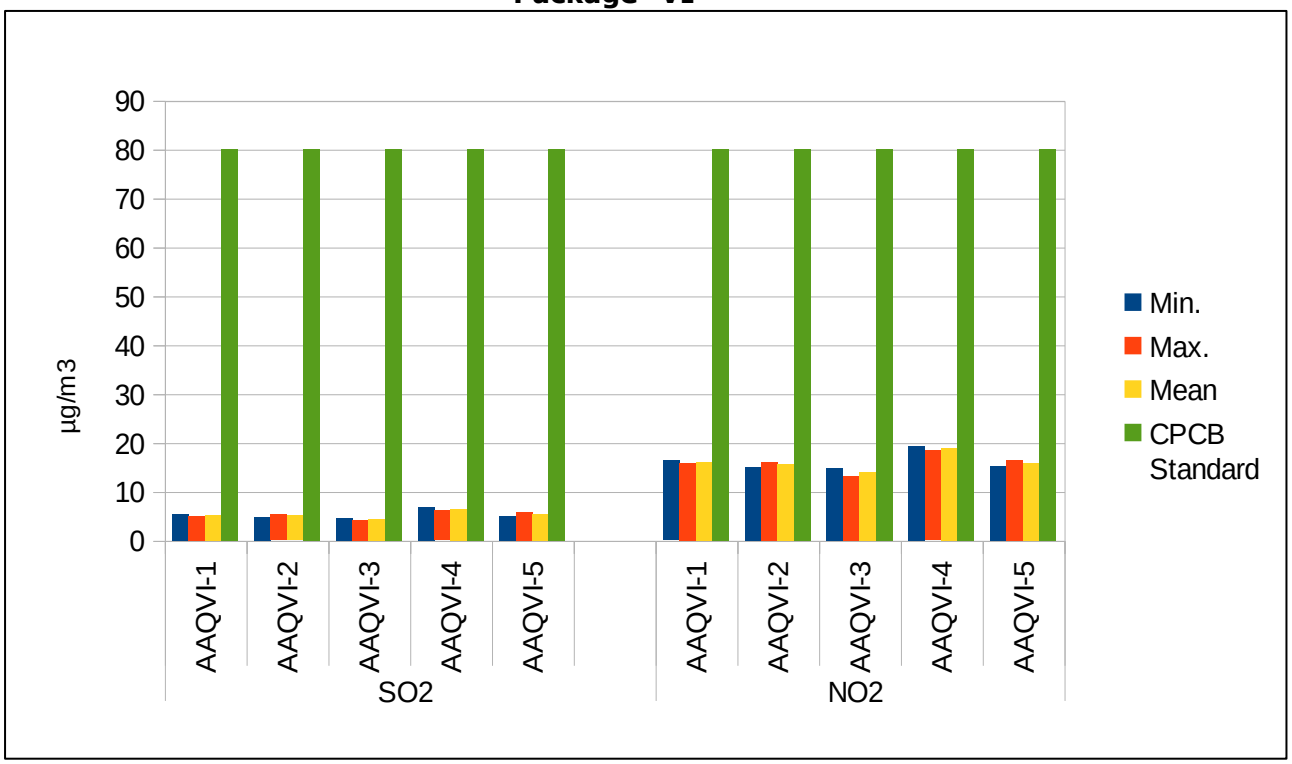



**Figure 6-21 : Graph Showing the $NO_2$ & $SO_2$ Concentrations in the Package -VI**

## 6.4 Water Environment

Selected physico-chemical parameters along with bacteriological indicators of pollution have been used for describing the baseline status of water environment. Generation of baseline data for water quality covers sources of ground and surface water. Assessment of water quality in the study area includes.

- Surface water quality (IS – 2296)
- Ground water quality (IS – 10500)

### 6.4.1 Surface water quality

#### 6.4.1.1 Surface water quality for Package –I

During the study period two (02) samples were collected for assessing the water quality in Package -I (E8). The sampling locations are designated as SWI1 to SWI2 as described in Table -6.17 and are shown in Figure -6.22. These were identified considering proximity to the project site, their activities and depending upon its utility by the people in the region. Table -6.17 presents surface water quality obtained at different locations.

**Figure 6-22 Surface Water Sample Collected at Nekkallu and Sakhamuru**

**Table 6-17 Surface water sampling locations in Package -I**

| Location Code | Location |
|---|---|
| SWI-1 | Tank near Nekkallu |
| SWI-2 | Tank near Shakamuru |

**Table 6-18 Results of Surface Water Quality in Package -I**

| S. No | Parameter | Units | IS:2296 Class C Limits | SWI-1 | SWI-2 |
|---|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 8.18 | 8.16 |
| 2 | Color | Hazen | 300 | 120 | 18 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 1162 | 414 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 738 | 252 |
| 5 | Turbidity | NTU | -- | 18.0 | 5.80 |
| 6 | Dissolved Oxygen | mg/L | 4 | 4.5 | 5.4 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 82 | 20 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 24 | 05 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 260 | 130 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 180 | 120 |
| 11 | Calcium as Ca | mg/L | -- | 56 | 32.0 |
| 12 | Magnesium as Mg | mg/L | -- | 28.8 | 12.0 |
| 13 | Chloride as Cl | mg/L | 600 | 220 | 45.0 |
| 14 | Sodium as Na | mg/L | -- | 142.6 | 32.4 |
| 15 | Potassium as K | mg/L | -- | 3.5 | 1.7 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 76.8 | 16.4 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 6.3 | 3.4 |
| 18 | Silica as $SiO_2$ | mg/L | -- | 5.6 | 2.8 |
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.50 | 0.30 |
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.12 | 0.04 |
| 22 | Zinc as Zn | mg/L | 15 | 0.040 | 0.020 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 | <0.001 |
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 | <0.001 |
| 26 | Temperature | $^{o}$C | -- | 25.8 | 26.2 |
| 27 | Total Suspended Solids | mg/L | -- | 26.2 | 8.6 |
| 28 | Phosphate as $po^4$ | mg/L | -- | <0.02 | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 | <0.0001 |
| 31 | Totlal Arsenic as As | mg/L | 0.2 | <0.001 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.036 | 0.026 |

| | | | | | |
|---|---|---|---|---|---|
| 35 | Total Plate Count | MPN/250ml | -- | $48*10^2$ | 560 |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 380 | 14 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 8.16 – 8.18 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed to be constant in all samples and is in the range of 130 to 260 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.
    - The total dissolved solids observed are ranged between 252 mg/l to 738 mg/l and are well within the limits.
    - The chlorides ranged between 45.0 – 220.0 mg/l and are well within the limits.
    - The Nitrates ranged between 3.4– 6.3 mg/l and the Sulphates ranged between 16.4 – 76.8 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
    - The Fluoride values found to be in the range of 0.30 to 0.50mg/l as against the desirable limits of 1 mg/l.
- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen in the sources is ranging between 4.5 mg/l to 5.4 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.

- Bio-chemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 5 – 24mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents in to near by water bodies. The COD is found to be ranged between 20-82 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Chloride & Sulphate, Nitrate, pH, Conductivity, Turbidity and TDS in the Package -I are shown in the Figures -6.23, 6.24, 6.25, 6.26, 6.27, 6.28 & 6.29.

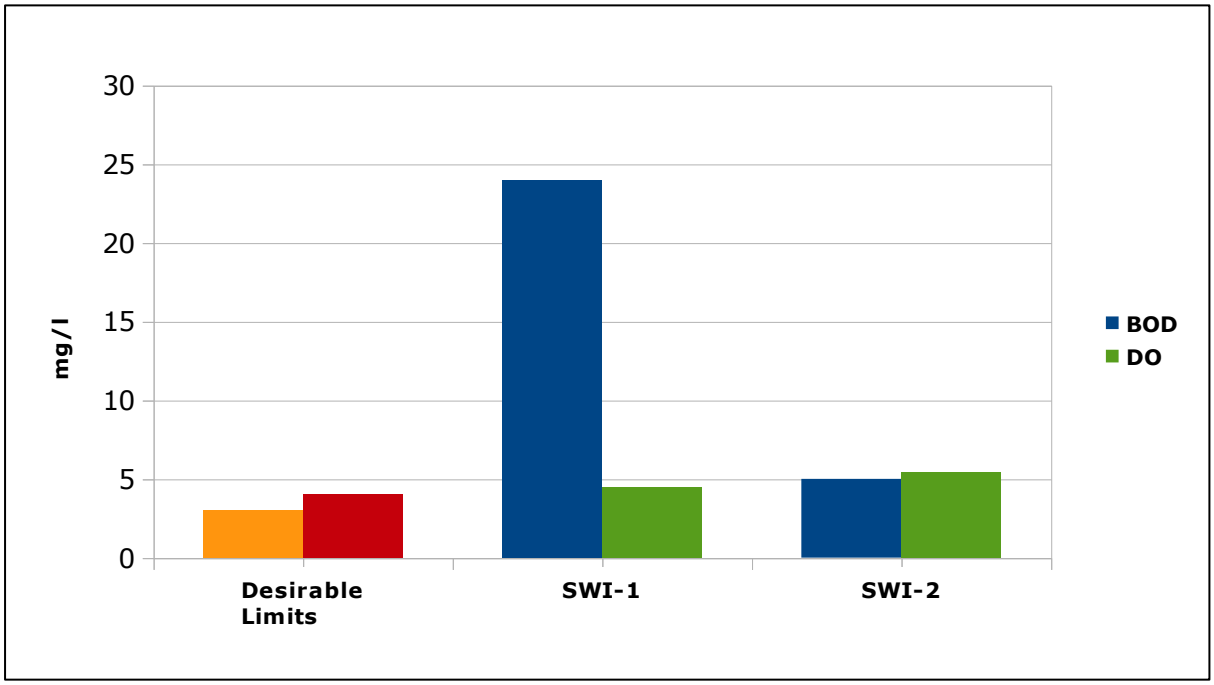



**Figure 6-23 Graph Showing the BOD and DO Concentrations in Package –I**

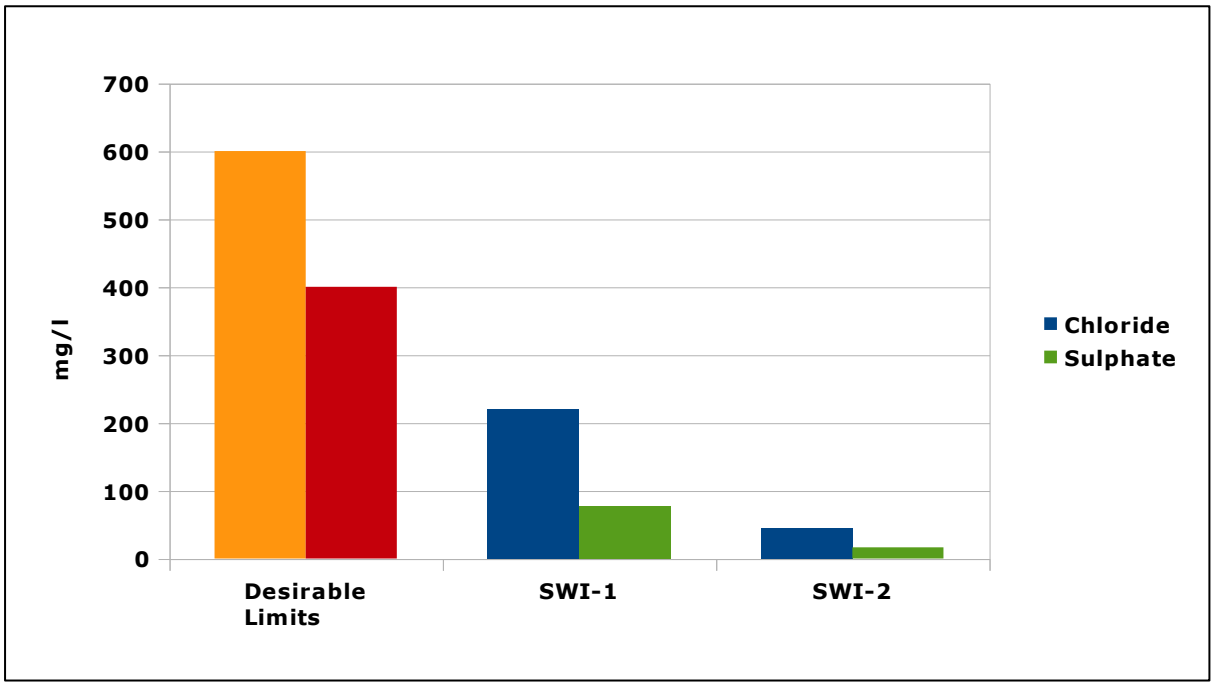



**Figure 6-24 Graph Showing the Chloride and Sulphate Concentrations in the Package -I**

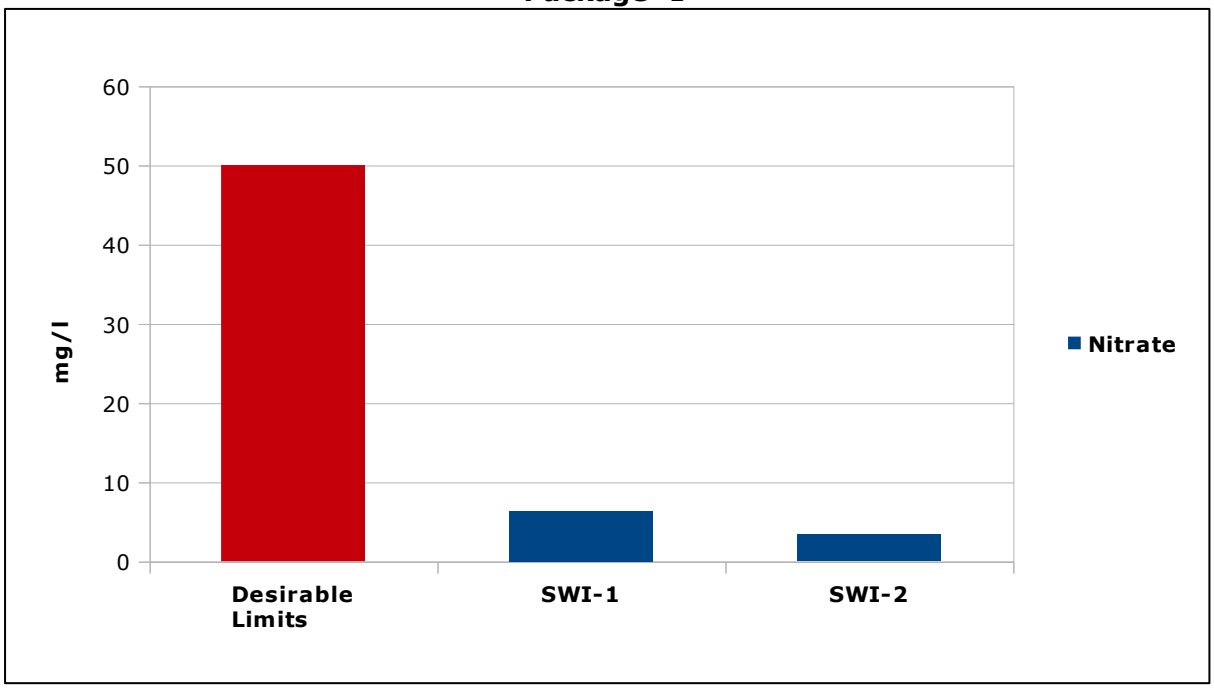



**Figure 6-25 Graph Showing the Nitrate Concentration in the Package -I**

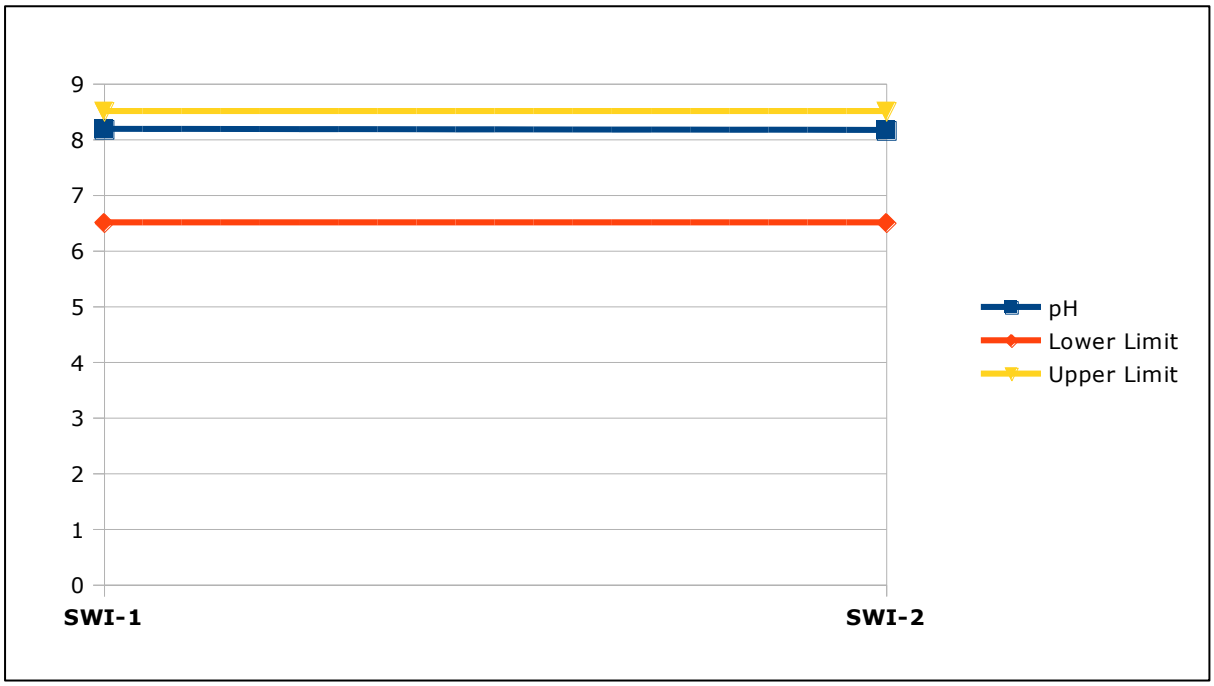



**Figure 6-26 Graph Showing the pH values in the Package -I**

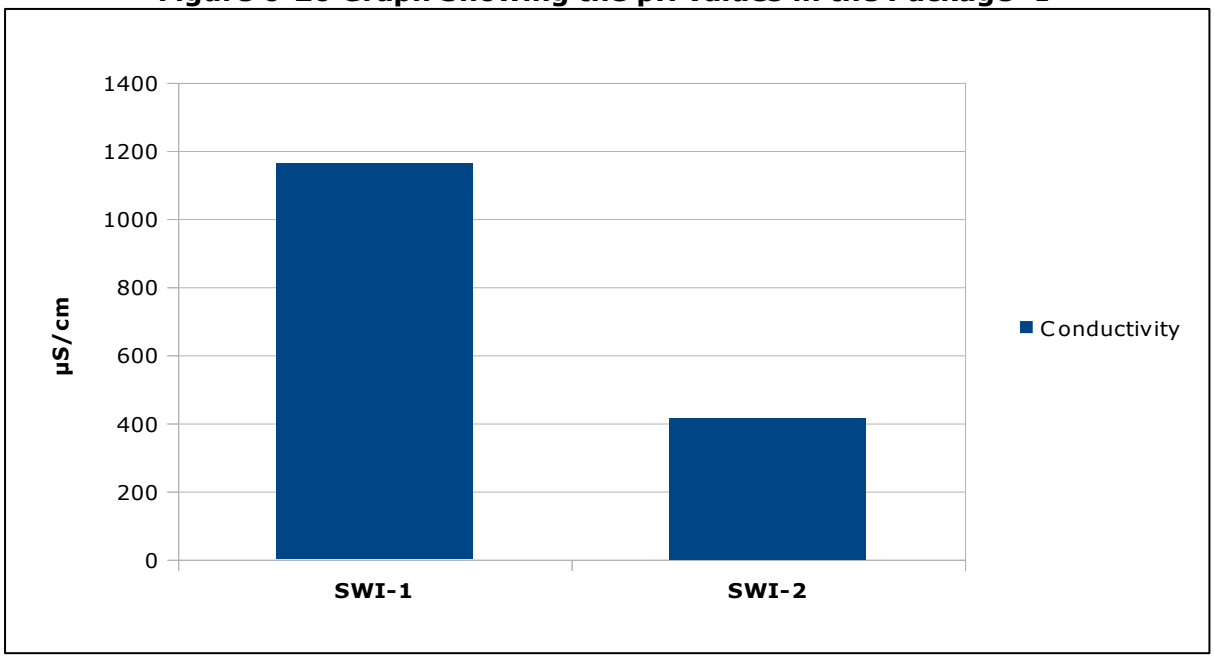



**Figure 6-27Graph Showing the Conductivity values in the Package -I**

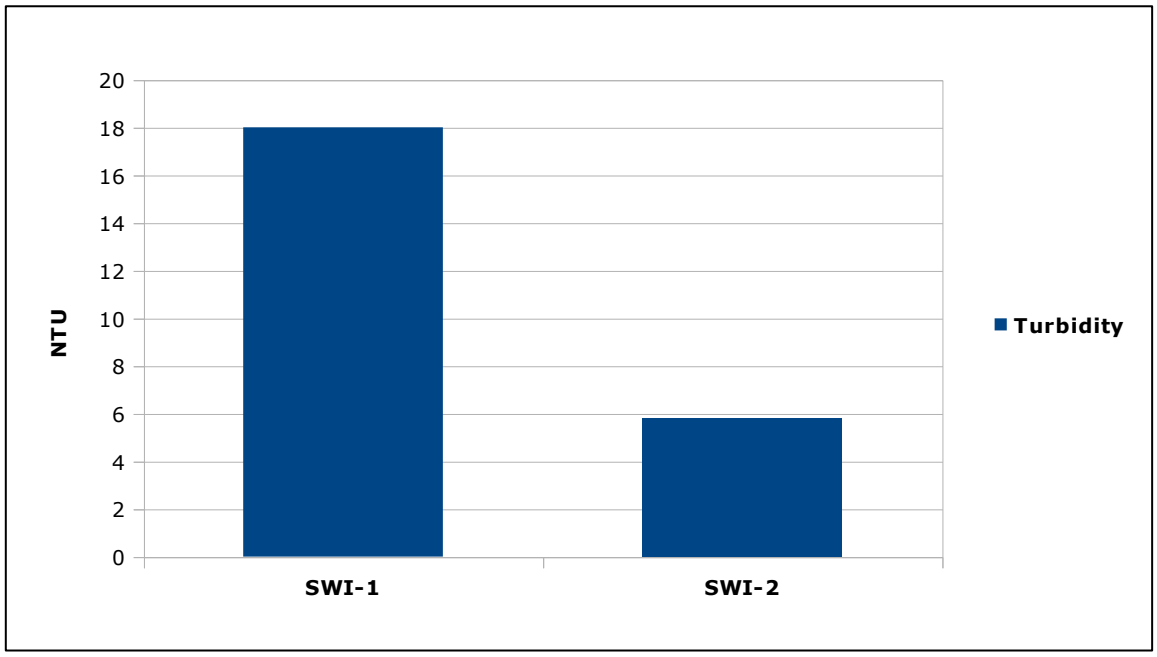



**Figure 6-28 Graph Showing the Turbidity Concentrations in the Package -I**

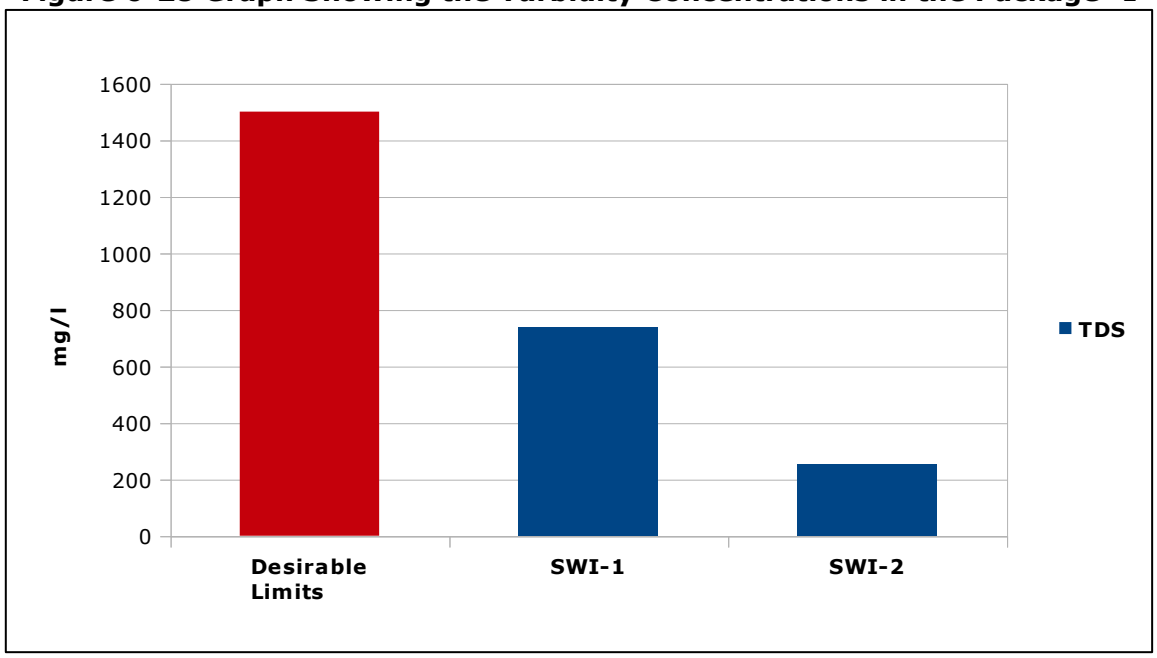



**Figure 6-29 Graph Showing the TDS Concentrations in the Package -I**

### 6.4.1.2 Surface water quality for Package -II

During the study period three (03) samples were collected for assessing the water quality in Package -II (N9). The sampling locations are designated as SWI1 to SWI3 as described in Table -6.19 and are shown in Figure -6.30. These were identified considering proximity to the project site, their activities and depending upon its utility by

the people in the region. Table -6.20 presents surface water quality obtained at different locations.

**Figure 6-30 Surface Water Sample Collected at Malkapuram and Velagapudi**

**Table 6-19 Surface water sampling locations in Package -II**

| Location Code | Location |
|---|---|
| SWII-1 | River Krishna near Uddandarayunipalem |
| SWII-2 | Stream near Velagapudi |
| SWII-3 | Stream near Malkapuram |

**Table 6-20 Results of Surface Water Quality in Package -II**

| S. No | Parameter | Units | IS:2296 ClassC Limits | SWII-1 | SWII-2 | SWII-3 |
|---|---|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 7.98 | 7.80 | 7.93 |
| 2 | Color | Hazen | 300 | 130 | 150 | 140 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 570 | 2276 | 1492 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 336 | 1428 | 954 |
| 5 | Turbidity | NTU | -- | 14.20 | 15.30 | 17.6 |
| 6 | Dissolved Oxygen | mg/L | 4 | 4.4 | 4.9 | 4.4 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 48 | 104 | 62 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 14 | 30 | 18 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 160 | 700 | 520 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 160 | 460 | 480 |
| 11 | Calcium as Ca | mg/L | -- | 36 | 144 | 112 |
| 12 | Magnesium as Mg | mg/L | -- | 16.8 | 81.6 | 57.6 |
| 13 | Chloride as Cl | mg/L | 600 | 75 | 430 | 165.0 |
| 14 | Sodium as Na | mg/L | -- | 54 | 194.8 | 98.9 |
| 15 | Potassium as K | mg/L | -- | 2.1 | 4.9 | 3.5 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 11.8 | 53.9 | 215.6 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 3.7 | 9.4 | 6.3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 18 | Silica as $SiO_2$ | mg/L | -- | 1.8 | 8.0 | 4.2 |
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.60 | 0.80 | 0.80 |
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 | <0.1 | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.12 | 0.14 | 0.14 |
| 22 | Zinc as Zn | mg/L | 15 | 0.030 | 0.036 | 0.032 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 | <0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 | <0.001 | <0.001 |
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 | <0.001 | <0.001 |
| 26 | Temperature | $^oC$ | -- | 25.8 | 25.8 | 26.5 |
| 27 | Total Suspended Solids | mg/L | -- | 22.6 | 29.1 | 32.2 |
| 28 | Phosphate as $po^4$ | mg/L | -- | <0.02 | <0.02 | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 | <0.001 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 | <0.0001 | <0.0001 |
| 31 | Totlal Arsenic as As | mg/L | 0.2 | <0.001 | <0.001 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 | <0.001 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 | <0.05 | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.016 | 0.040 | 0.038 |
| 35 | Total Plate Count | MPN/250ml | -- | $24*10^2$ | $46*10^2$ | $45*10^2$ |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 140 | 360 | 380 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.80 – 7.98 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed to be constant in all samples and is in the range of 160 to 700 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.

- The total dissolved solids observed are ranged between 336 mg/l to 1428 mg/l and are well within the limits.
- The chlorides ranged between 75.0 – 430.0 mg/l and are well within the limits.
- The Nitrates ranged between 3.7– 9.4 mg/l and the Sulphates ranged between 11.8 – 53.9 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
- The Fluoride values found to be in the range of 0.60 to 0.80mg/l as against the desirable limits of 1 mg/l.

- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen in the sources is ranging between 4.4mg/l to 4.9 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.
- Bio-chemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 14 – 30 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents in to nearby water bodies. The COD is found to be ranged between 48-104 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Chloride & Sulphate, Nitrate, pH, Conductivity, Turbidity and TDS in the study area are shown in the Figures -6.31 6.32, 6.33, 6.34, 6.358, 6.36, & 6.37.

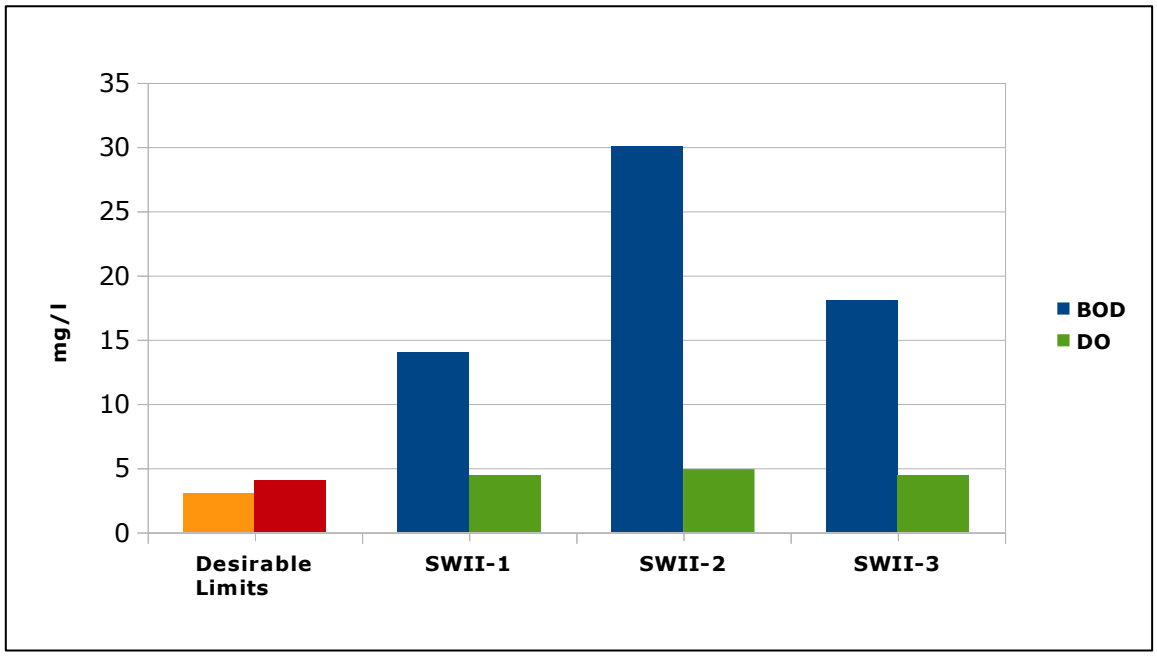



**Figure 6-31 Graph Showing the BOD and DO Concentrations in Package –II**

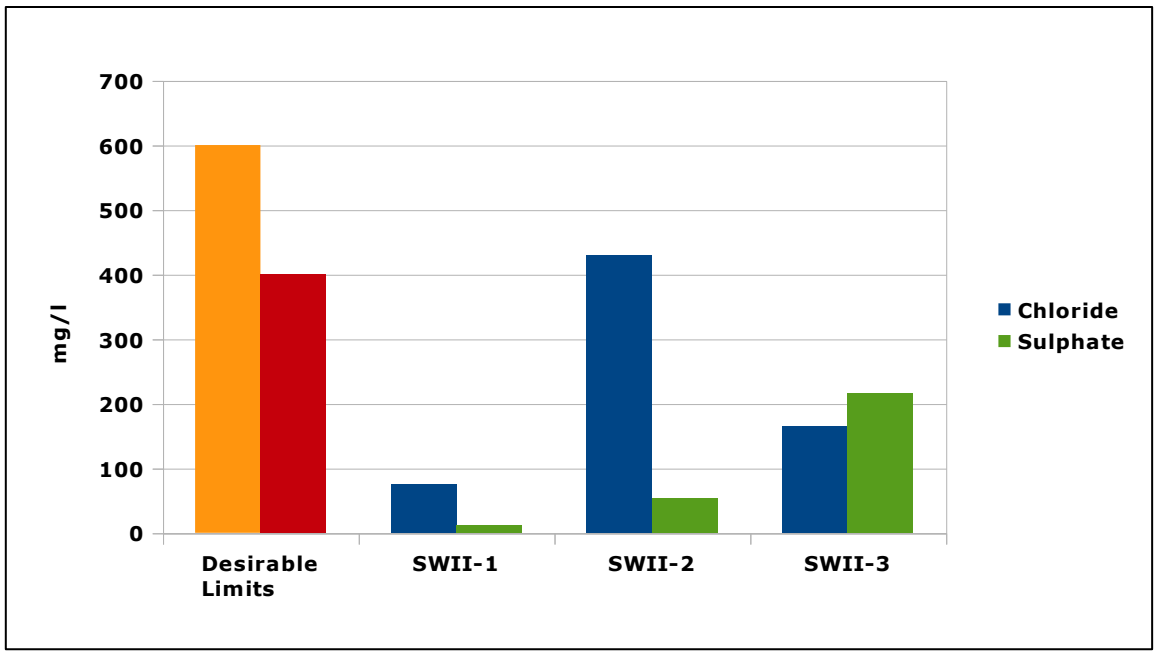



**Figure 6-32 Graph Showing the Chloride and Sulphate Concentrations in the Package -II**

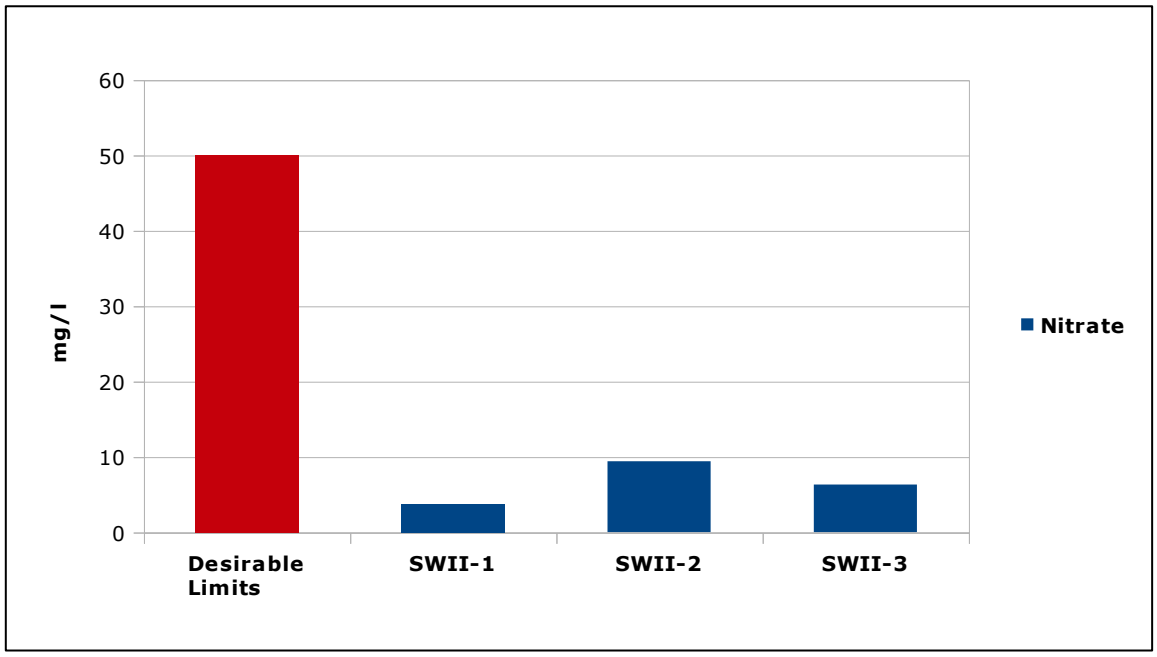



**Figure 6-33 Graph Showing the Nitrate Concentration in the Package -II**

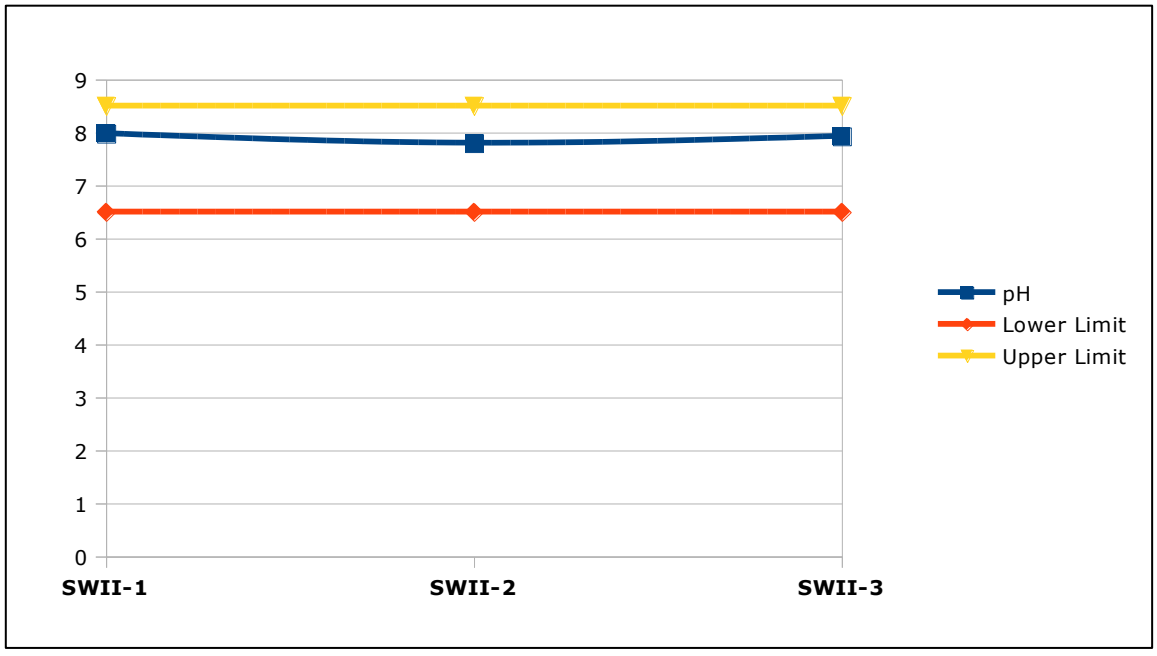



**Figure 6-34 Graph Showing the pH values in the Package -II**

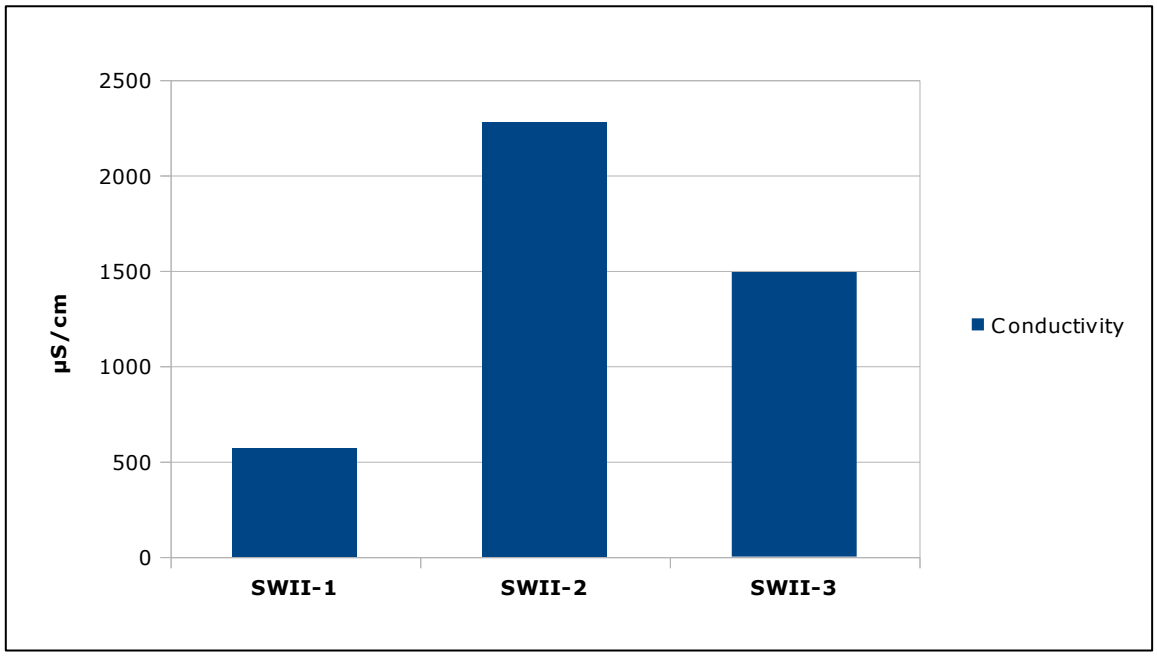



**Figure 6-35 Graph Showing the Conductivity values in the Package -II**

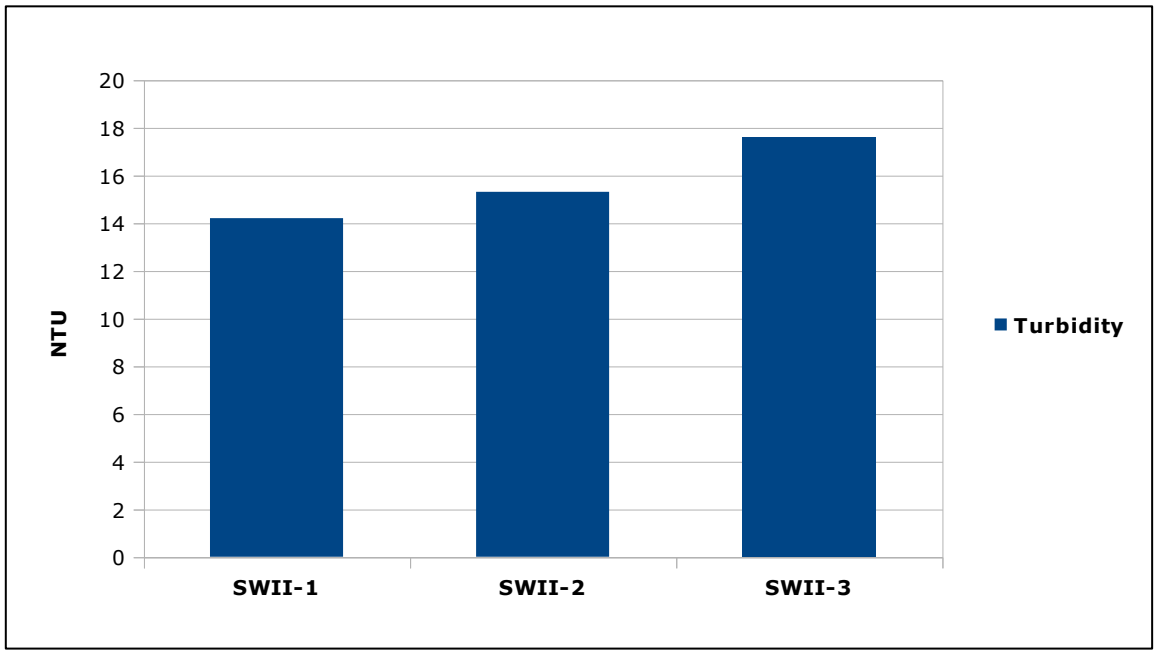



**Figure 6-36 Graph Showing the Turbidity Concentrations in the Package -II**

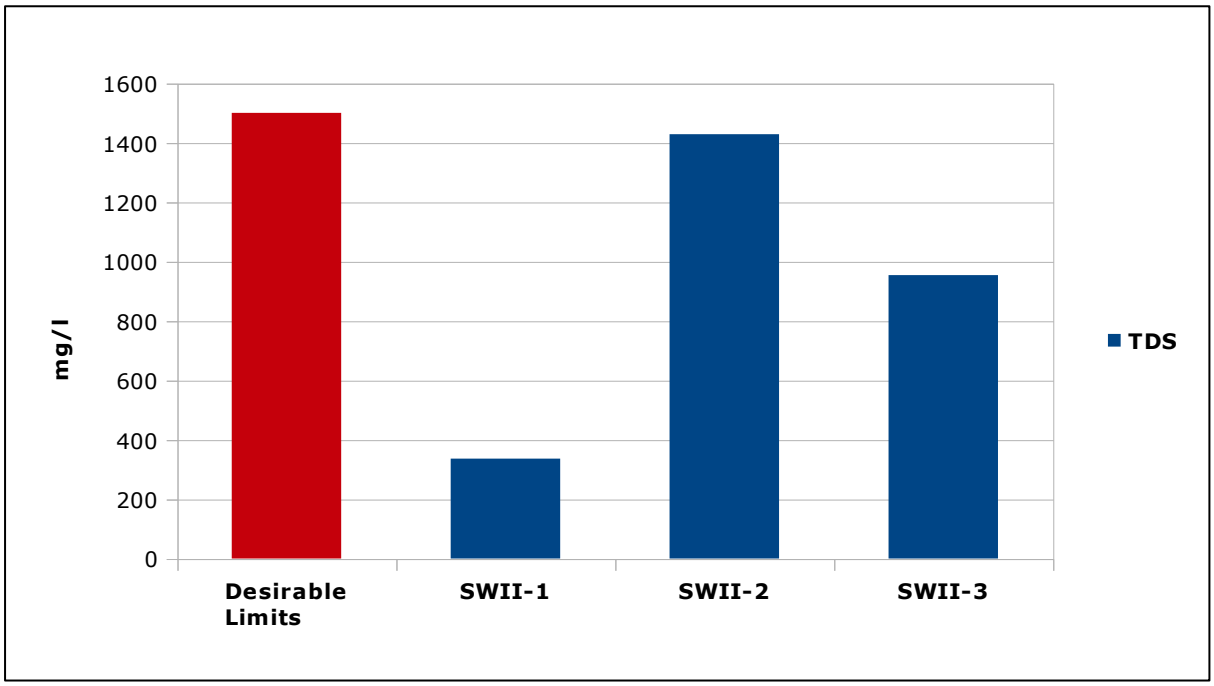



**Figure 6-37 Graph Showing the TDS Concentrations in the Package -II**

### 6.4.1.3 Surface water quality for Package -III

During the study period seven (07) samples were collected for assessing the water quality in Package -III (N4 & N14). The sampling locations are designated as SWIII1 to SWIII7 as described in Table -6.21 and are shown in Figure -6.38. These were identified considering proximity to the project site, their activities and depending upon its utility by the people in the region. Table -6.22 presents surface water quality obtained at different locations.

**Figure 6-38 Surface Water Sample Collected at Venkatapalem and Thullur Chakali Tank**

**Table 6-21 Surface water sampling locations in Package -III**

| Location Code | Location |
|---|---|
| SWIII-1 | Lake near Navuluru |
| SWIII-2 | Pala Vagu near Krishnayapalem |
| SWIII-3 | Kondaveeti Vagu near Krishnayapalem |
| SWIII-4 | River Krishna near Venkatapalem |
| SWIII-5 | River Krishna near Borupalem |
| SWIII-6 | Lake in Thullur |
| SWIII-7 | Chakali cheruvu near Thullur |

**Table 6-22 Results of Surface Water Quality in Package -III**

| S.No | Parameter | Units | IS:2296 Class C Limits | SWIII-1 | SWIII-2 | SWIII-3 | SWIII-4 | SWIII-5 | SWIII-6 | SWIII-7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 8.03 | 7.28 | 7.65 | 8.16 | 8.10 | 8.09 | 8.15 |
| 2 | Color | Hazen | 300 | 140 | 120 | 225 | 18 | 15 | 180 | 240 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 664 | 470 | 464 | 414 | 516 | 1402 | 1128 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 418 | 292 | 288 | 252 | 320 | 898 | 1436 |
| 5 | Turbidity | NTU | -- | 16.3 | 12.8 | 15.6 | 5.80 | 5.50 | 14.0 | 17.5 |
| 6 | Dissolved Oxygen | mg/L | 4 | 4.1 | 5.4 | 4.5 | 5.4 | 5.8 | 4.4 | 4.2 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 38 | 30 | 58 | 20 | 26 | 56 | 82 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 06 | 06 | 16 | 05 | 06 | 18 | 24 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 140 | 150 | 140 | 130 | 220 | 100 | 580 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 160 | 130 | 140 | 120 | 140 | 270 | 100 |
| 11 | Calcium as Ca | mg/L | -- | 32 | 32.0 | 32 | 32.0 | 48 | 24.0 | 120 |
| 12 | Magnesium as Mg | mg/L | -- | 14.4 | 16.8 | 14.4 | 12.0 | 24 | 9.6 | 67.2 |
| 13 | Chloride as Cl | mg/L | 600 | 100 | 60 | 50.0 | 45.0 | 70 | 275 | 485 |
| 14 | Sodium as Na | mg/L | -- | 84.6 | 36.3 | 39.1 | 32.4 | 12.7 | 266.8 | 233.5 |
| 15 | Potassium as K | mg/L | -- | 2.4 | 2.3 | 2.0 | 1.7 | 3.6 | 6.2 | 5.8 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 22.2 | 14.4 | 14.0 | 16.4 | 12.8 | 32.2 | 30.1 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 4.4 | 4.4 | 3.8 | 3.4 | 3.1 | 5.6 | 10.0 |
| 18 | Silica as $SiO_2$ | mg/L | -- | 3.0 | 2.8 | 2.6 | 2.8 | 2.6 | 4.2 | 4.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.30 | 0.30 | 0.30 | 0.30 | 0.4 | 0.9 | 0.90 |
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.08 | 0.06 | 0.04 | 0.04 | 0.10 | 0.16 | 0.20 |
| 22 | Zinc as Zn | mg/L | 15 | 0.034 | 0.020 | 0.016 | 0.020 | 0.0 40 | 0.050 | 0.042 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 26 | Temperature | $^oC$ | -- | 26.3 | 25.6 | 26.8 | 26.2 | 25.4 | 26.3 | 26.2 |
| 27 | Total Suspended Solids | mg/L | -- | 14.6 | 10.2 | 10.1 | 8.6 | 10.0 | 32.2 | 38.4 |
| 28 | Phosphate as $po^4$ | mg/L | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| 31 | Totlal Arsenic as As | mg/L | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.035 | 0.042 | 0.022 | 0.026 | 0.020 | 0.028 | 0.032 |
| 35 | Total Plate Count | MPN/250ml | -- | $36*10^2$ | $25*10^2$ | $41*10^2$ | 560 | 420 | $54*10^2$ | $49*10^2$ |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 136 | 98 | 188 | 14 | <0.0001 | 360 | 390 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.28 – 8.16 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed to be constant in all samples and is in the range of 100 to 580 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.
    - The total dissolved solids observed are ranged between 252 mg/l to 1436 mg/l and are within the limits.
    - The chlorides ranged between 12.8 – 485.0 mg/l and are well within the limits.
    - The Nitrates ranged between 3.1– 10.0 mg/l and the Sulphates ranged between 12.8 – 32.2 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
    - The Fluoride values found to be in the range of 0.30 to 0.90mg/l as against the desirable limits of 1 mg/l.
- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen in the sources is ranging between 4.1mg/l to 5.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.
- Bio-chemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 4.1 – 24 mg/l as against the specified limit of 3mg/l. This may be due to

intrusion of domestic effluents in to nearby water bodies. The COD is found to be ranged between 20-82 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Chloride & Sulphate, Nitrate, pH, Conductivity, Turbidity and TDS in the study area are shown in the Figures -6.39, 6.40, 6.41, 6.42, 6.43, 6.44 & 6.45.

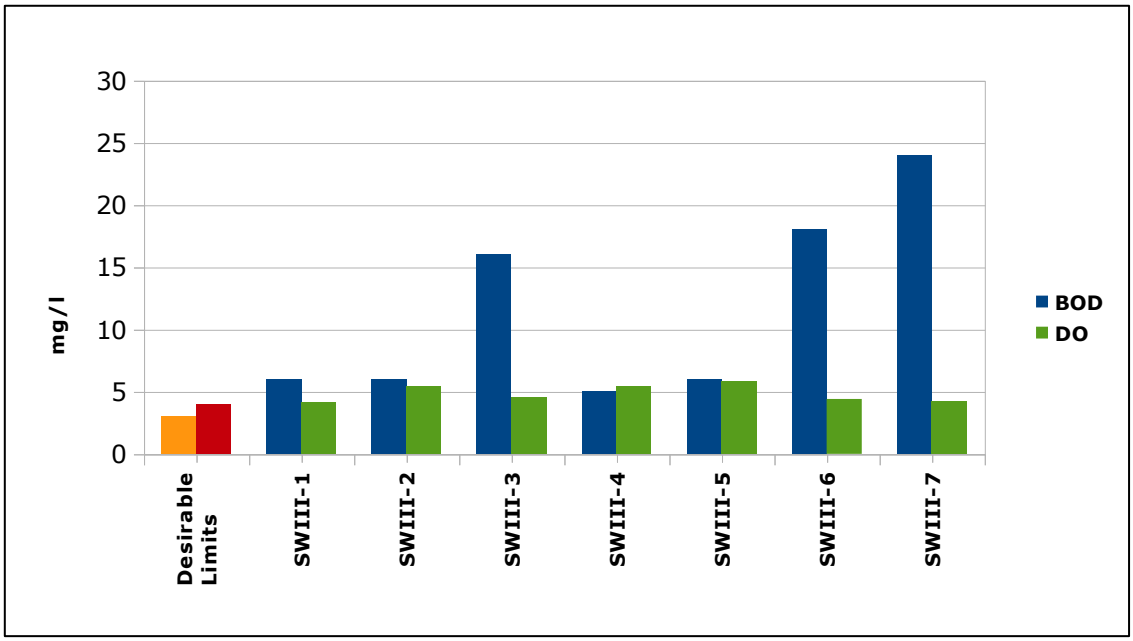



**Figure 6-39 Graph Showing the BOD and DO Concentrations in the Package –III**

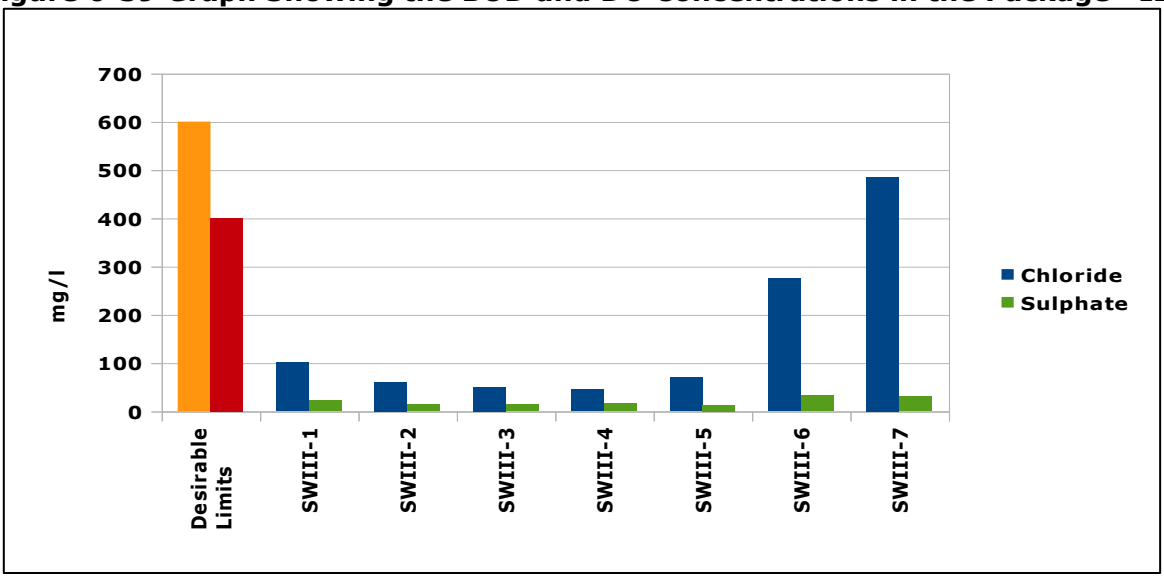



**Figure 6-40 Graph Showing the Chloride and Sulphate Concentrations in the Package -III**

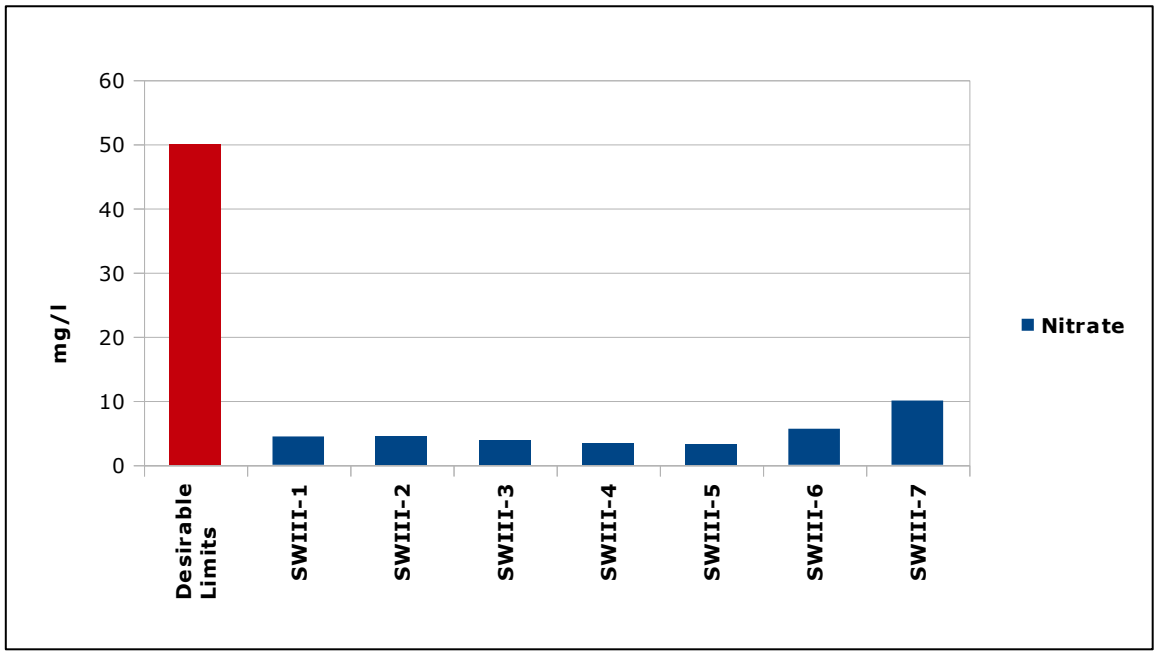



**Figure 6-41 Graph Showing the Nitrate Concentration in the Package –III**

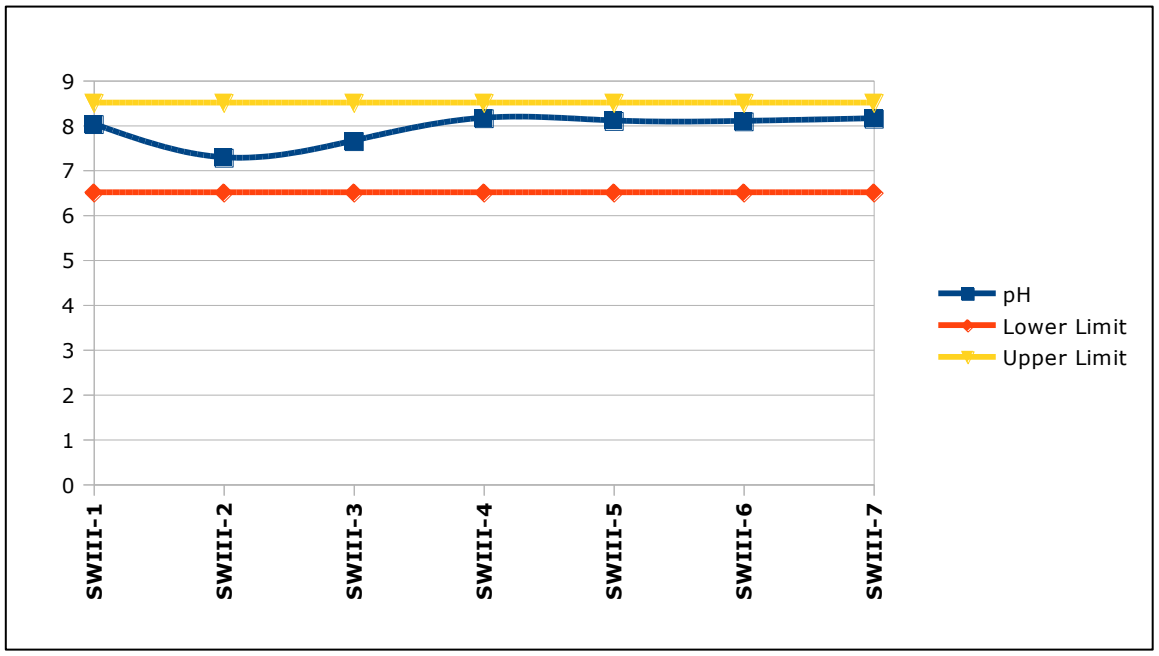



**Figure 6-42 Graph Showing the pH values in the Package -III**

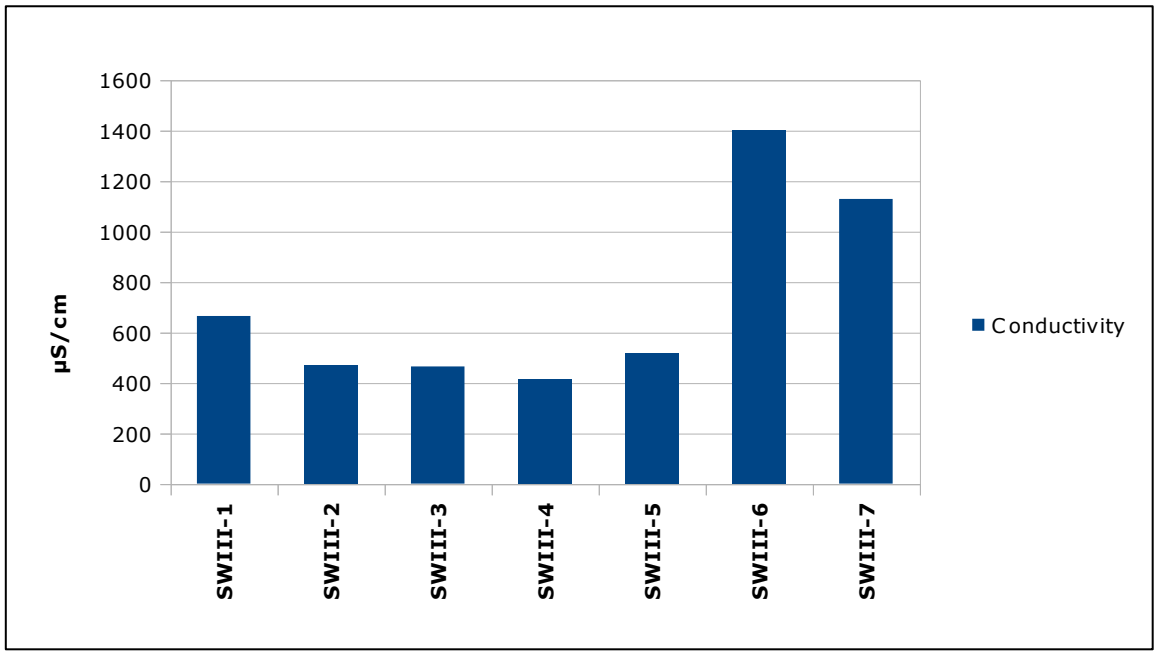



**Figure 6-43 Graph Showing the Conductivity values in the Package –III**

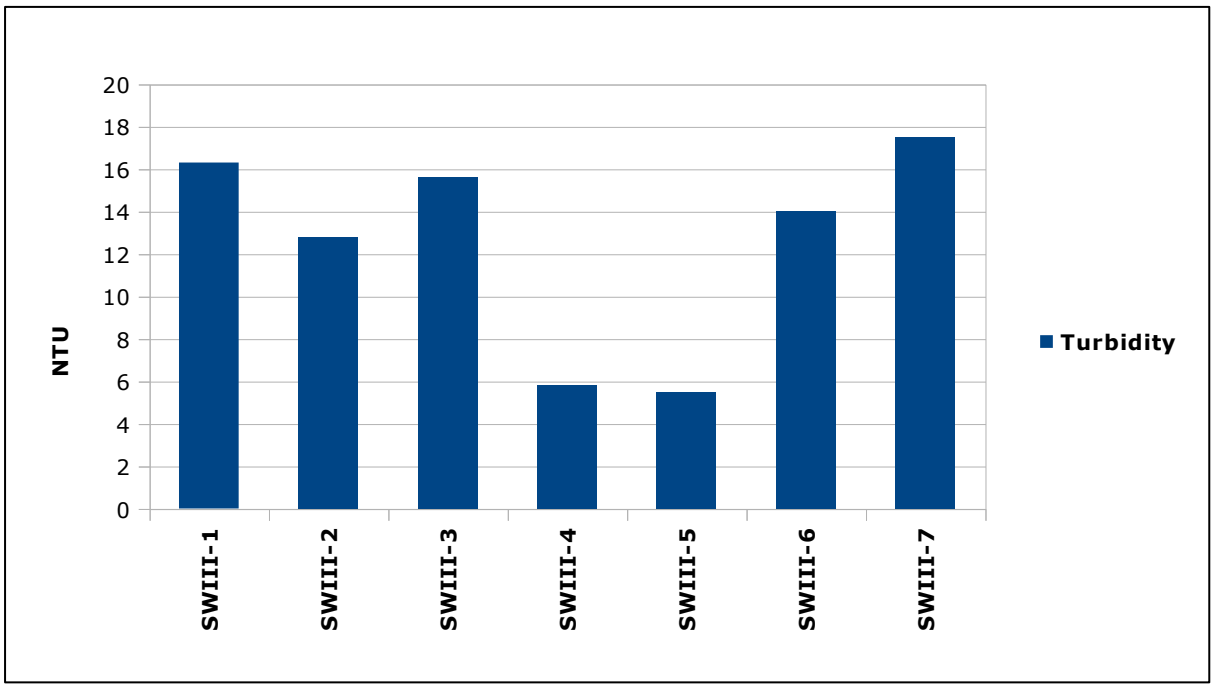



**Figure 6-44 Graph Showing the Turbidity Concentrations in the Package –III**

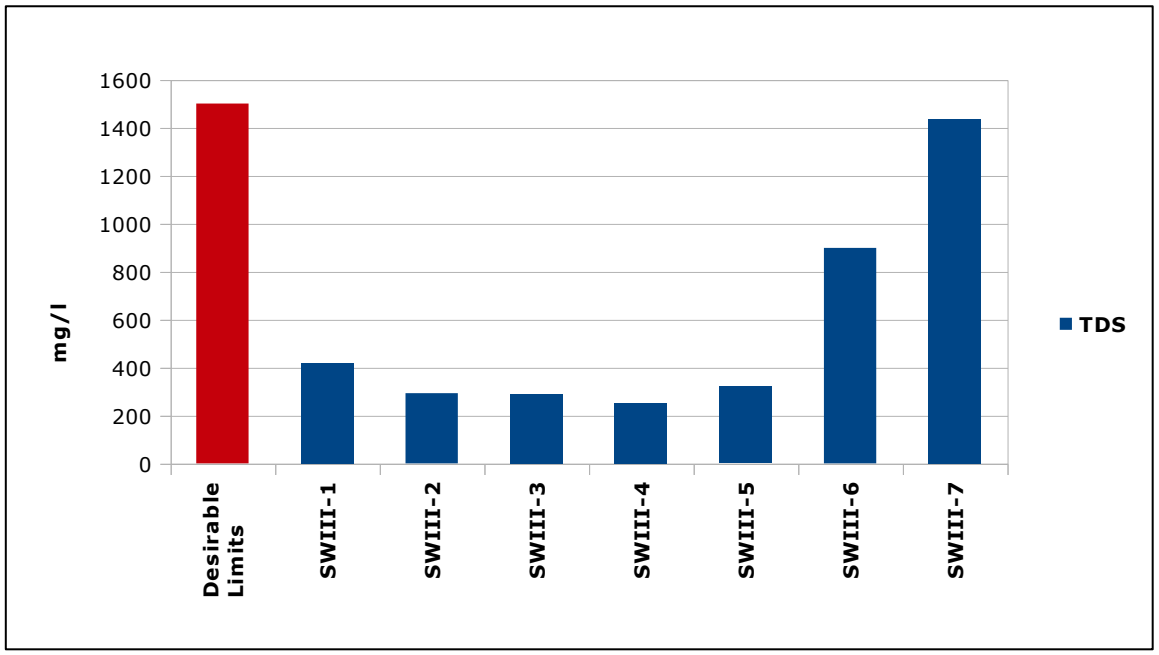



**Figure 6-45 Graph Showing the TDS Concentrations in the Package -III**

### 6.4.1.4 Surface water quality for Package -IV

During the study period eight (08) samples were collected for assessing the water quality in Package -IV (E10, E14 & N16). The sampling locations are designated as SWIV1 to SWIV8 as described in Table -6.23 and are shown in Figure -6.46. These were identified considering proximity to the project site, their activities and depending upon its utility by the people in the region. Table -6.24 presents surface water quality obtained at different locations.

**Figure 6-46 Surface Water Sample Collected at Navuluruand and Dondapadu**

**Table 6-23 Surface water sampling locations in Package -IV**

| Location Code | Location |
|---|---|
| SWIV-1 | Kondaveeti Vagu near Krishnayapalem |
| SWIV-2 | Pala Vagu near Krishnayapalem |
| SWIV-3 | Tank near Penumaka Jr. College |
| SWIV-4 | Tank near Penumaka |
| SWIV-5 | Lake in Bethapadu |
| SWIV-6 | Lake in Navuluru |
| SWIV-7 | Tank near Nekkallu |
| SWIV-8 | Lake in Dondapadu |

**Table 6-24 Results of Surface Water Quality in the Package -IV**

| S.No | Parameter | Units | IS:2296 Class C Limits | SWIV-1 | SWIV-2 | SWIV-3 | SWIV-4 | SWIV-5 | SWIV-6 | SWIV-7 | SWIV-8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 7.66 | 7.28 | 8.50 | 7.64 | 8.22 | 8.03 | 8.18 | 8.12 |
| 2 | Color | Hazen | 300 | 125 | 120 | 220 | 230 | 150 | 140 | 120 | 220 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 564 | 470 | 1334 | 1392 | 528 | 664 | 1162 | 1174 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 342 | 292 | 836 | 878 | 320 | 418 | 738 | 742 |
| 5 | Turbidity | NTU | -- | 13.6 | 12.8 | 15.8 | 18.3 | 15.0 | 16.3 | 18.0 | 15.1 |
| 6 | Dissolved Oxygen | mg/L | 4 | 5.2 | 5.4 | 4.5 | 4.6 | 4.9 | 4.1 | 4.5 | 4.6 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 32 | 30 | 70 | 82 | 44 | 38 | 82 | 50 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 08 | 06 | 18 | 20 | 12 | 06 | 24 | 14 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 150 | 150 | 380 | 420 | 150 | 140 | 260 | 180 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 150 | 130 | 390 | 420 | 140 | 160 | 180 | 380 |
| 11 | Calcium as Ca | mg/L | -- | 36.0 | 32.0 | 80.0 | 88.0 | 32.0 | 32 | 56 | 40.0 |
| 12 | Magnesium as Mg | mg/L | -- | 14.4 | 16.8 | 43.2 | 48.0 | 16.8 | 14.4 | 28.8 | 19.2 |
| 13 | Chloride as Cl | mg/L | 600 | 70 | 60 | 170 | 165.0 | 60.0 | 100 | 220 | 130 |
| 14 | Sodium as Na | mg/L | -- | 56.8 | 36.3 | 127.6 | 122.3 | 48.7 | 84.6 | 142.6 | 178.5 |
| 15 | Potassium as K | mg/L | -- | 2.5 | 2.3 | 3.0 | 3.1 | 2.3 | 2.4 | 3.5 | 4.3 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 24.4 | 14.4 | 27.3 | 32.2 | 30.7 | 22.2 | 76.8 | 15.2 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 4.4 | 4.4 | 5.0 | 5.6 | 4.2 | 4.4 | 6.3 | 4.4 |
| 18 | Silica as $SiO_2$ | mg/L | -- | 2.8 | 2.8 | 3.8 | 4.2 | 3.4 | 3.0 | 5.6 | 3.6 |
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.40 | 0.30 | 0.60 | 0.50 | 0.30 | 0.30 | 0.50 | 0.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.6 | 0.06 | 0.14 | 0.14 | 0.06 | 0.08 | 0.12 | 0.12 |
| 22 | Zinc as Zn | mg/L | 15 | 0.024 | 0.020 | 0.028 | 0.024 | 0.016 | 0.034 | 0.040 | 0.062 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 26 | Temperature | $^oC$ | -- | 26.6 | 25.6 | 26.5 | 26.5 | 26.8 | 26.3 | 25.8 | 25.9 |
| 27 | Total Suspended Solids | mg/L | -- | 12.8 | 10.2 | 18.2 | 15.3 | 08.4 | 14.6 | 26.2 | 28.8 |
| 28 | Phosphate as $po^4$ | mg/L | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| 31 | Totlal Arsenic as As | mg/L | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.042 | 0.042 | 0.036 | 0.030 | 0.016 | 0.035 | 0.036 | 0.032 |
| 35 | Total Plate Count | MPN/250ml | -- | $28*10^2$ | $25*10^2$ | $43*10^2$ | $42*10^2$ | $34*10^2$ | $36*10^2$ | $48*10^2$ | $46*10^2$ |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 114 | 98 | 245 | 222 | 138 | 136 | 380 | 350 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.28 – 8.50 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed to be constant in all samples and is in the range of 140 to 420 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.
    - The total dissolved solids observed are ranged between 292 mg/l to 878 mg/l and are well within the limits.
    - The chlorides ranged between 60 – 220.0 mg/l and are well within the limits.
    - The Nitrates ranged between 4.2– 6.3 mg/l and the Sulphates ranged between 14.4 – 76.8 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
    - The Fluoride values found to be in the range of 0.30 to 0.80mg/l as against the desirable limits of 1 mg/l.
- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen in the sources is ranging between 4.1 mg/l to 5.4 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.
- Bio-chemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 6 – 24.0 mg/l as against the specified limit of 3mg/l. This may be due to

intrusion of domestic effluents in to near by water bodies. The COD is found to be ranged between 30-82 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Chloride & Sulphate, Nitrate, pH, Conductivity, Turbidity and TDS in the study area are shown in the Figures -6.47, 6.48, 6.49, 6.50, 6.51, 6.52 & 6.53.

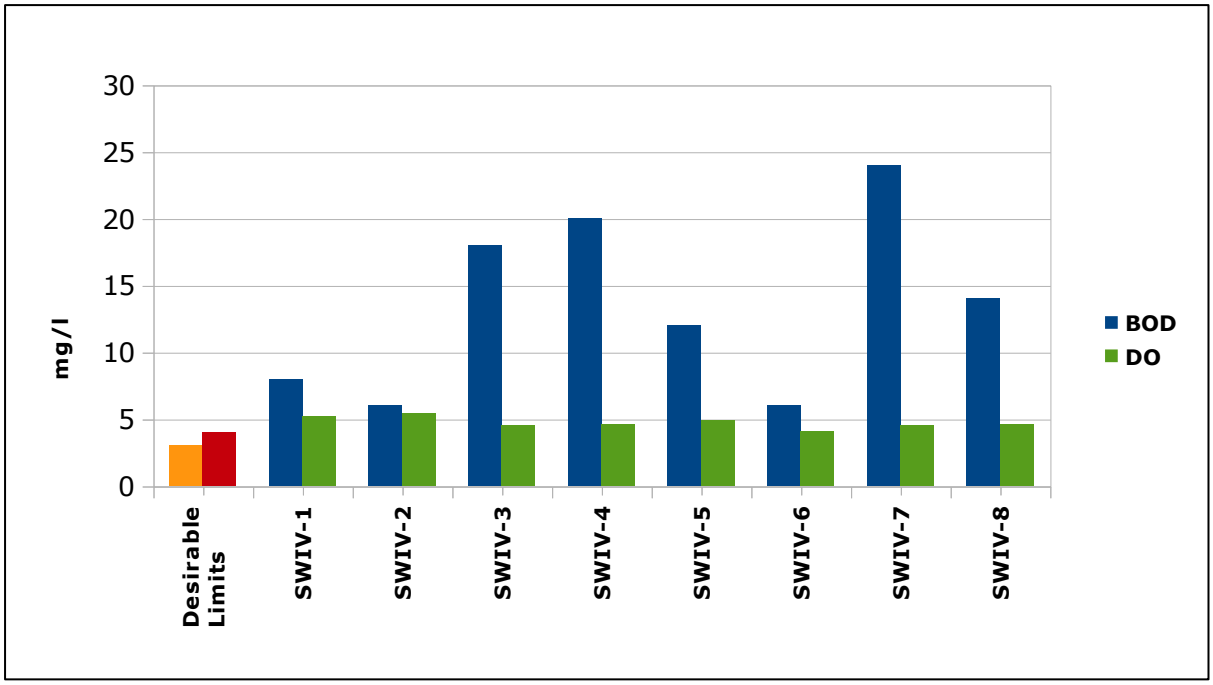



**Figure 6-47 Graph Showing the BOD and DO Concentrations in the Package –IV**

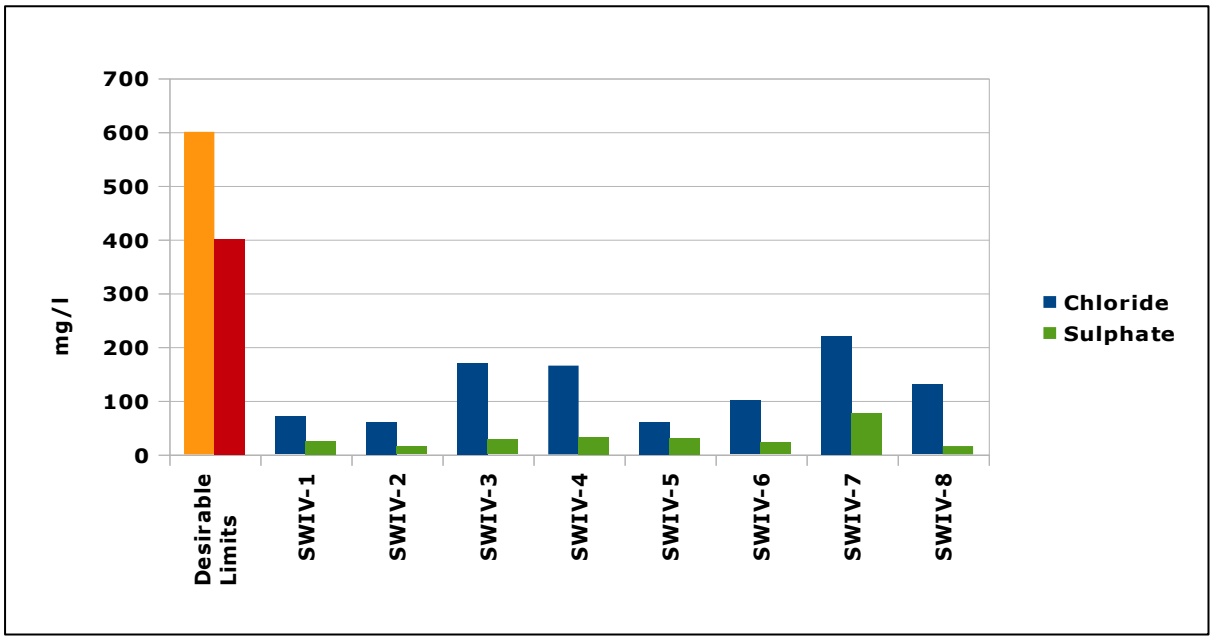



**Figure 6-48 Graph Showing the Chloride and Sulphate Concentrations in the Package –IV**

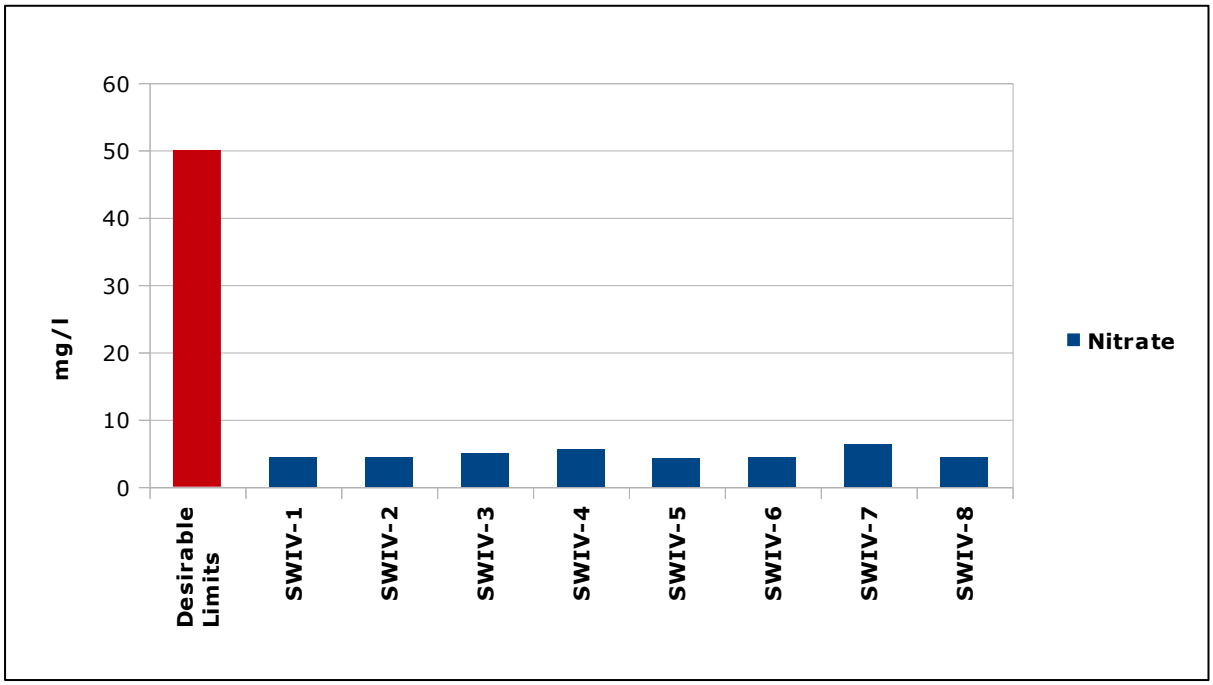



**Figure 6-49 Graph Showing the Nitrate Concentration in the Package –IV**

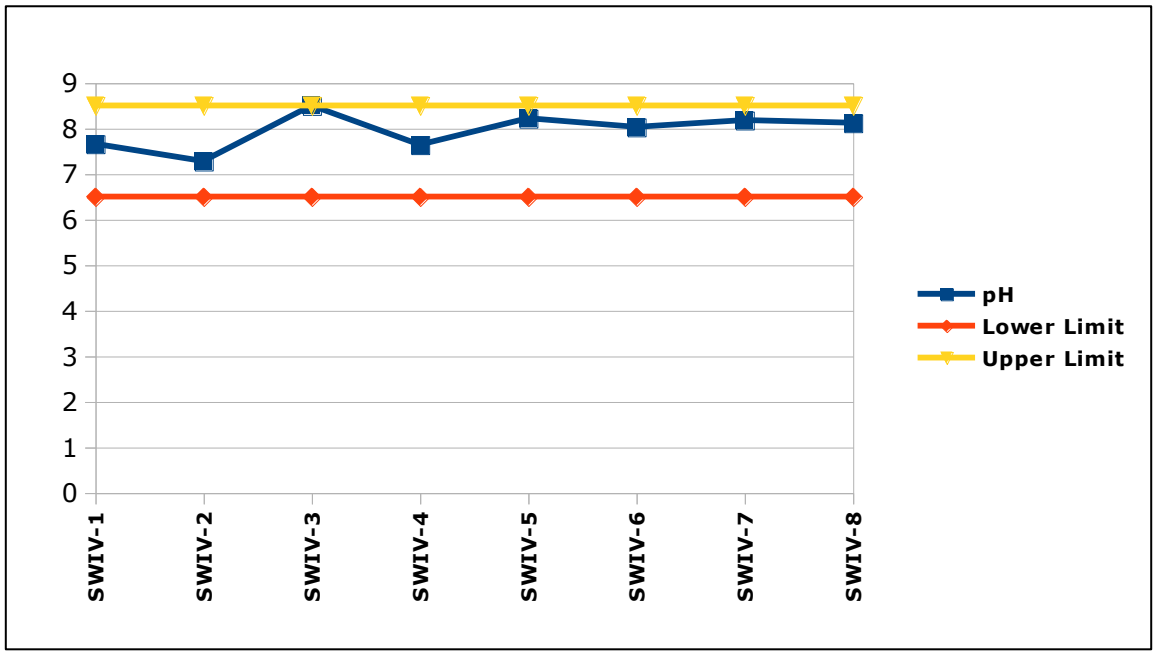



**Figure 6-50 Graph Showing the pH values in the Package -IV**

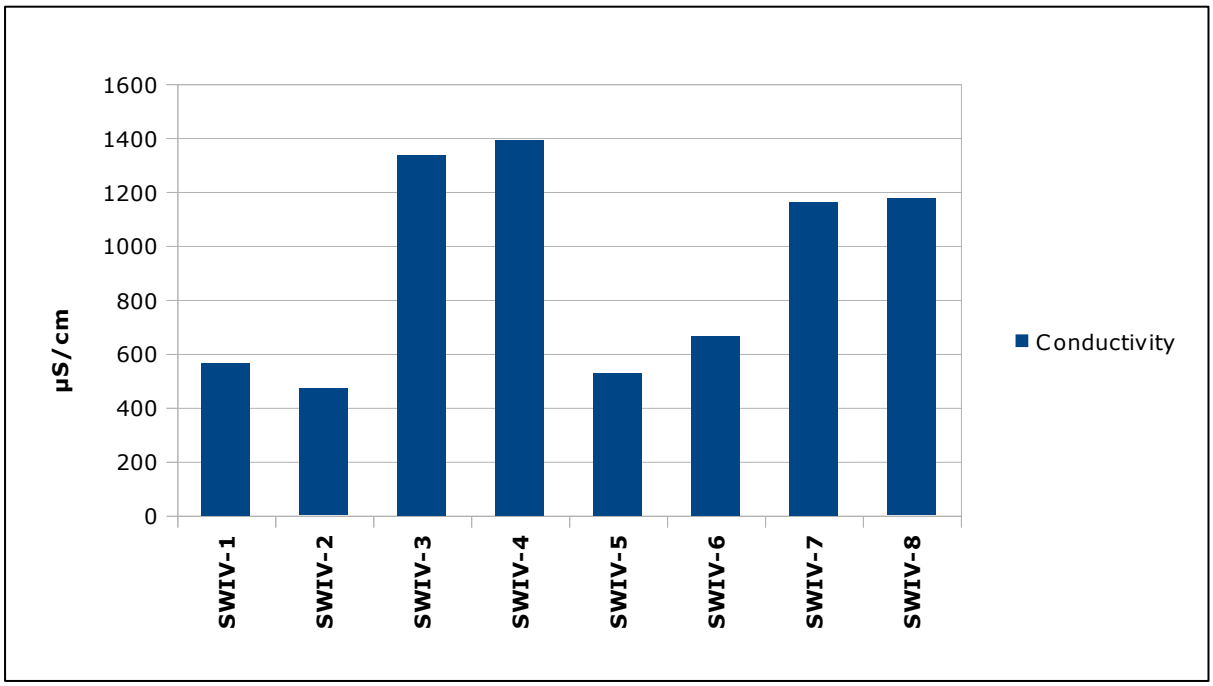



**Figure 6-51 Graph Showing the Conductivity values in the Package -IV**

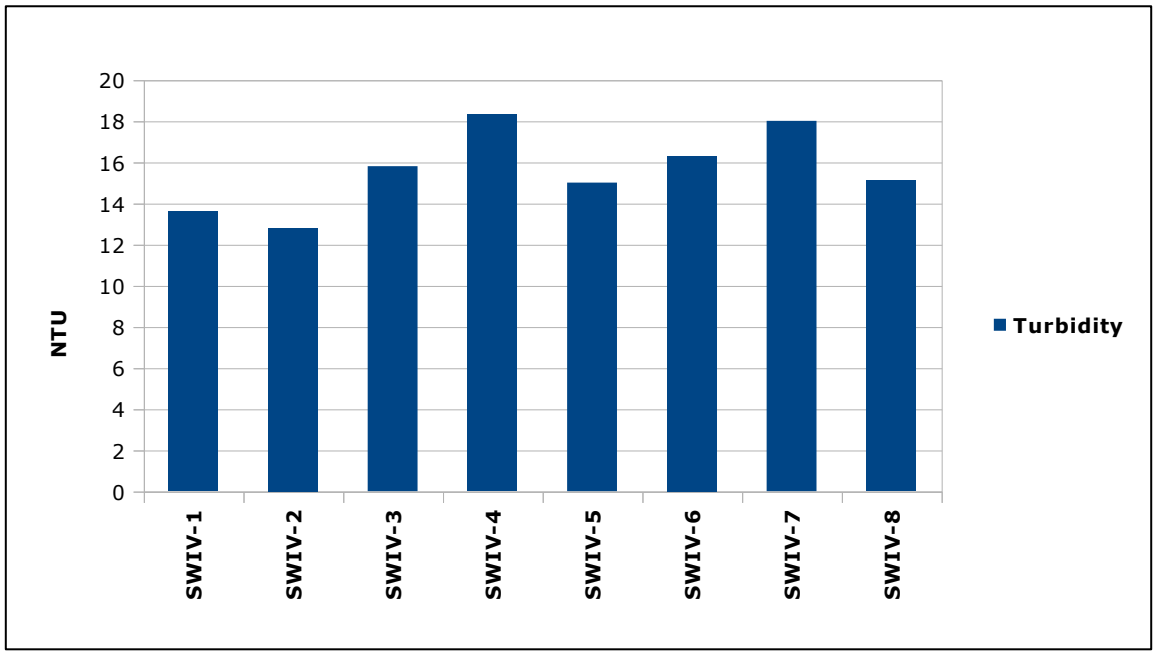



**Figure 6-52 Graph Showing the Turbidity Concentrations in the Package -IV**

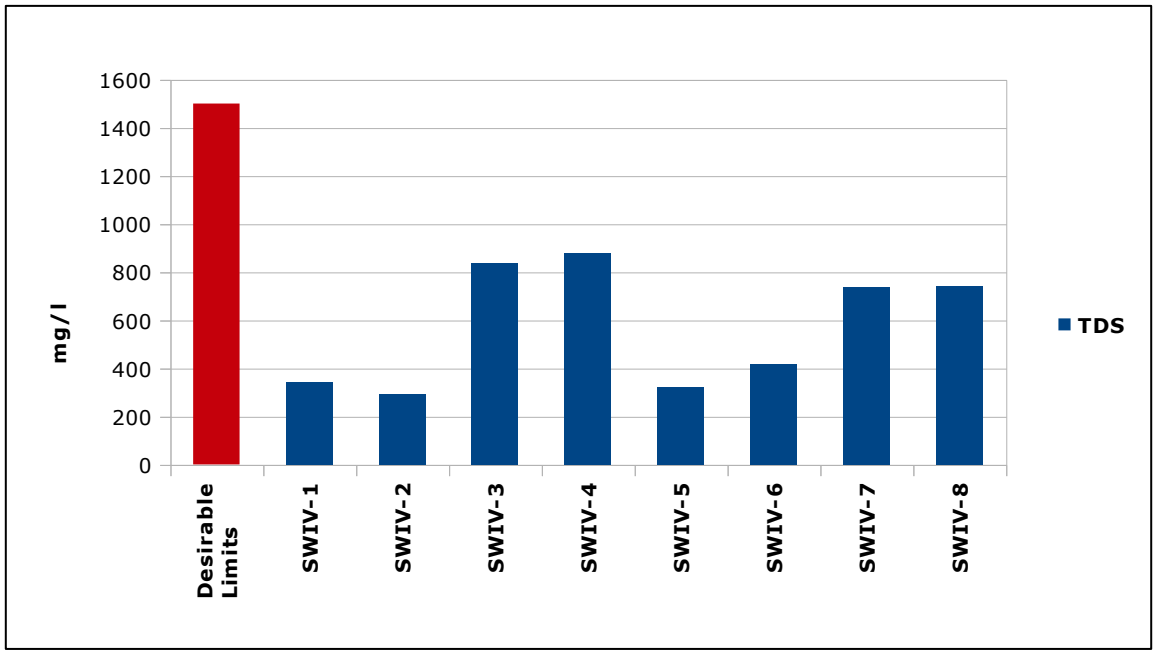



**Figure 6-53 Graph Showing the TDS Concentrations in the Package -IV**

### 6.4.1.5 Surface water quality for Package -V

During the study period one (1) sample were collected for assessing the water quality in Package -V (E6 roads). The sampling locations are designated as SWV1 as described in Table -6.25. These were identified considering proximity to the project site, their

activities and depending upon its utility by the people in the study area. Table -6.26 presents surface water quality obtained at different locations.

**Figure 6-54 : Surface Water Sample Collected Pond near Nelapadu**

**Table 6-25: Surface water sampling locations in Package -V**

| Location Code | Location |
|---|---|
| SWV-1 | Pond near Nelapadu |

**Table 6-26: Results of Surface Water Quality in Package -V**

| S. No | Parameter | Units | IS:2296 Class C Limits | SWV-1 |
|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 7.96 |
| 2 | Color | Hazen | 300 | 110 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 712 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 448 |
| 5 | Turbidity | NTU | -- | 13.3 |
| 6 | Dissolved Oxygen | mg/L | 4 | 4.8 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 44 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 14 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 160 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 140 |
| 11 | Calcium as Ca | mg/L | -- | 40.0 |
| 12 | Magnesium as Mg | mg/L | -- | 14.4 |
| 13 | Chloride as Cl | mg/L | 600 | 95.0 |
| 14 | Sodium as Na | mg/L | -- | 86.7 |
| 15 | Potassium as K | mg/L | -- | 2.1 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 72.1 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 3.8 |
| 18 | Silica as $SiO_2$ | mg/L | -- | 2.4 |

| S. No | Parameter | Units | IS:2296 Class C Limits | SWV-1 |
|---|---|---|---|---|
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.30 |
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.10 |
| 22 | Zinc as Zn | mg/L | 15 | 0.024 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 |
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 |
| 26 | Temperature | $^oC$ | -- | 246.3 |
| 27 | Total Suspended Solids | mg/L | -- | 26.1 |
| 28 | Phosphate as $po^4$ | mg/L | -- | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 |
| 31 | Total Arsenic as As | mg/L | 0.2 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.025 |
| 35 | Total Plate Count | MPN/250ml | -- | 35*102 |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 250 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristic indiacated a pH value of 7.96 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed is found to be 160 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.

- The total dissolved solids observed to be 448 mg/l and are well within the limits.
- The chlorides value is found to be 95 mg/l and are well within the limits.
- The Nitrates concentration is found to be 3.8 mg/l and the Sulphates concentration is found 72.1 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
- The Fluoride concentration is found to be 0.30 mg/l as against the desirable limits of 1 mg/l.

- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen is found to be 4.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.
- Bio-chemical Oxygen Demand (BOD) is found to be 14 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents in to nearby water bodies. The COD is found to be 44 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Sulphate & Nitrate, Chloride, pH, Conductivity, Turbidity and TDS in the Package -V are shown in the Figures -6.55, 6.56, 6.57, 6.58, 6.59, 6.60 & 6.61.

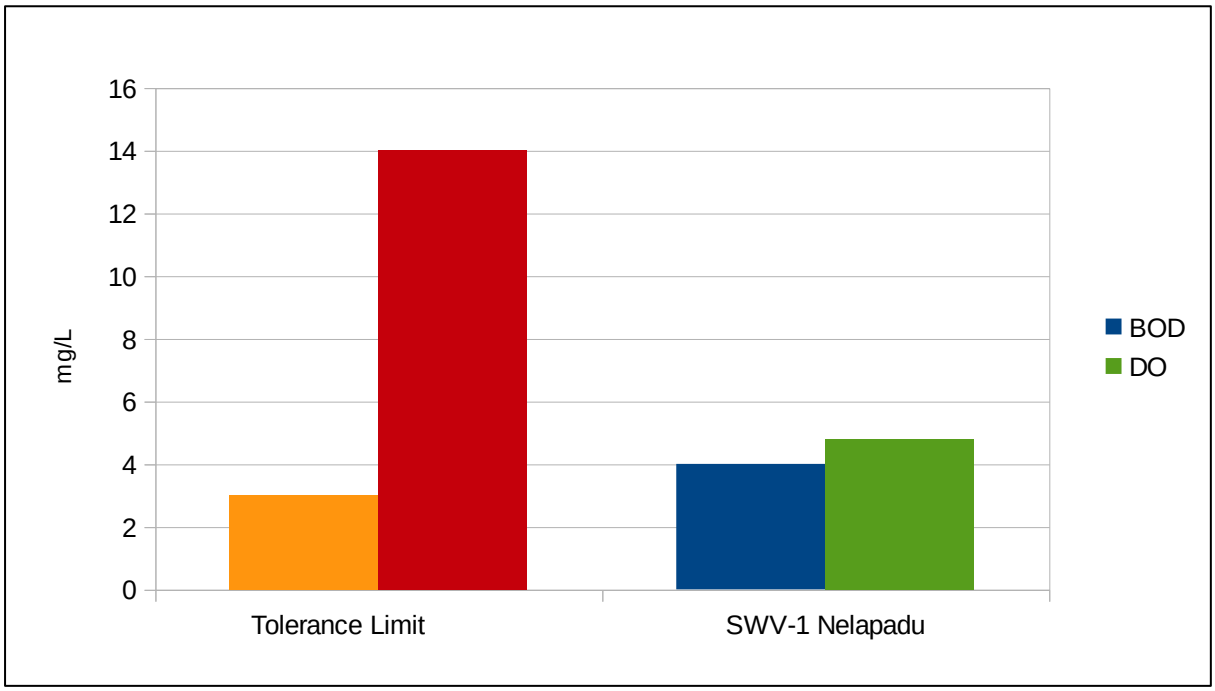



**Figure 6-55 : Graph Showing the BOD and DO Concentrations in Package -V**

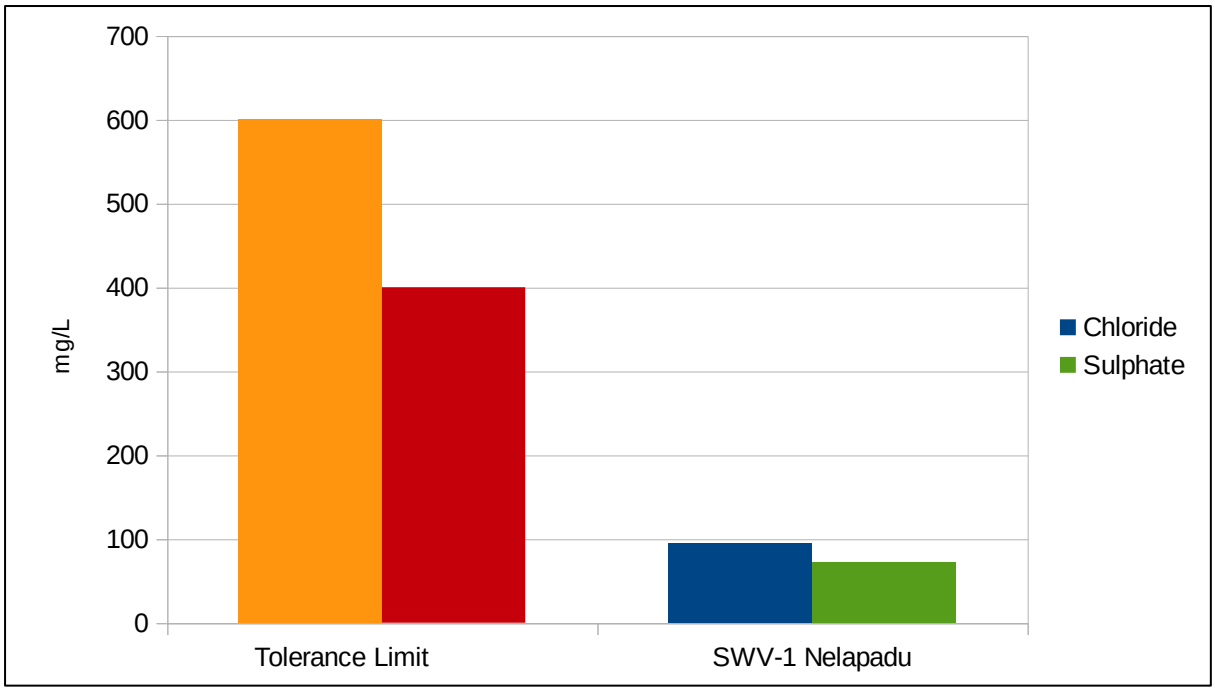



**Figure 6-56 : Graph Showing the Chloride & Sulphate Concentrations in the Package -V**

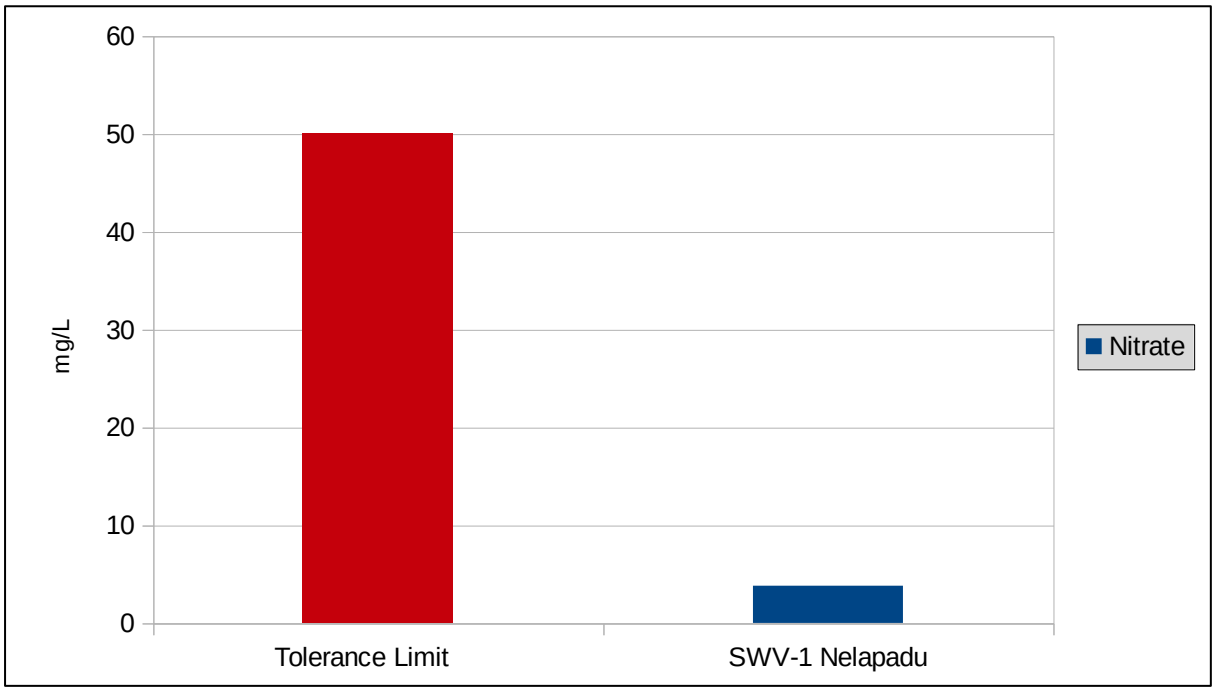



**Figure 6-57: Graph Showing the Nitrate Concentrations in the Package -V**

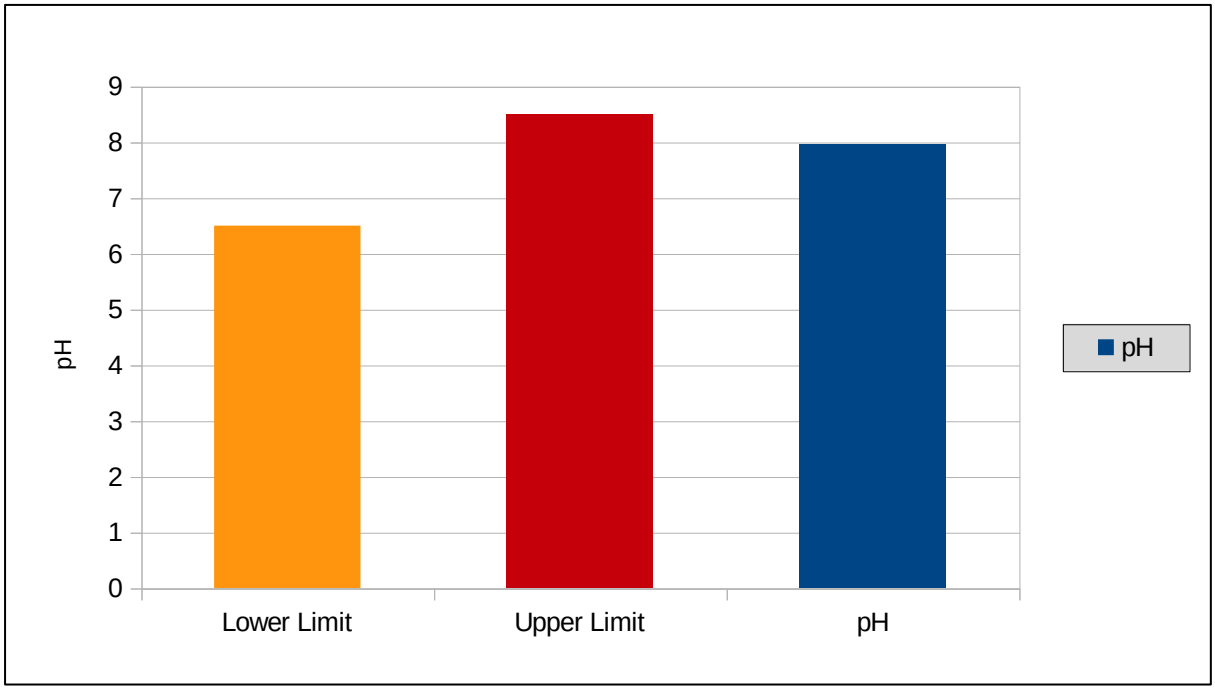



**Figure 6-58: Graph Showing the pH values in the Package -V**

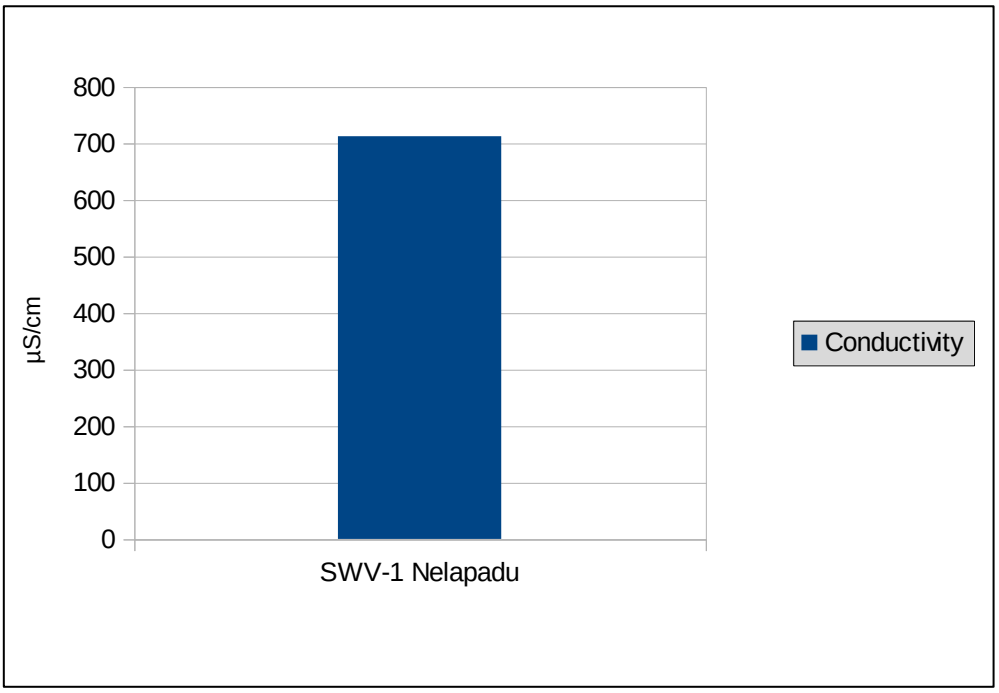



**Figure 6-59: Graph Showing the Conductivity values in the Package -V**

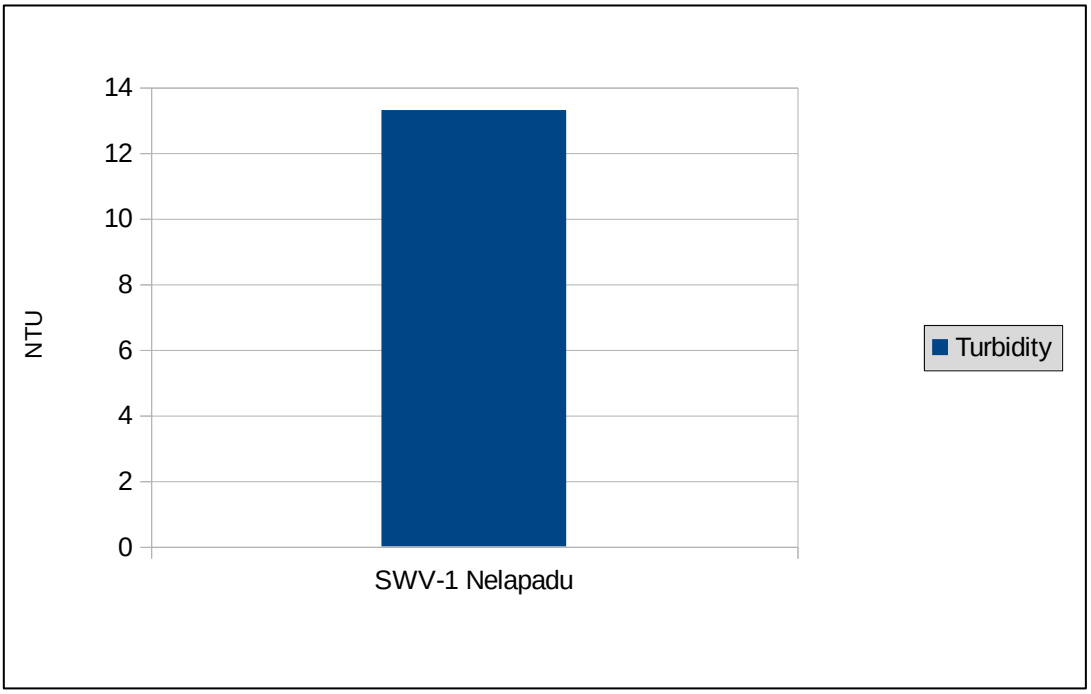



**Figure 6-60: Graph Showing the Turbidity values in the Package –V**

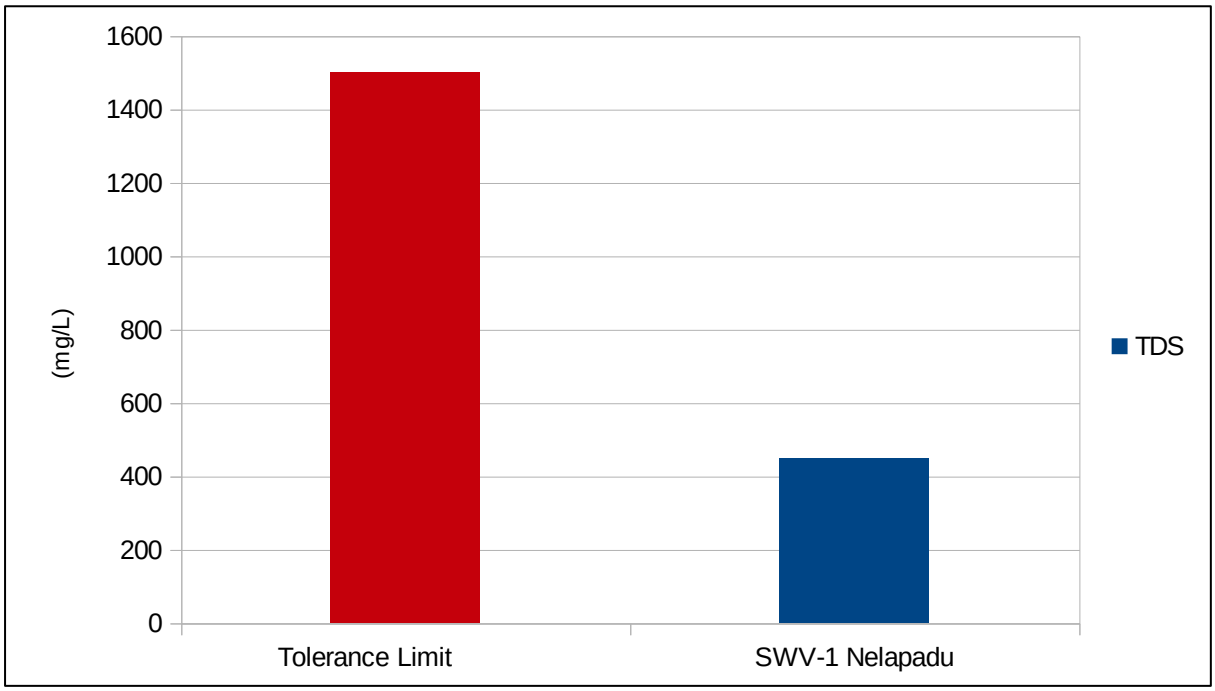



**Figure 6-61: Graph Showing the TDS values in the Package -V**

### 6.4.1.6 Surface water quality for Package -VI

During the study period six (06) samples were collected for assessing the water quality in Package -VI (E12, N11). The sampling locations are designated as SWVI-1 to SWVI-6 as described in Table -6.27. These were identified considering proximity to the project site, their activities and depending upon its utility by the people in the study area. Table -6.28 presents surface water quality obtained at different locations.

**Figure 6-62: Surface Water Samples Collected at River Krishna near Lingayapalem and Kuragallu lake**

**Table 6-27 : Surface water sampling locations in Package -VI**

| Location Code | Location |
|---|---|
| SWVI-1 | Tank near Ainavolu |
| SWVI-2 | Krishna River near Lingayapalem |
| SWVI-3 | Pond near Neerukonda |
| SWVI-4 | Kuragallu lake |
| SWVI-5 | Lake near Yerrabalem |
| SWVI-6 | Kondaveeti Vagu _Mandadam-Kuragallu Road |

**Table 6-28 : Results of Surface Water Quality in Package -VI**

| S. No | Parameter | Units | IS:2296 Class C Limits | SWVI-1 | SWVI-2 | SWVI-3 | SWVI-4 | SWVI-5 | SWVI-6 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | pH at 25 $^{O}$C | - | 6.5 – 8.5 | 8.22 | 8.16 | 7.20 | 8.29 | 8.26 | 7.12 |
| 2 | Color | Hazen | 300 | 110 | 15 | 165 | 180 | 185 | 120 |
| 3 | Conductivity at 25 $^{O}$C | µS/cm | -- | 596 | 486 | 944 | 1876 | 1366 | 710 |
| 4 | Total Dissolved Solids | mg/L | 1500 | 364 | 304 | 592 | 1186 | 858 | 234 |
| 5 | Turbidity | NTU | -- | 12.8 | 6.8 | 16.5 | 19.2 | 18.1 | 13.1 |
| 6 | Dissolved Oxygen | mg/L | 4 | 4.5 | 5.8 | 4.3 | 4.8 | 4.5 | 4.6 |
| 7 | Chemical Oxygen Demand | mg/L | -- | 56 | 24 | 40 | 64 | 54 | 50 |
| 8 | BOD ( 3 days at 27$^{o}$C) | mg/L | 3 | 18 | 04 | 12 | 20 | 16 | 14 |
| 9 | Total Hardness as $CaCO_3$ | mg/L | -- | 120 | 130 | 160 | 360 | 240 | 210 |
| 10 | Alkalinity as $CaCO_3$ | mg/L | -- | 160 | 130 | 240 | 400 | 340 | 190 |
| 11 | Calcium as Ca | mg/L | -- | 28 | 32 | 36.0 | 80 | 52 | 44 |
| 12 | Magnesium as Mg | mg/L | -- | 12 | 12 | 16.8 | 38.4 | 26.4 | 24 |
| 13 | Chloride as Cl | mg/L | 600 | 85 | 65 | 140 | 310 | 215 | 115 |
| 14 | Sodium as Na | mg/L | -- | 78.6 | 48.7 | 138.9 | 260.8 | 198.7 | 72.3 |
| 15 | Potassium as K | mg/L | -- | 2.0 | 2.0 | 3.1 | 3.5 | 3.5 | 2.8 |
| 16 | Sulphate as $SO_4^{--}$ | mg/L | 400 | 12.3 | 13.8 | 23.8 | 85.6 | 27.9 | 172.6 |
| 17 | Nitrates as $NO_3$ | mg/L | 50 | 3.5 | 3.8 | 5.6 | 6.9 | 6.3 | 5.3 |
| 18 | Silica as $SiO_2$ | mg/L | -- | 2.0 | 2.6 | 4.0 | 5.2 | 5.4 | 3.5 |
| 19 | Fluorides as $F^-$ | mg/L | 1.5 | 0.30 | 0.30 | 0.40 | 0.80 | 0.60 | 0.30 |
| 20 | Residual Sodium Carbonate | mg/L | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 21 | Iron as Fe | mg/L | 50 | 0.14 | 0.08 | 0.10 | 0.16 | 0.15 | 0.08 |
| 22 | Zinc as Zn | mg/L | 15 | 0.025 | 0.024 | 0.030 | 0.028 | 0.042 | 0.022 |
| 23 | Oil and grease | mg/L | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 24 | Chromium as Cr | mg/L | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

| S. No | Parameter | Units | IS:2296 Class C Limits | SWVI-1 | SWVI-2 | SWVI-3 | SWVI-4 | SWVI-5 | SWVI-6 |
|---|---|---|---|---|---|---|---|---|---|
| 25 | Lead as Pb | mg/L | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 26 | Temperature | $^{o}C$ | -- | 25.6 | 25.8 | 26.8 | 26.5 | 26.3 | 27.2 |
| 27 | Total Suspended Solids | mg/L | -- | 26.4 | 10.2 | 16.1 | 20.4 | 12.5 | 12.6 |
| 28 | Phosphate as $po^{4}$ | mg/L | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 29 | Phenolic Compounds | mg/L | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 30 | Mercury as Hg | mg/L | 0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| 31 | Total Arsenic as As | mg/L | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Cadmium as Cd | mg/L | 0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 33 | Hexavalent Chromium as cr-6 | mg/L | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 34 | Copper as Cu | mg/L | 1.5 | 0.020 | 0.020 | 0.054 | 0.061 | 0.060 | 0.028 |
| 35 | Total Plate Count | MPN/250ml | -- | 34*102 | 480 | 38*102 | 43*102 | 41*102 | 25*102 |
| 36 | Coli form Organisms | cfu/ 100ml | Should not exceed 5000 | 240 | 12 | 122 | 168 | 148 | 102 |

**Data analysis:**

The surface water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS- 2296 Class -C Limit (Drinking water source after conventional treatment). The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.20-8.29 as against IS standard of 6.5 – 8.5. Odour of water is un-objectionable. The Colour of water found to be well within desirable limit.
- Data on chemical characteristics:
    - The total hardness observed to be constant in all samples and is in the range of 120-360 mg/l. The contribution of calcium is more than magnesium to the total hardness, which is reflected clearly from calcium and magnesium values.
    - The total dissolved solids observed are ranged between 234-1186 mg/l and are well within the limits.
    - The chlorides ranged between 65-310 mg/l and are well within the limits.
    - The Nitrates ranged between 3.5-6.9 mg/l and the Sulphates ranged between 12.3-172.6 mg/l and the observed values found to be consistent in Nitrates and Sulphates. Nitrates and Sulphate values are well within the limits.
    - The Fluoride values found to be in the range of 0.30-0.80 mg/l as against the desirable limits of 1 mg/l.

- Data on trace metals i.e., Fe, Zn, B, Cr & Cd concentrations found to be consistent in all the analyzed samples and are found to be very well within desirable limit.
- The Dissolved Oxygen in the sources is ranging between 4.3-5.8 mg/l as against the minimum requirement limit 4mg/l, which implies sustainability of aquatic life in the tanks /lakes.
- Bio-chemical Oxygen Demand (BOD) is observed to be slightly high and ranged between 4-20 mg/l as against the specified limit of 3mg/l. This may be due to intrusion of domestic effluents in to nearby water bodies. The COD is found to be ranged between 24-64 mg/l.

Overall, the surface water quality is found to be satisfactory. The graphs of BOD & DO, Sulphate & Nitrate,Chloride, pH, Conductivity, Turbidity and TDS in the study area are shown in the Figures -6.63, 6.64, 6.65, 6.66, 6.67, 6.68 & 6.69.

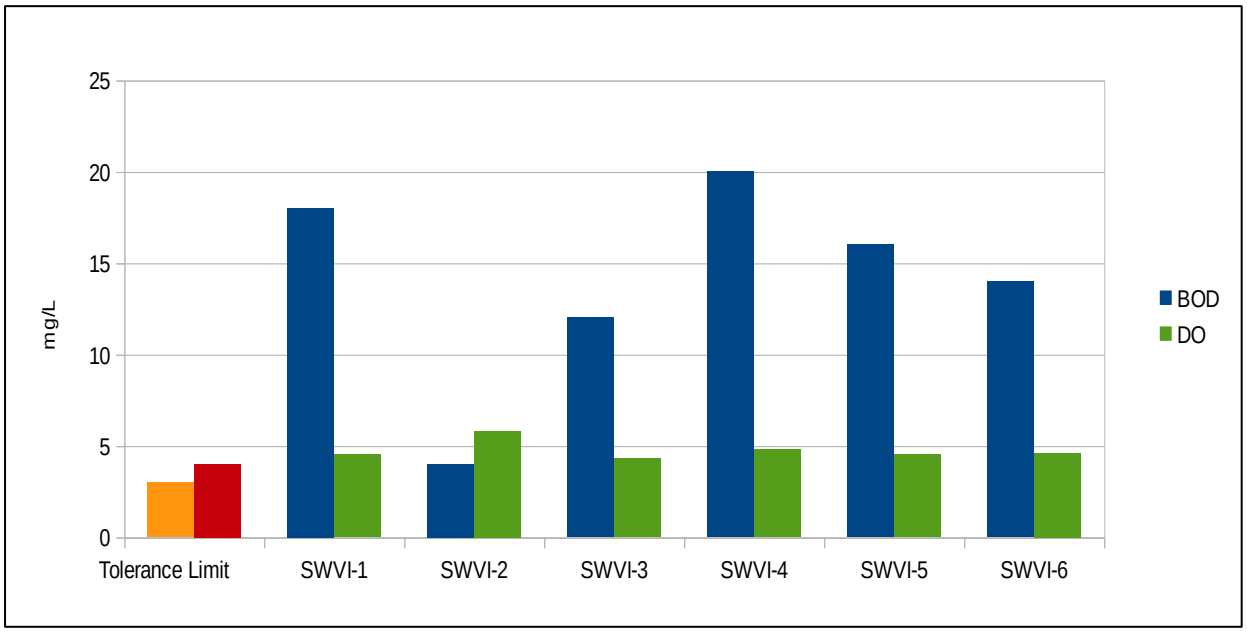



**Figure 6-63 : Graph Showing the BOD and DO Concentrations in Package -VI**

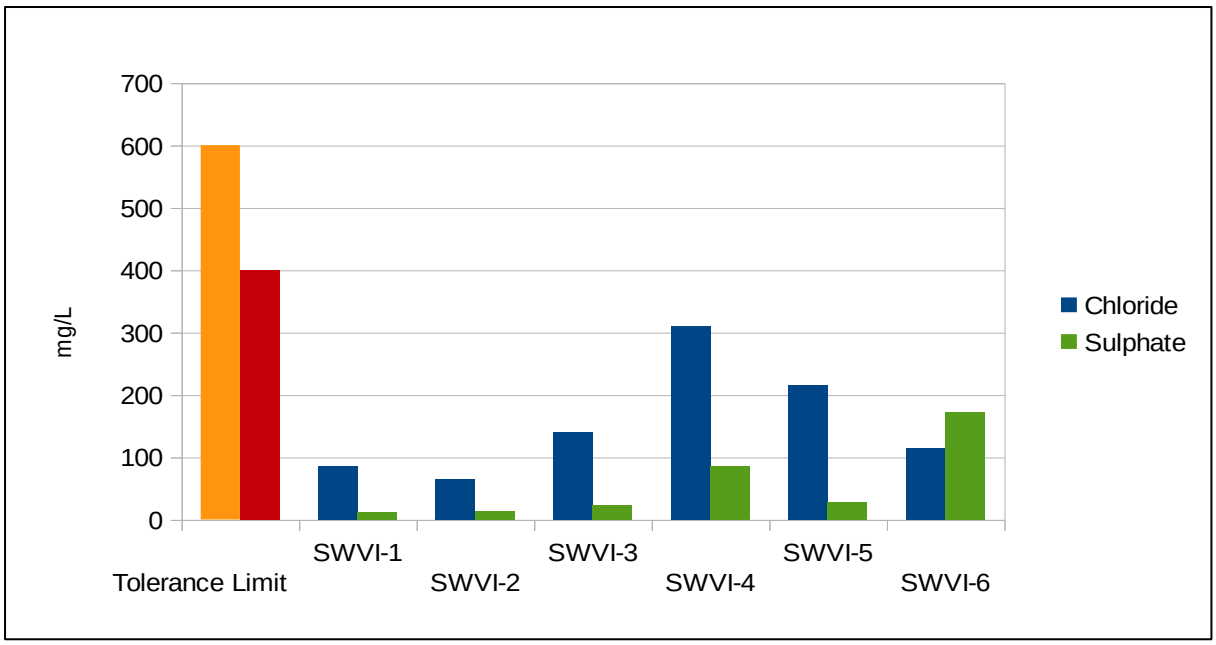



**Figure 6-64: Graph Showing the Sulphate and Chloride Concentrations in Package –VI**

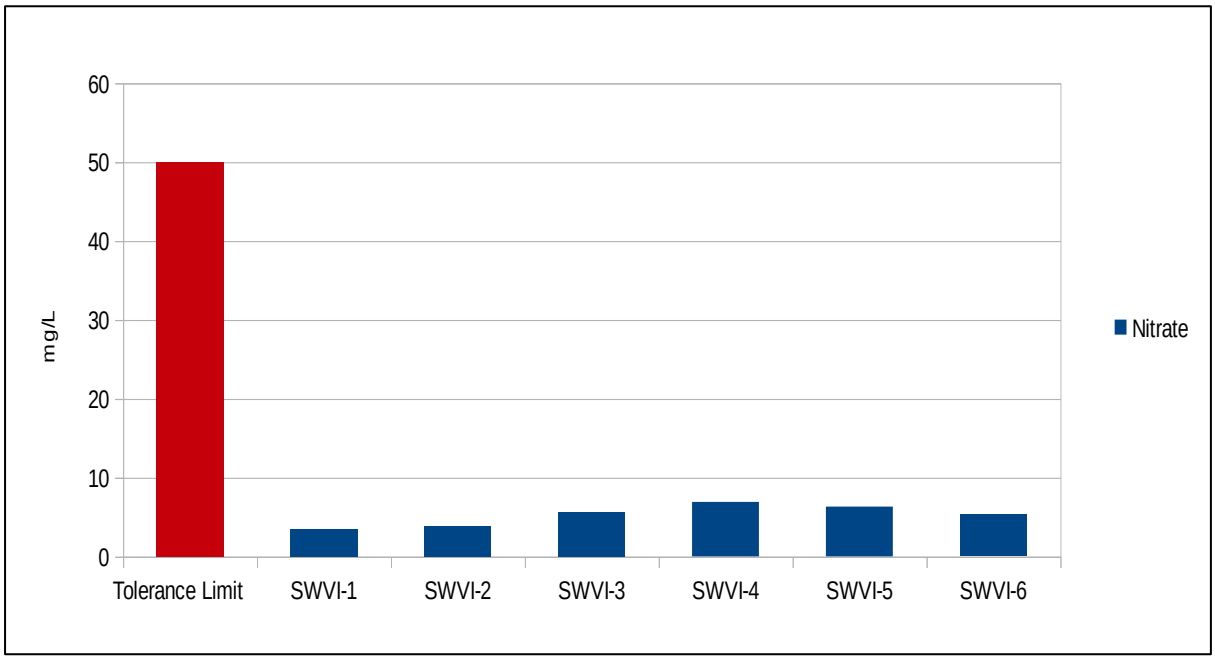



**Figure 6-65: Graph Showing the Nitrate Concentrations in Package -VI**

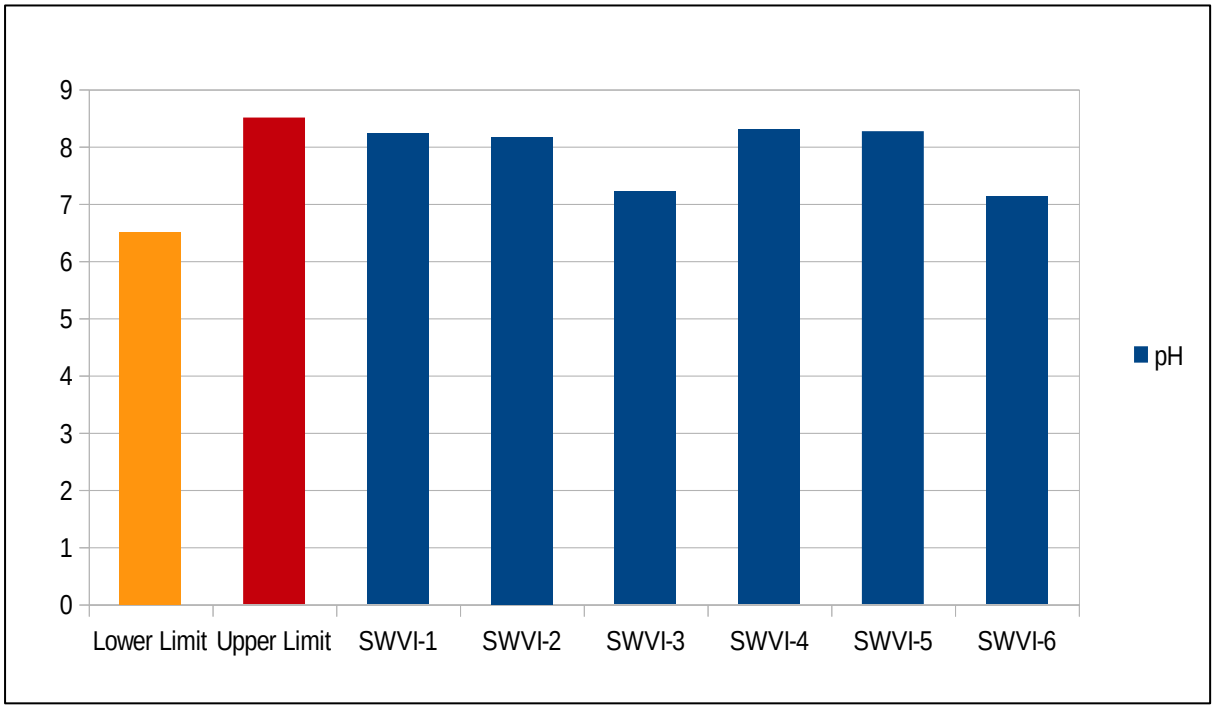



**Figure 6-66 : Graph Showing the pH values in the Package -VI**

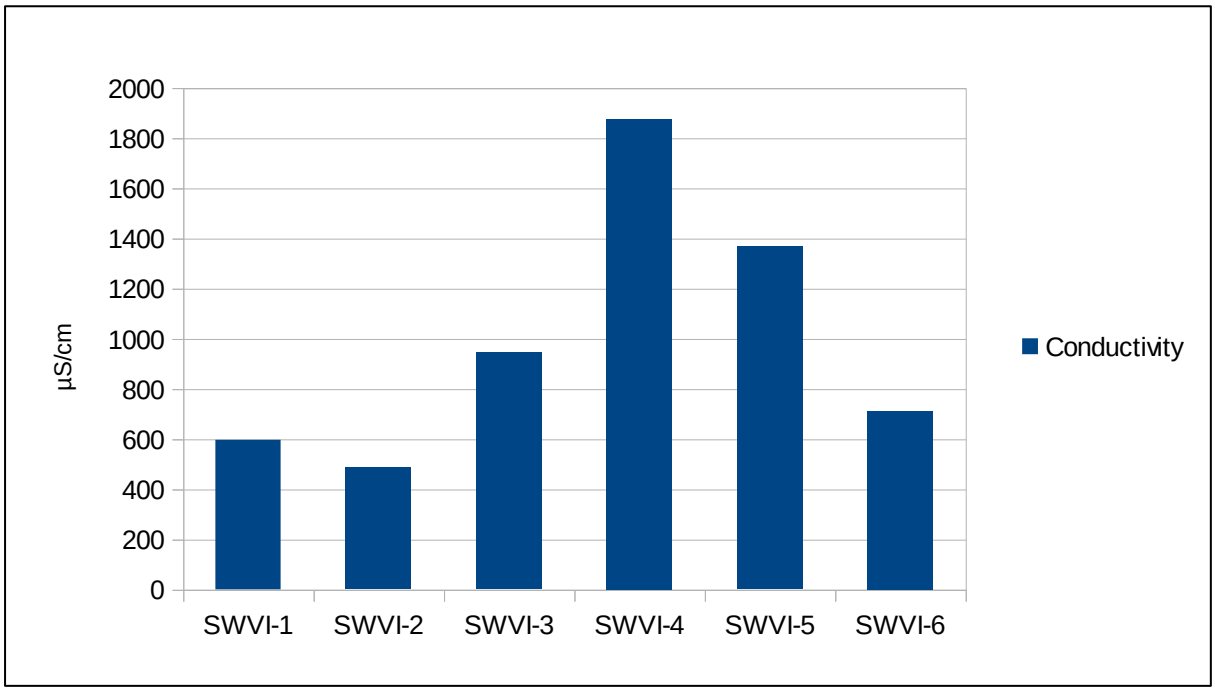



**Figure 6-67 : Graph Showing the Conductivity values in the Package –VI**

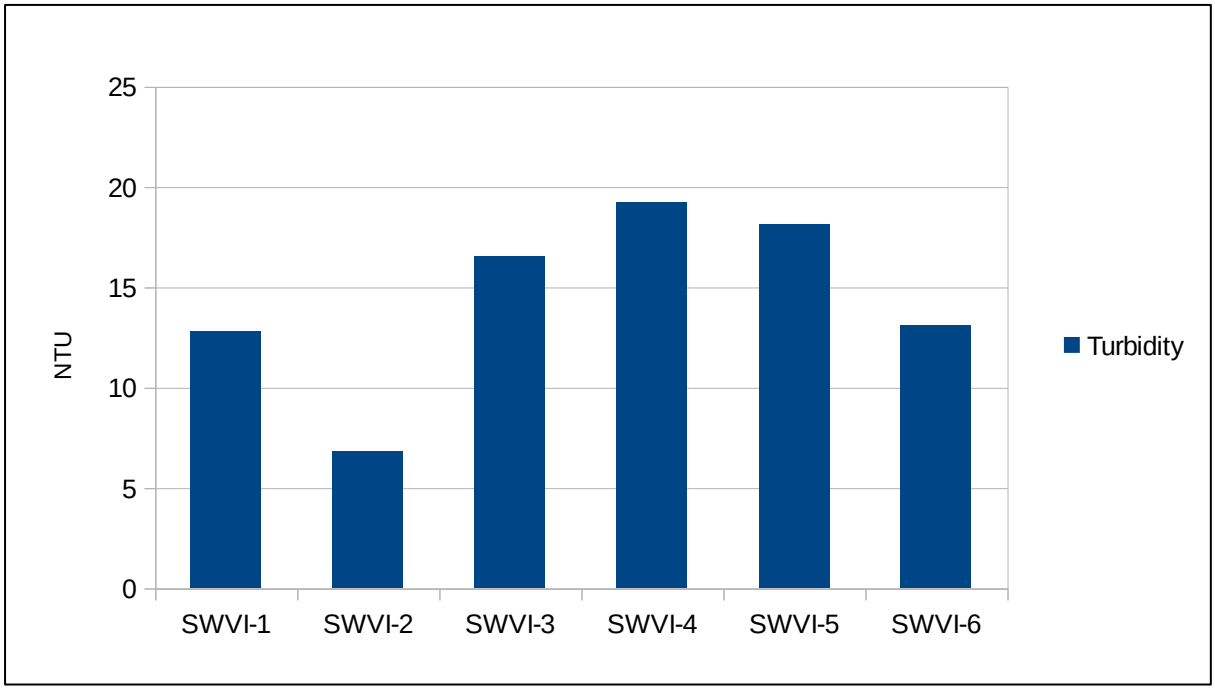



**Figure 6-68: Graph Showing the Turbidity values in the Package -VI**

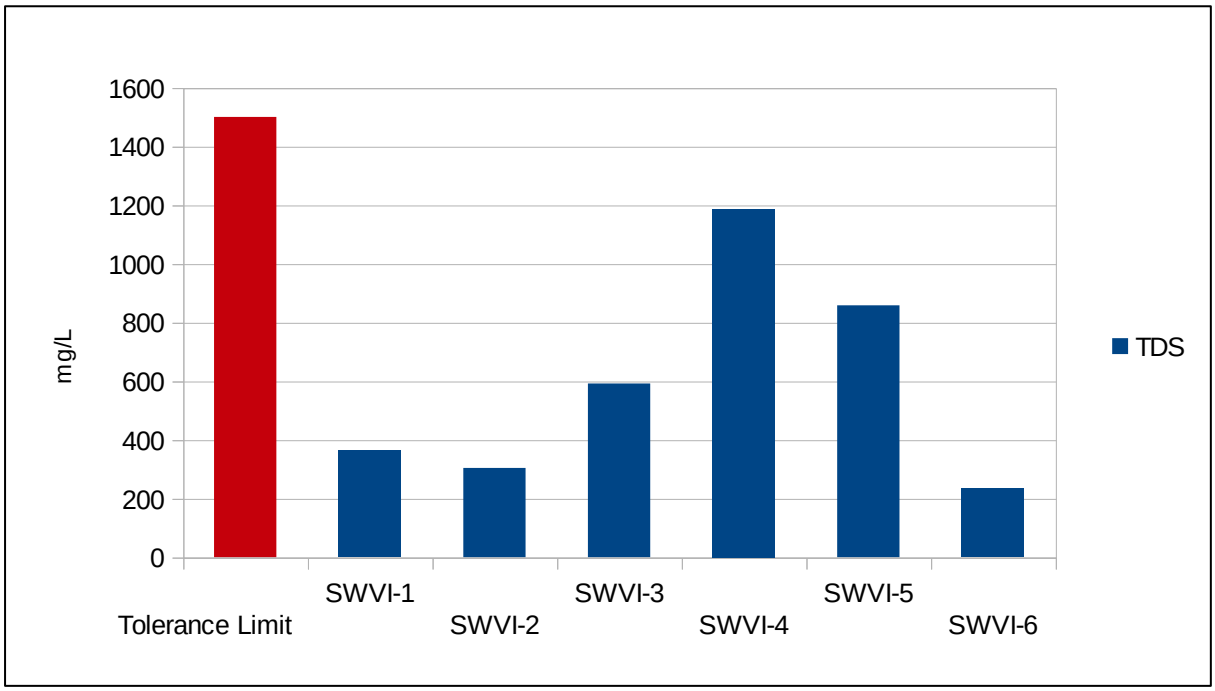



**Figure 6-69 : Graph Showing the TDS values in the Package -VI**

### 6.4.2 Ground water quality

#### 6.4.2.1 Ground water quality for Package -I

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use, hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -I (E8) of 10 Priority roads, two (02) samples were collected from the identified bore wells/dug wells and given in Table -6.29. Selection of samples considered as per the utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.30 and the locations are shown in Figure -6.70.

**Table 6-29 Ground Water sampling Locations in Package -I**

| Location Code | Bore Well Location |
|---|---|
| GWI-1 | Nekkallu |
| GWI-2 | Sakhamuru |

**Figure 6-70 Ground Water Sample Collected at Nekkallu and Sakhamuru**

**Table 6-30 Ground water quality analysis results for Package -I**

| S.No | Parameter | Units | IS:10500 | | GWI-1 | GWI-2 |
|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.18 | 7.90 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 |
| 3 | Taste | - | Agree | Agree | Agree | Agree |
| 4 | Odor | - | Agree | Agree | UO | UO |
| 5 | Conductivity | µS/cm | -- | -- | 2814 | 2464 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 2.80 | 2.10 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 1802 | 1527 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 600 | 800 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 560 | 500 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 140 | 192.0 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 60 | 76.8 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 370 | 320 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 291.5 | 257.4 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 1.20 | 1.40 |
| 15 | Nitrates as $NO_3$ | mg/L | 45 | 100 | 13.3 | 7.6 |
| 16 | Sodium as Na | mg/L | -- | -- | 363.8 | 192.9 |
| 17 | Potassium as K | mg/L | -- | -- | 5.5 | 4.1 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.20 | 0.16 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.082 | 0.080 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 12.0 | 5.2 |
| 22 | Temperature | °C | 0.003 | NR | 26.8 | 27.3 |
| 23 | Total Suspended Solids | mg/L | 0.05 | NR | <0.1 | <0.1 |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 |
| 25 | Bio chemical oxygen Demand | mg/L | -- | -- | <01 | <01 |
| 26 | Phosphate as $po_4$ | mg/L | -- | -- | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 |
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 |
| 29 | Residual sodium carbonate | mg/L | -- | -- | <0.02 | <0.02 |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 |
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as cr-6 | mg/L | -- | -- | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.050 | 0.025 |
| 37 | Total Plate Count | MPN/ml | -- | -- | ND | ND |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | ND | ND |

Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable

**Data analysis:**

The ground water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.18 – 7.90 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations
- Data on chemical characteristics:
    - The Total Hardness observed to be varying in all samples and is in the range of 600 to 800 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits and the permissible limits.
    - The Total Dissolved Solids observed to be high and ranged between 1527 mg/l to 1802 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l.
    - The chlorides ranged between 320.0-370.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.
    - The Nitrates and Sulphates values observed to be ranged between 7.6 – 13.3 mg/l and 257.4 – 291.5 mg/l. Samples are exceeding the permissible limits but within the desirable limits for both Nitrates and Sulphates.
    - The Fluoride values found are in the range of 1.2 – 1.4 mg/l as against the desirable limit of 1.0 mg/l. The samples are within the permissible limit of 1.5mg/l.
- Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It

can also be used for drinking after treatment. The Concentrations of Nitrate, Chloride & Sulphate, Fluoride, Total hardness & Total Alkalinity, Total Dissolved Solids, pH and Conductivity in the Package -I are shown in the Figures -6.71, 6.72, 6.73, 6.74, 6.75, 6.76 & 6.77 respectively.

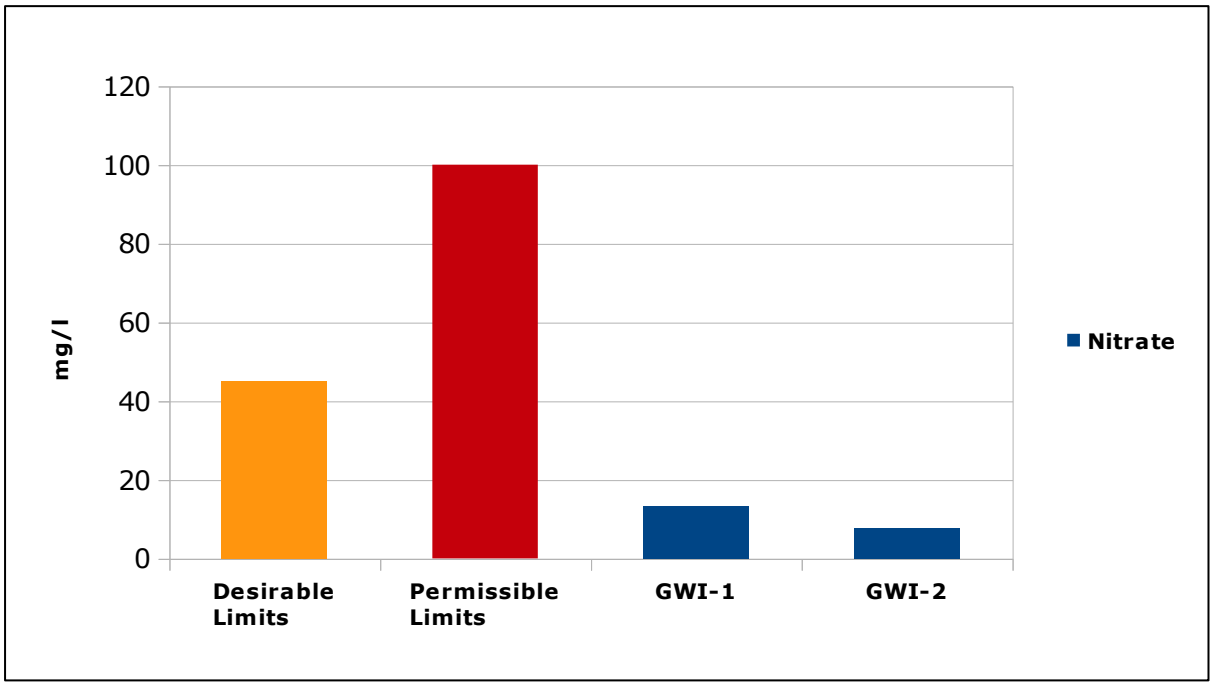



**Figure 6-71 Graph Showing the Nitrate Concentration in the Package –I**

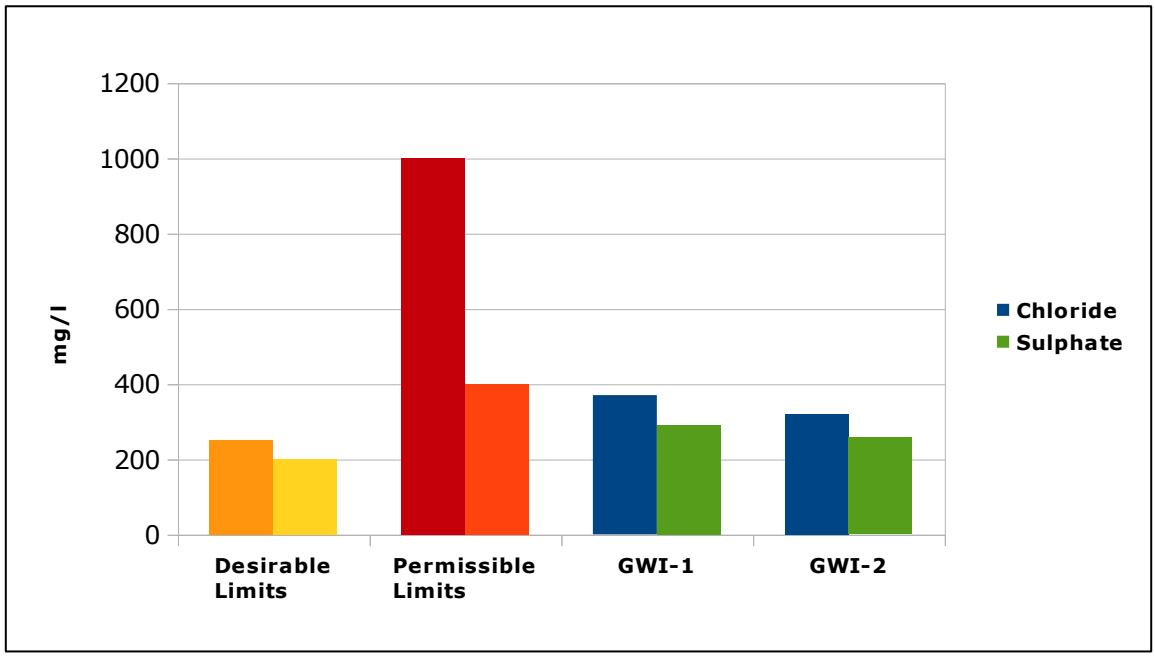



**Figure 6-72 Graph Showing the Chloride & Sulphate Concentrations in the Package –I**

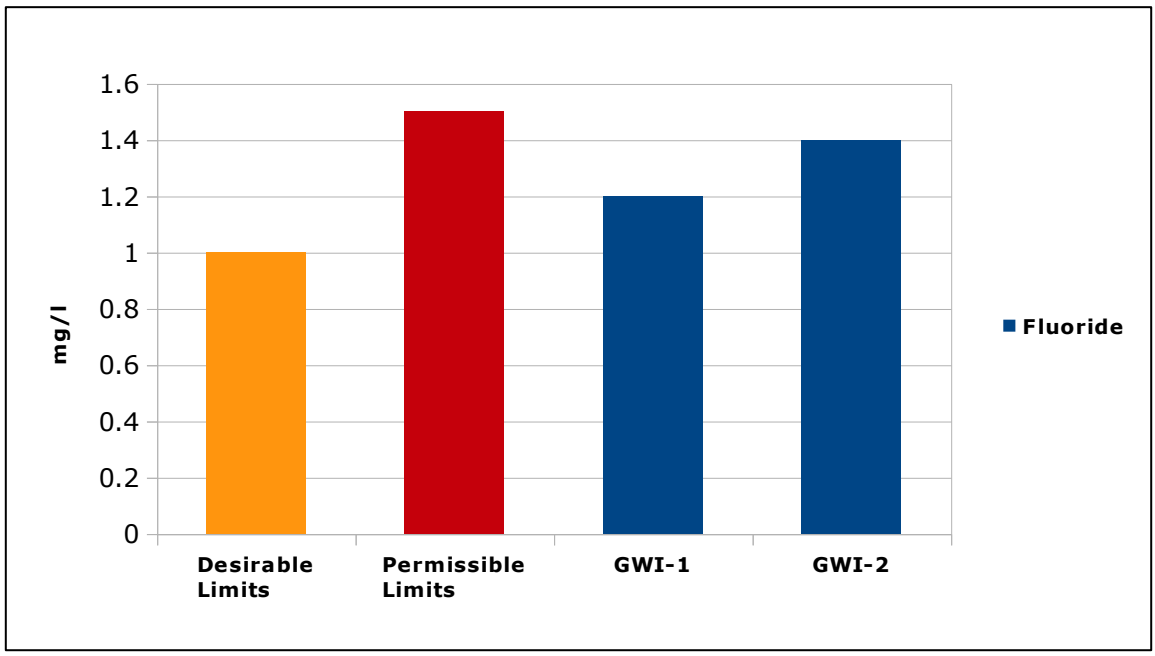



**Figure 6-73 Graph Showing the Fluorides Concentration in the Package -I**

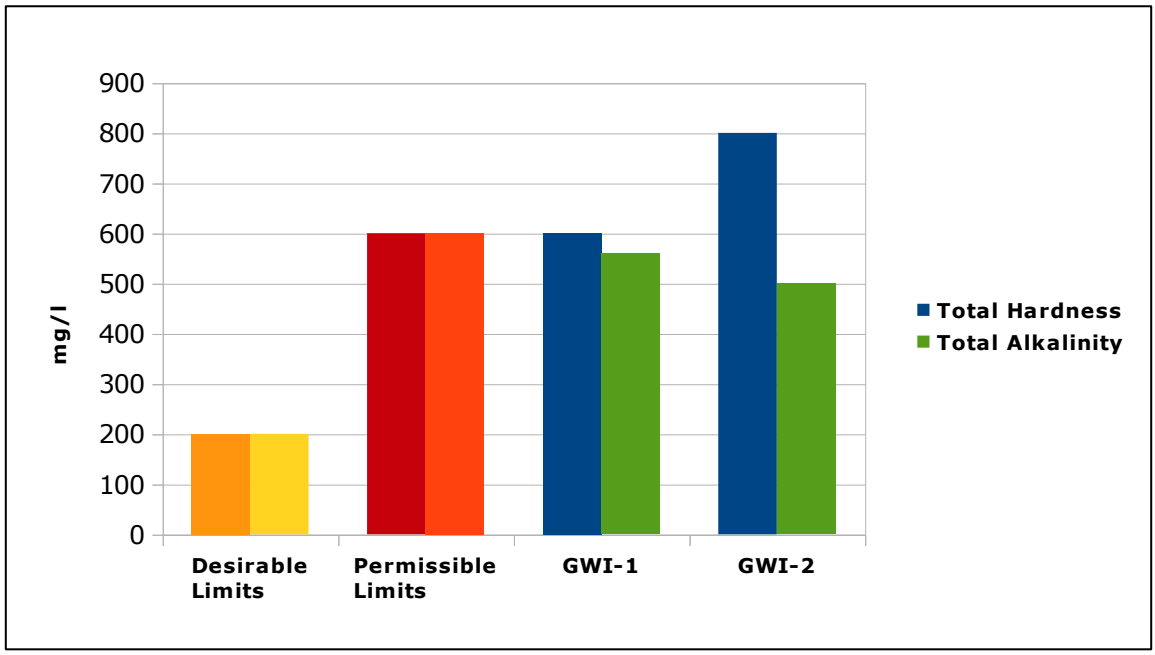



**Figure 6-74 Graph Showing the Total Hardness and Total Alkalinity Concentration in the Package -I**

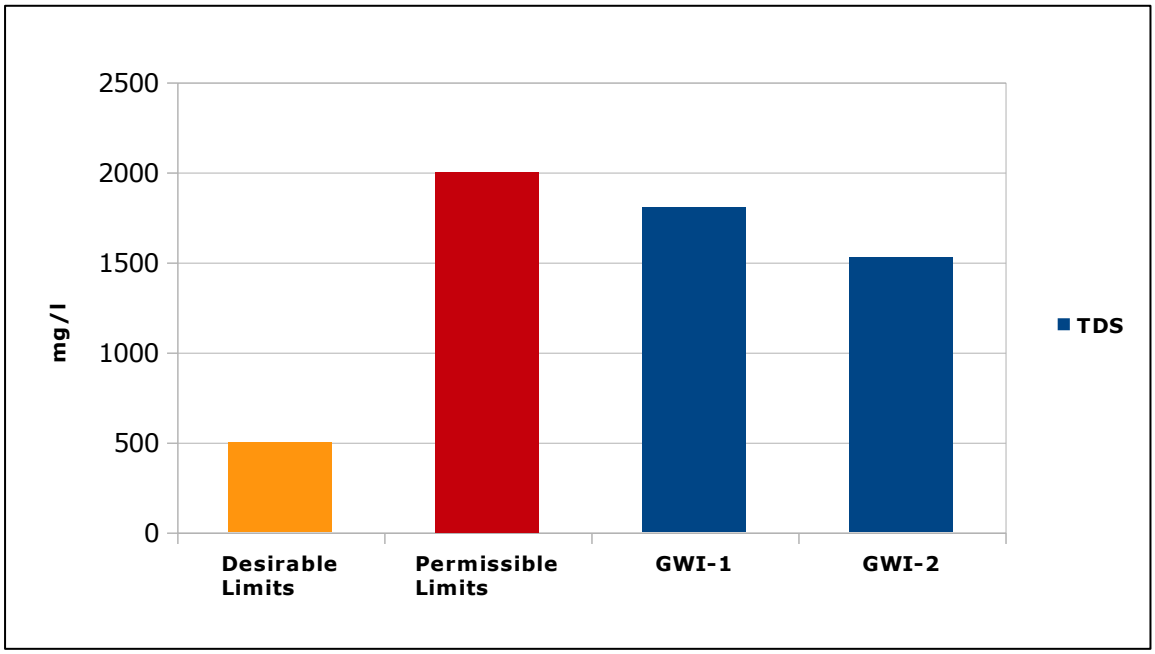



**Figure 6-75 Graph Showing the TDS Concentration in the Package -I**

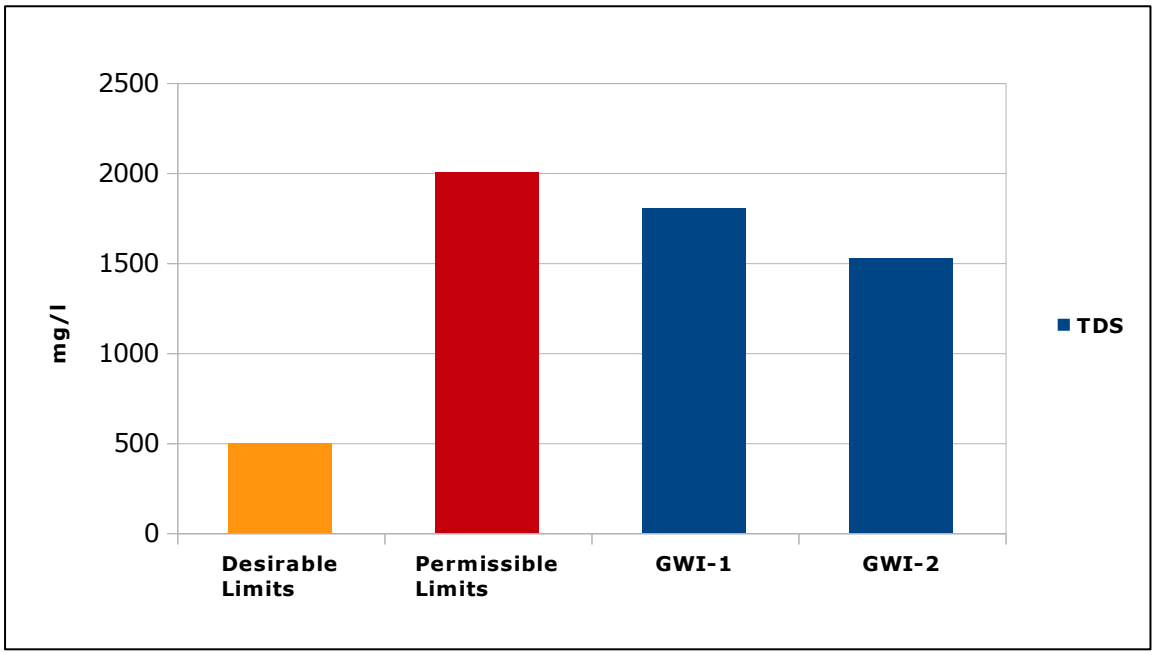



**Figure 6-76 Graph Showing the pH values in the Package –I**

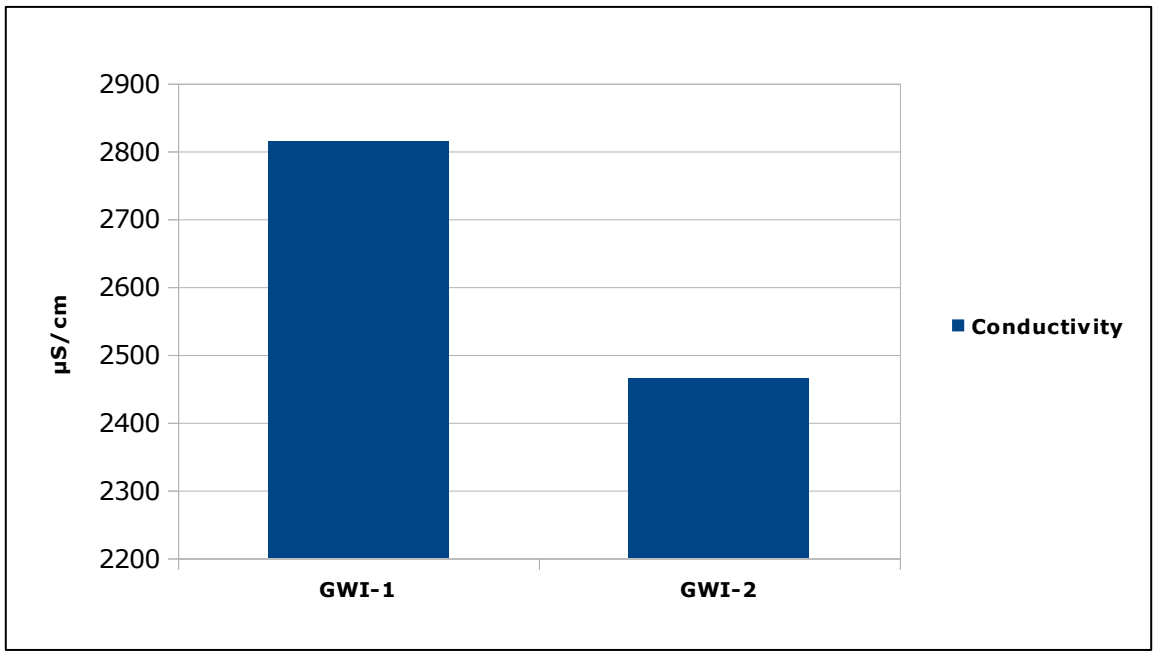



**Figure 6-77 Graph Showing the Conductivity values in the Package -I**

### 6.4.2.2 Ground water quality for Package -II

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use; hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -II (N9) of 10 Priority roads, two (02) samples were collected from the identified bore wells/dug wells and given in Table -6.31. Selection of samples considered as per the

utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.32 and the locations are shown in Figure -6.78.

**Table 6-31 Ground Water sampling Locations in Package -II**

| Location Code | Bore Well Location |
|---|---|
| GWII-1 | Malkapuram |
| GWII-2 | Velagapudi |

**Figure 6-78 Ground Water Sample Collected at Malkapuram and Velagapudi**

**Table 6-32 Ground water quality analysis results for Package -II**

| S.No | Parameter | Units | IS:10500 | | GWII-1 | GWII-2 |
|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.08 | 7.41 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 |
| 3 | Taste | - | Agre | Agre | Agre | Agre |
| 4 | Odor | - | Agre | Agre | UO | UO |
| 5 | Conductivity | µS/cm | -- | -- | 2614 | 1638 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 2.10 | 2.10 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 1620 | 1014 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 920 | 350 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 1040 | 490 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 232 | 68 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 81.6 | 36 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 145.1 | 210 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 45.8 | 20.7 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 0.80 | 1.1 |
| 15 | Nitrates as $NO_3$ | mg/L | 45 | 100 | 8.8 | 6.3 |
| 16 | Sodium as Na | mg/L | -- | -- | 172 | 224.0 |
| 17 | Potassium as K | mg/L | -- | -- | 4.3 | 3.3 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.20 | 0.16 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.072 | 0.062 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 9.4 | 4.8 |
| 22 | Temperature | °C | 0.003 | NR | 26.9 | 27.2 |
| 23 | Total Suspended | mg/L | 0.05 | NR | <0.1 | <0.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Solids | | | | | |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 |
| 25 | Bio chemical oxygen Demand | mg/L | -- | -- | <01 | <01 |
| 26 | Phosphate as $po_4$ | mg/L | -- | -- | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 |
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 |
| 29 | Residual sodium carbonate | mg/L | -- | -- | <0.02 | <0.02 |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 |
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 |
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as cr-6 | mg/L | -- | -- | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.042 | 0.034 |
| 37 | Total Plate Count | MPN/ml | -- | -- | ND | ND |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | ND | ND |

Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable

**Data analysis:**

The ground water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.08 – 7.41 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.
- Data on chemical characteristics:
    - The Total Hardness observed to be varying in all samples and is in the range of 350 to 920mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. How ever, the total hardness values exceeded the permissible limits at Malkapuram.
    - The Total Dissolved Solids observed to be high and ranged between 1014 mg/l to 1620 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l.
    - The chlorides ranged between 145.1-210.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.
    - The Nitrates and Sulphates values observed to be ranged between 6.3 – 8.8 mg/l and 20.7 – 45.8 mg/l. Samples are not exceeding the desirable limits for both Nitrates and Sulphates.

- The Fluoride values found are in the range of 0.80 – 1.1 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples are not exceeding the permissible limit of 1.5mg/l.

- Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after treatment. The Concentrations of Nitrate, Chloride & Sulphate, Fluoride, Total hardness & Total Alkalinity, Total Dissolved Solids, pH and Conductivity in the study area are shown in the Figures -6.79, 6.80, 6.81, 6.82, 6.83, 6.84 & 6.85 respectively.

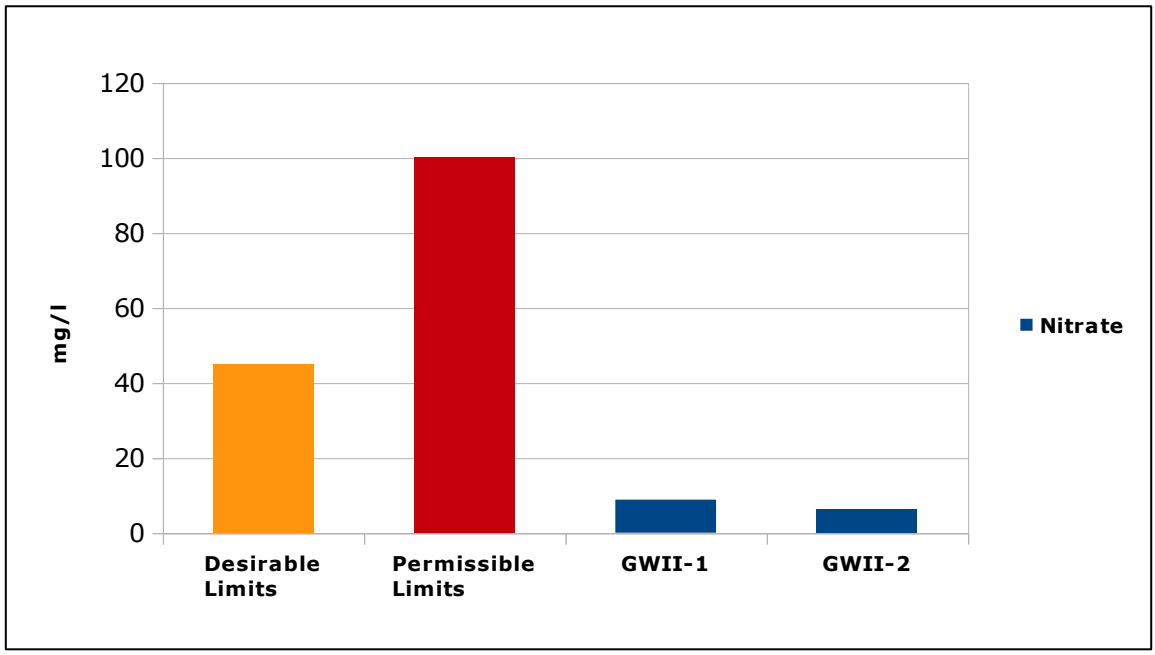



**Figure 6-79 Graph Showing the Nitrate Concentration in the Package -II**

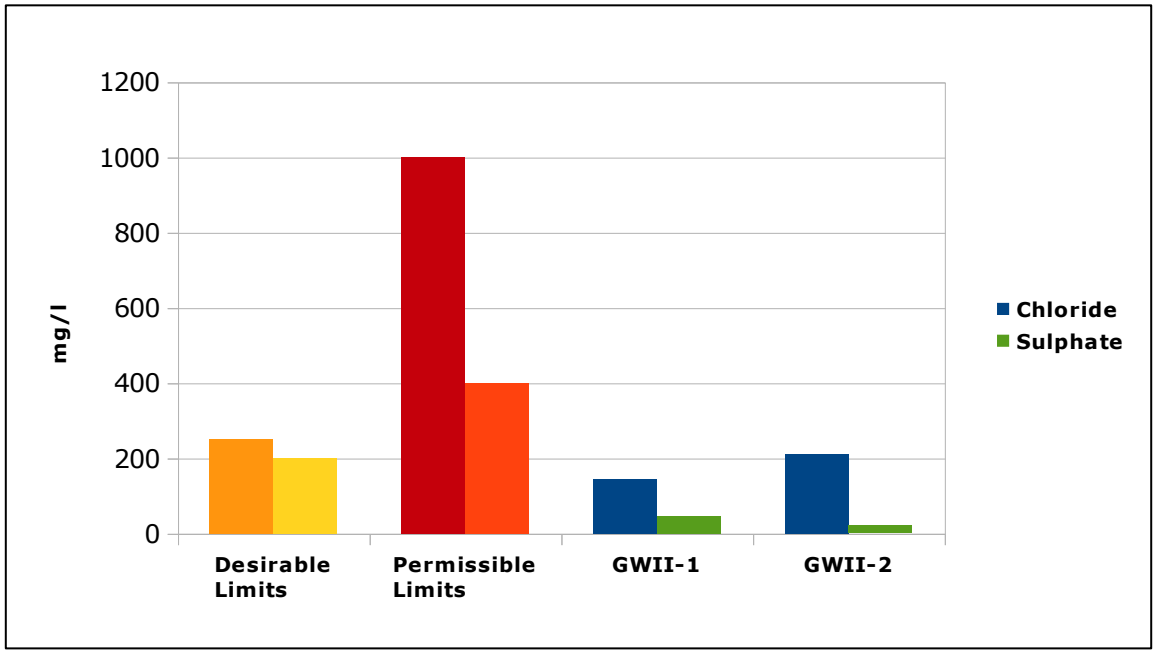



**Figure 6-80 Graph Showing the Chloride & Sulphate Concentrations in the Package -II**

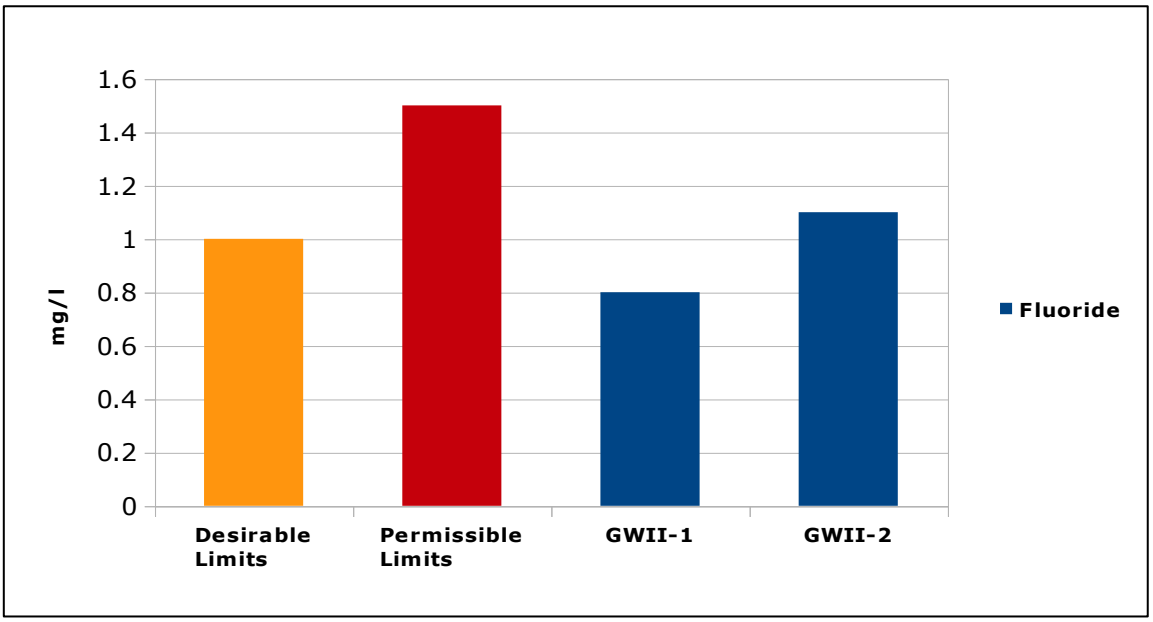



**Figure 6-81 Graph Showing the Fluorides Concentration in the Package –II**

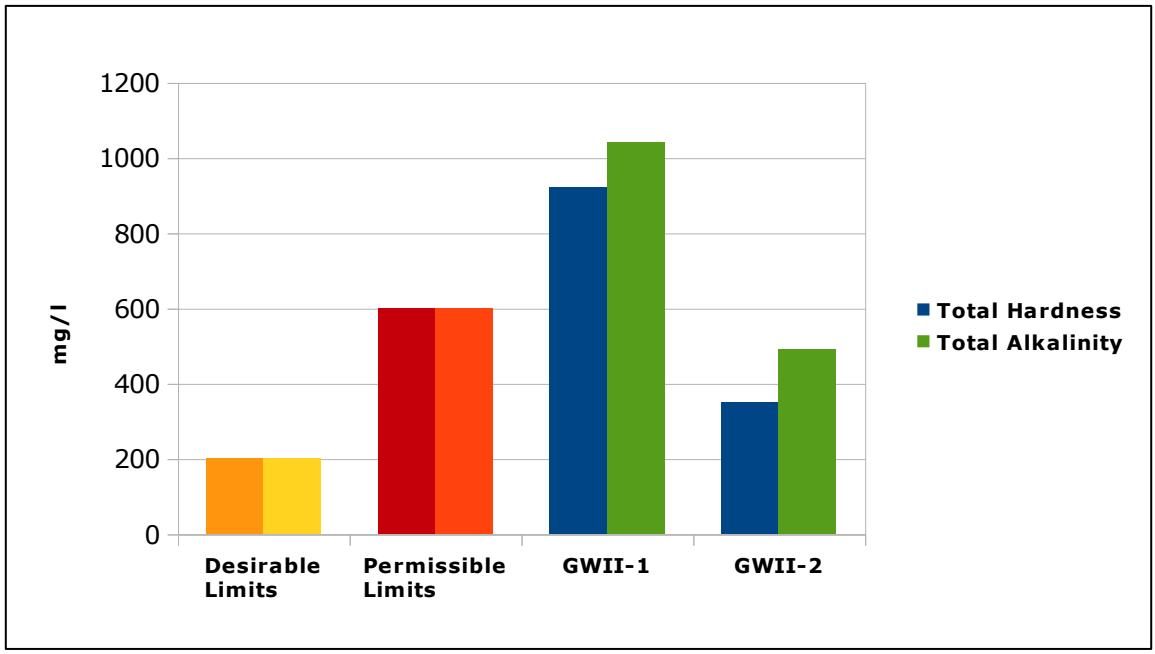



**Figure 6-82 Graph Showing the Total Hardness and Total Alkalinity Concentration in the Package –II**

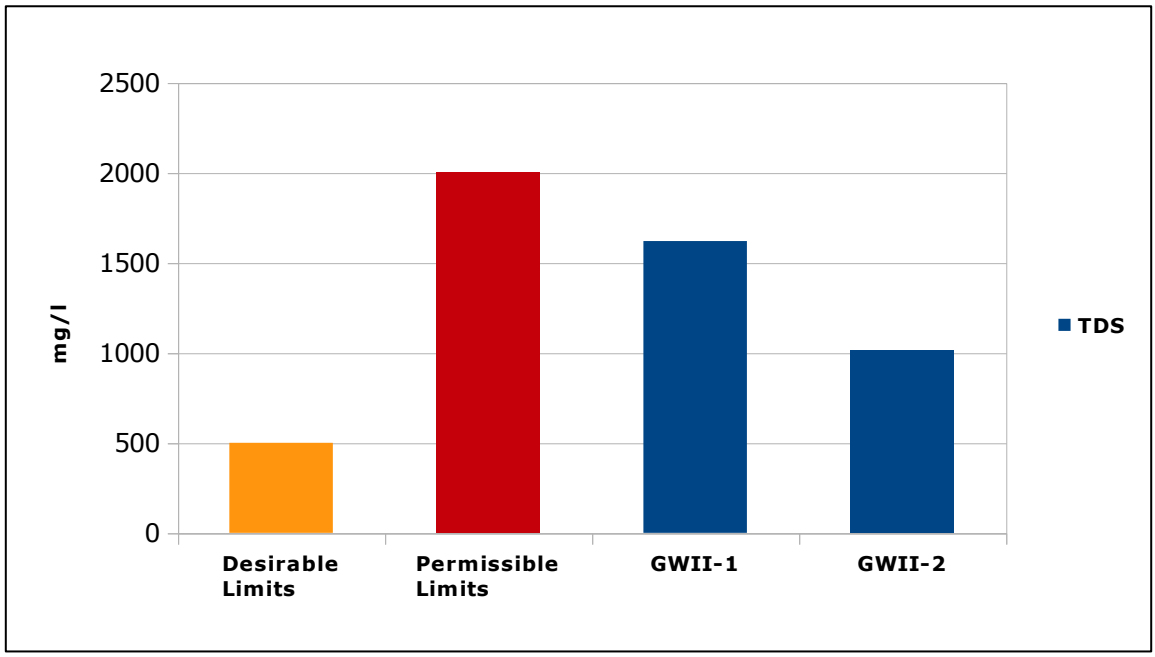



**Figure 6-83 Graph Showing the TDS Concentration in the Package –II**

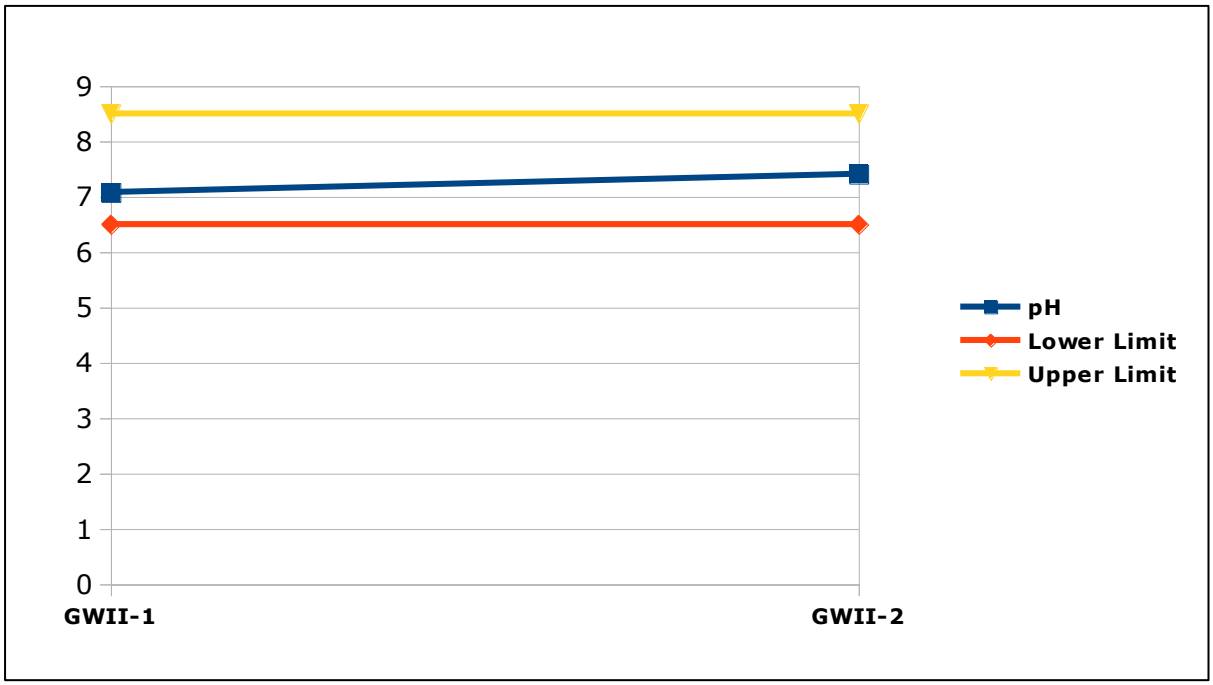



**Figure 6-84 Graph Showing the pH values in the Package –II**

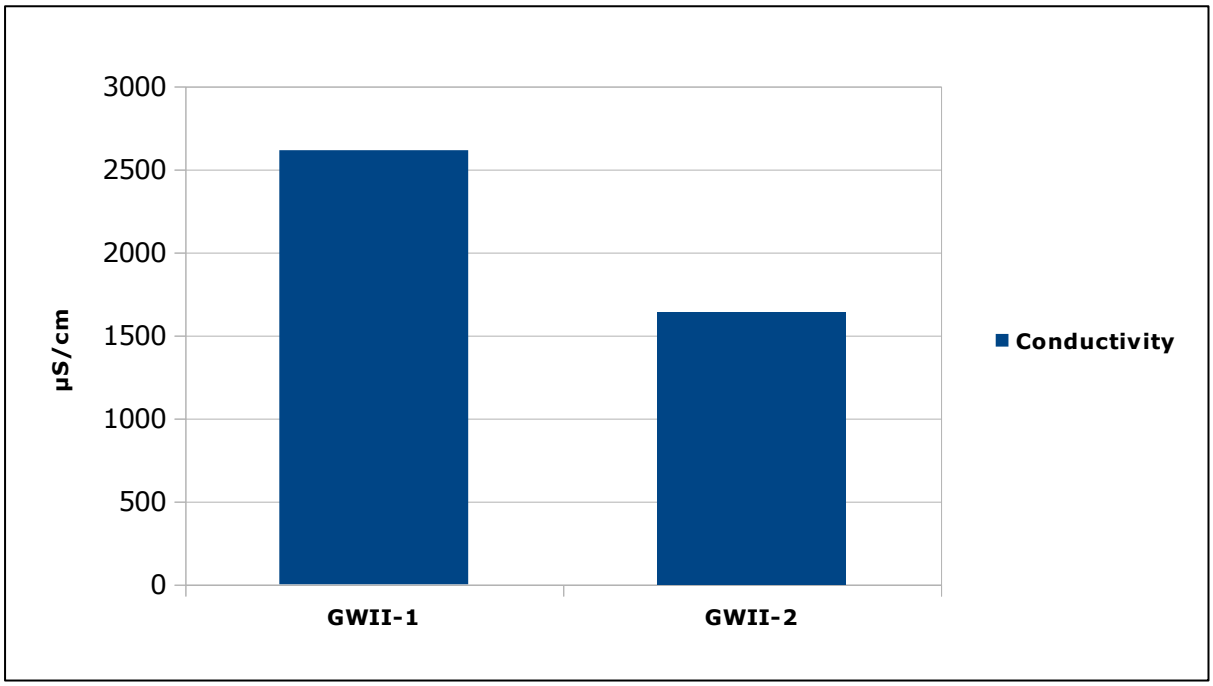



**Figure 6-85 Graph Showing the Conductivity values in the Package -II**

### 6.4.2.3 Ground water quality for Package -III

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use, hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -III (N4 & N14) of 10 Priority roads, four (04) samples were collected from the identified bore wells/dug wells and given in Table -6.33. Selection of samples considered as per the utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.34 and the locations are shown in Figure -6.86.

**Table 6-33 Ground Water sampling Locations for Package -III**

| Location Code | Bore Well Location |
|---|---|
| GWIII-1 | Venkatapalem |
| GWIII-2 | Krishnayapalem |
| GWIII-3 | Thulluru |
| GWIII-4 | Abbarajupalem |

**Figure 6-86 Ground Water Sample Collected at Abbarajupalem and Thullur**

**Table 6-34 Ground water quality analysis results for Package -III**

| S.No | Parameter | Units | IS:10500 | | GWIII-1 | GWIII-2 | GWIII-3 | GWIII-4 |
|---|---|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.78 | 7.42 | 7.78 | 7.28 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 | <05 | <05 |
| 3 | Taste | - | Agre | Agre | Agre | Agre | Agre | Agre |
| 4 | Odor | - | Agre | Agre | UO | UO | UO | UO |
| 5 | Conductivity | µS/cm | -- | -- | 1540 | 2218 | 2094 | 2688 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 2.10 | 2.40 | 2.10 | 2.30 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 954 | 1376 | 1348 | 1714 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 680 | 580 | 320 | 640 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 430 | 630 | 570 | 620 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 148 | 108 | 72 | 132 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 88.8 | 74.4 | 33 | 74.4 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 170 | 320 | 230 | 410 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 82.1 | 16.4 | 174.7 | 117.4 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 1.20 | 0.80 | 1.30 | 0.90 |
| 15 | Nitrates as $NO_3$ | mg/L | 45 | 100 | 8.8 | 6.3 | 12.6 | 14.5 |
| 16 | Sodium as Na | mg/L | -- | -- | 37.0 | 236.9 | 327.5 | 316.9 |
| 17 | Potassium as K | mg/L | -- | -- | 3.7 | 4.7 | 5.1 | 5.1 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.18 | 0.12 | 0.18 | 0.80 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.72 | 0.690 | 0.084 | 0.920 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 5.2 | 6.8 | 10.8 | 11.6 |
| 22 | Temperature | °C | 0.003 | NR | 26.8 | 26.2 | 26.8 | 26.6 |
| 23 | Total Suspended Solids | mg/L | 0.05 | NR | <0.1 | <0.1 | <0.1 | <01 |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 | <01 | <01 |
| 25 | Bio chemical oxygen Demand | mg/L | -- | -- | <01 | <01 | <01 | <01 |
| 26 | Phosphate as $po_4$ | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 | <0.1 | <0.1 |
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 |
| 29 | Residual sodium | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | carbonate | | | | | | | |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as cr-6 | mg/L | -- | -- | <0.05 | <0.05 | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.034 | 0.023 | 0.040 | 0.030 |
| 37 | Total Plate Count | MPN/ml | -- | -- | ND | ND | ND | ND |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | ND | ND | ND | ND |

**Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable**

**Data analysis:**

The ground water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

Data on physical characteristics indicated variations in pH ranged between 7.28 – 7.78 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.

**Data on chemical characteristics:**

The Total Hardness observed to be varying in all samples and is in the range of 320 to 680 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. How ever, the total hardness values exceeded the permissible limits at two sampling locations namely Venkatapalem and Abbarajupalem.

The Total Dissolved Solids observed to be high and ranged between 954 mg/l to 1714 mg/l as against the desirable limits of 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits of 2000 mg/l.

The chlorides ranged between 170.0-410.1 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.

The Nitrates and Sulphates values observed to be ranged between 6.3 – 14.5 mg/l and 16.4 – 174.7 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.

The Fluoride values found are in the range of 0.80 – 1.30 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples found to be within the permissible limit of 1.5mg/l.

Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the Package -III is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after treatment. The Concentrations of Nitrate, Chloride & Sulphate, Fluoride, Total hardness & Total Alkalinity, Total Dissolved Solids, pH and Conductivity in the study area are shown in the Figures -6.87, 6.88, 6.89, 6.90, 6.91, 6.92 & 6.93 respectively

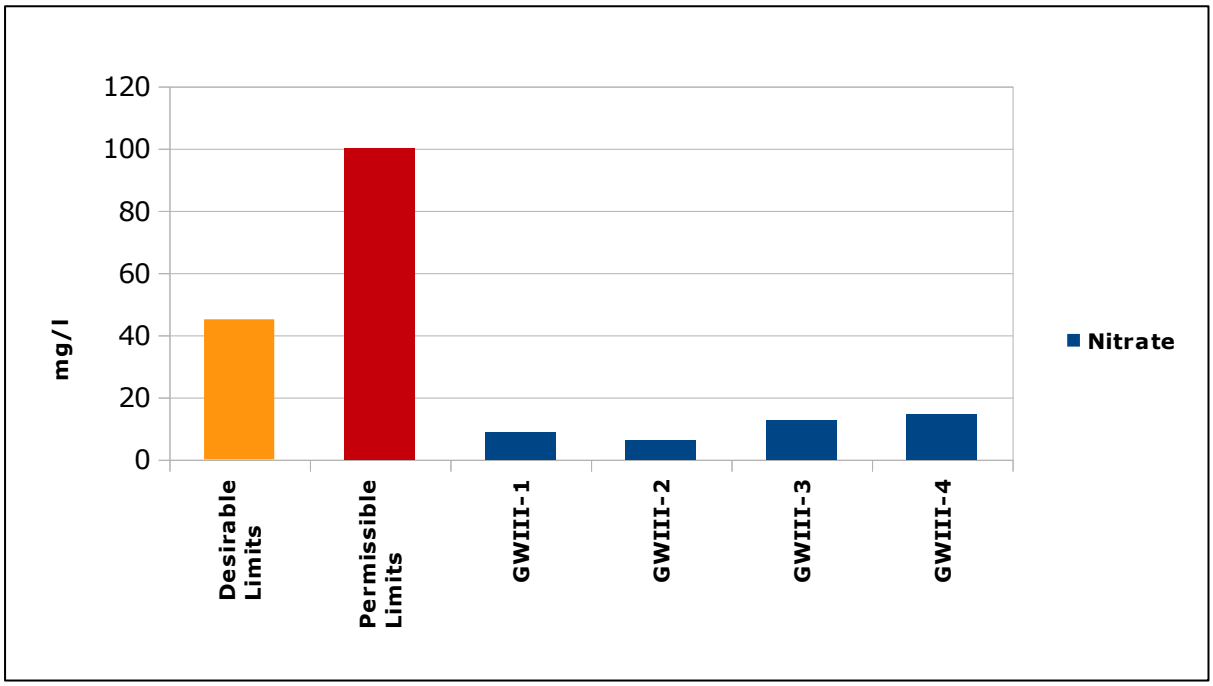



**Figure 6-87 Graph Showing the Nitrate Concentration in the Package –III**

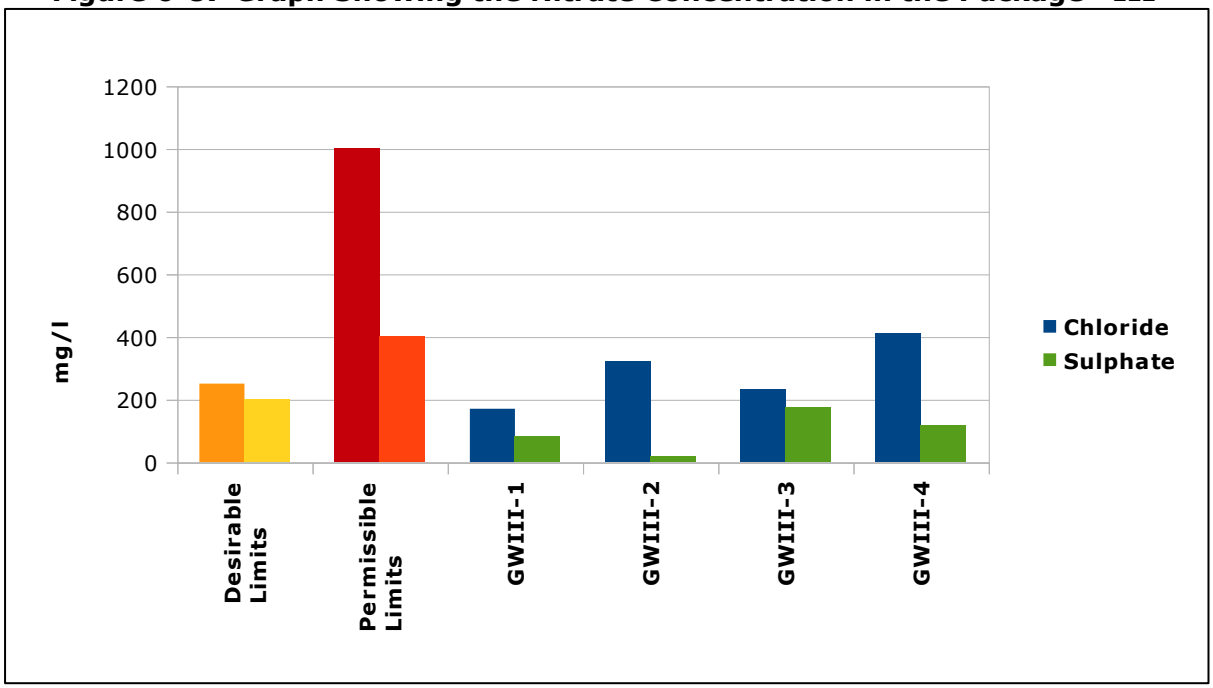



**Figure 6-88 Graph Showing the Chloride & Sulphate Concentrations in the Package -III**

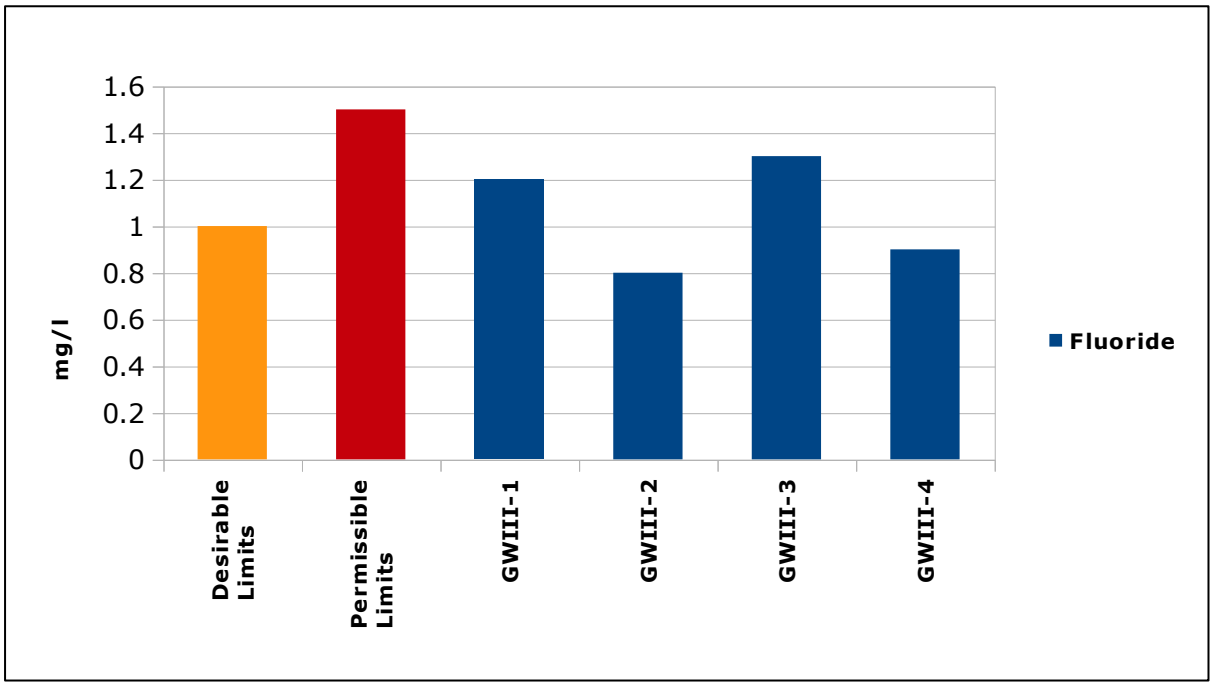



**Figure 6-89 Graph Showing the Fluorides Concentration in the Package –III**

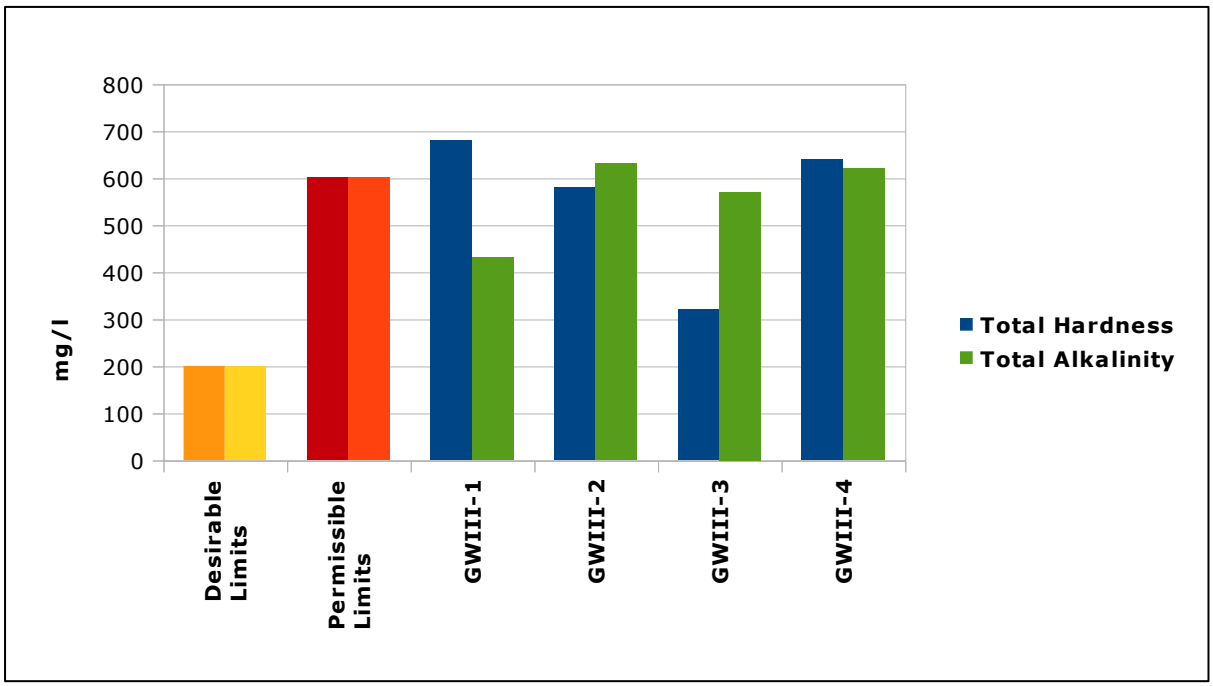



**Figure 6-90 Graph Showing the Total Hardness and Total Alkalinity Concentration in the Package –III**

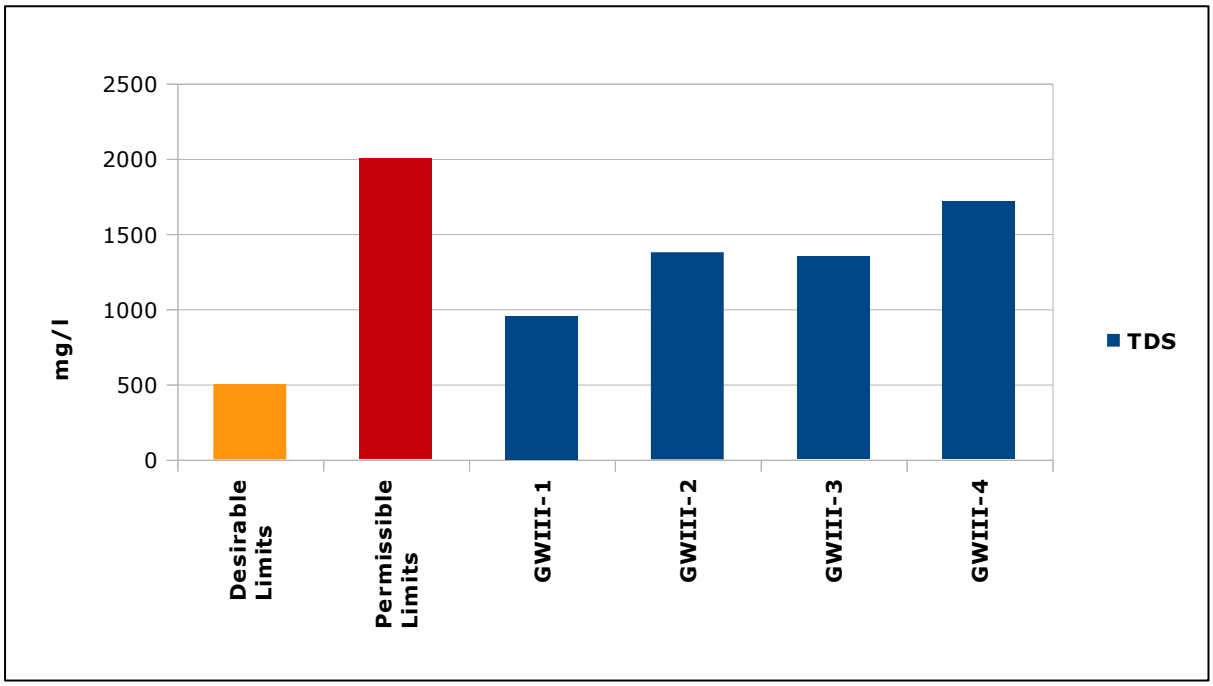



**Figure 6-91 Graph Showing the TDS Concentration in the Package –III**

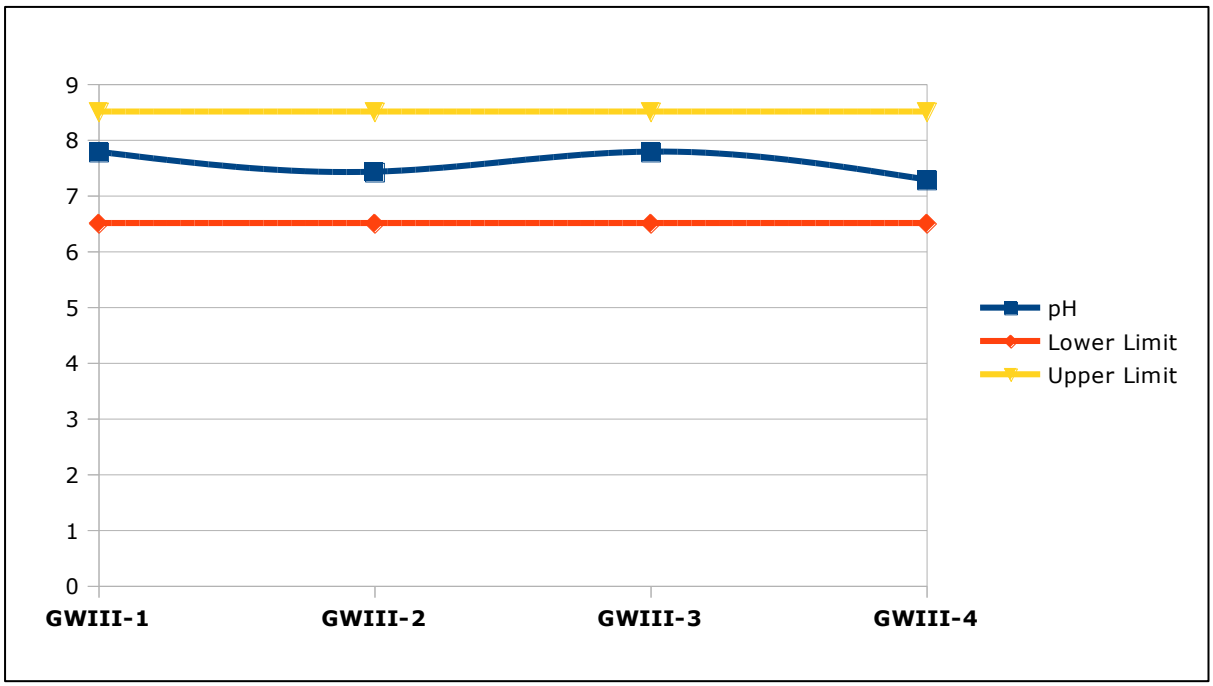



**Figure 6-92 Graph Showing the pH values in the Package –III**

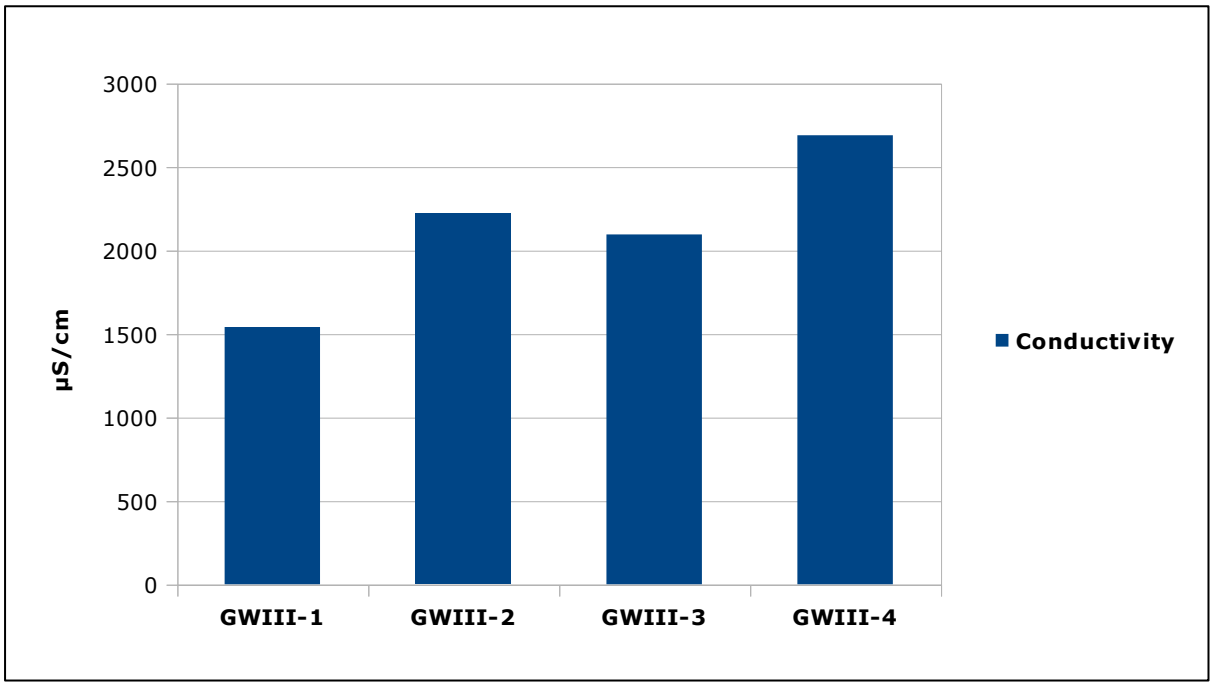



**Figure 6-93 Graph Showing the Conductivity values in the Package -III**

#### 6.4.2.4 Ground water quality for Package -IV

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use, hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -IV (E10, E14 & N16) of 10 Priority roads, six (06) samples were collected from the identified bore wells/dug wells and given in Table -6.35. Selection of samples considered as per the utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.36 and the locations are shown in Figure -6.94.

**Table 6-35 Ground Water sampling Locations for Package -IV**

| Location Code | Bore Well Location |
|---|---|
| GWIV-1 | Krishnayapalem |
| GWIV-2 | Penumaka |
| GWIV-3 | Navuluru |
| GWIV-4 | Bethapudi |
| GWIV-5 | Nekkallu |
| GWIV-6 | Dondapadu |

**Figure 6-94 Ground Water Sample Collected at Nekkallu and Dondapadu**

**Table 6-36 Ground water quality analysis results for Package -IV**

| S.No | Parameter | Units | IS:10500 | | GWIV-1 | GWIV-2 | GWIV-3 | GWIV-4 | GWIV-5 | GWIV-6 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | | | | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.42 | 7.12 | 7.16 | 7.40 | 7.18 | 7.58 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 | <05 | <05 | <05 | <05 |
| 3 | Taste | - | Agre | Agre | Agre | Agre | Agre | Agre | Agre | Agre |
| 4 | Odor | - | Agre | Agre | UO | UO | UO | UO | UO | UO |
| 5 | Conductivity | µS/cm | -- | -- | 2218 | 1870 | 4624 | 3964 | 2814 | 1452 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 2.40 | 2.00 | 3.10 | 2.90 | 2.80 | 1.8 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 1376 | 1118 | 2868 | 2458 | 1802 | 930 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 580 | 750 | 890 | 940 | 600 | 210 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 630 | 440 | 960 | 820 | 560 | 460 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 108 | 136 | 160 | 248 | 140 | 52.0 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 74.4 | 98.4 | 119.6 | 77 | 60 | 19.2 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 320 | 300 | 710 | 740 | 370 | 140 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 16.4 | 54.5 | 296.3 | 100.2 | 291.5 | 52.6 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 0.80 | 1.10 | 1.60 | 1.80 | 1.20 | 0.60 |
| 15 | Nitrates as $NO_3$ | mg/L | 45 | 100 | 6.3 | 8.8 | 27.1 | 8.8 | 13.3 | 8.2 |
| 16 | Sodium as Na | mg/L | -- | -- | 236.9 | 78.2 | 647.7 | 472.8 | 363.8 | 231.8 |
| 17 | Potassium as K | mg/L | -- | -- | 4.7 | 4.8 | 5.0 | 4.7 | 5.5 | 4.0 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.12 | 0.20 | 0.26 | 0.28 | 0.20 | 0.60 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.690 | 0.580 | 0.760 | 0.560 | 0.082 | 0.450 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 | <02 | <02 | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 6.8 | 6.4 | 20.4 | 10.2 | 12.0 | 6.6 |
| 22 | Temperature | $^oC$ | 0.003 | NR | 26.2 | 26.2 | 26.2 | 26.4 | 26.8 | 26.2 |
| 23 | Total Suspended Solids | mg/L | 0.05 | NR | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <01 |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 | <01 | <01 | <01 | <01 |
| 25 | Bio chemical oxygen Demand | mg/L | -- | -- | <01 | <01 | <01 | <01 | <01 | <01 |
| 26 | Phosphate as $po_4$ | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 29 | Residual sodium carbonate | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as $Cr^{6+}$ | mg/L | -- | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.023 | 0.030 | 0.092 | 0.058 | 0.050 | 0.024 |
| 37 | Total Plate Count | MPN/ml | -- | -- | ND | ND | ND | ND | ND | ND |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | ND | ND | ND | ND | ND | ND |

Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable

**Data analysis:**

The ground water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.12 – 7.58 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.
- Data on chemical characteristics:
    - The Total Hardness observed to be varying in all samples and is in the range of 210 to 940mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits. How ever, the total hardness values exceeded the permissible limits at three sampling locations namely Penumaka, Navuluru and Bethapudi.
    - The Total Dissolved Solids observed to be high and ranged between 930 mg/l to 2868 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l except at Navuluru and Bethapudi.
    - The chlorides ranged between 140.0-740.0 mg/l and are well within the desirable and permissible limits of 250 mg/l – 1000 mg/l.
    - The Nitrates and Sulphates values observed to be ranged between 6.3 – 27.1 mg/l and 16.4 – 296.3 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.
    - The Fluoride values found are in the range of 0.60 – 1.80 mg/l as against the desirable limit of 1.0 mg/l. The fluoride content in the samples collected at Navuluru and Bethapudi are found to be exceeding the permissible limit of 1.5mg/l.
- Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after treatment. The Concentrations of Nitrate, Chloride & Sulphate, Fluoride, Total hardness & Total Alkalinity, Total Dissolved Solids, pH and

Conductivity in the study area are shown in the Figures -6.95, 6.96, 6.97, 6.98, 6.99, 6.100 & 6.101 respectively.

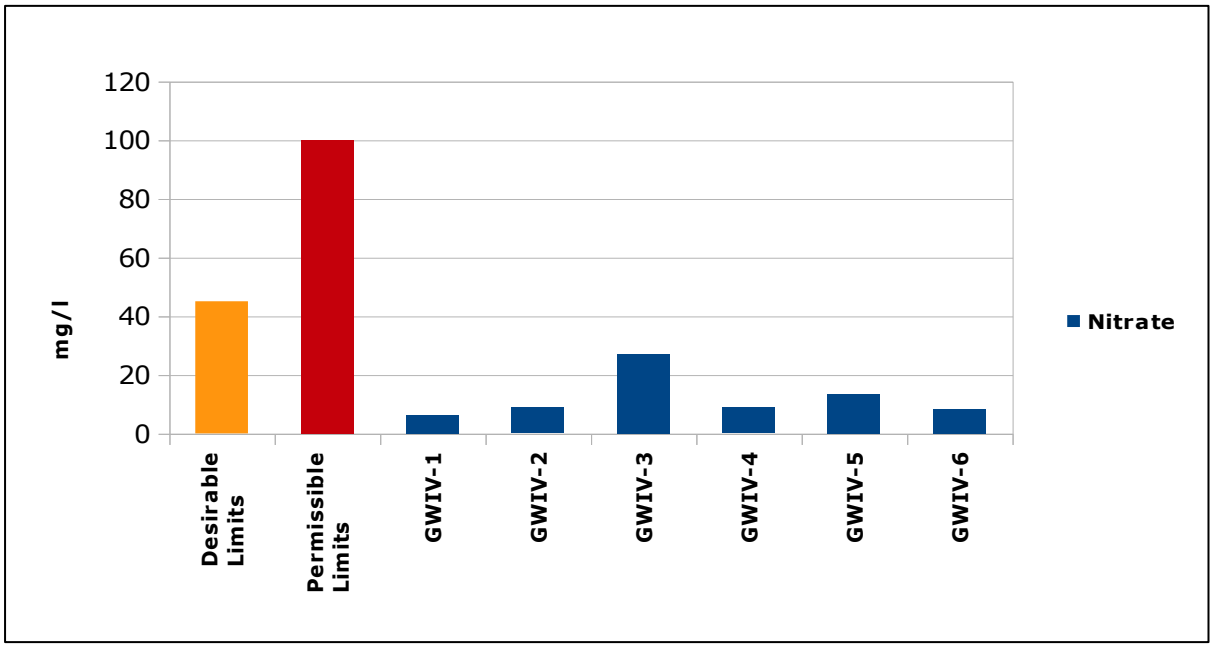



**Figure 6-95 Graph Showing the Nitrate Concentration in the Package –IV**

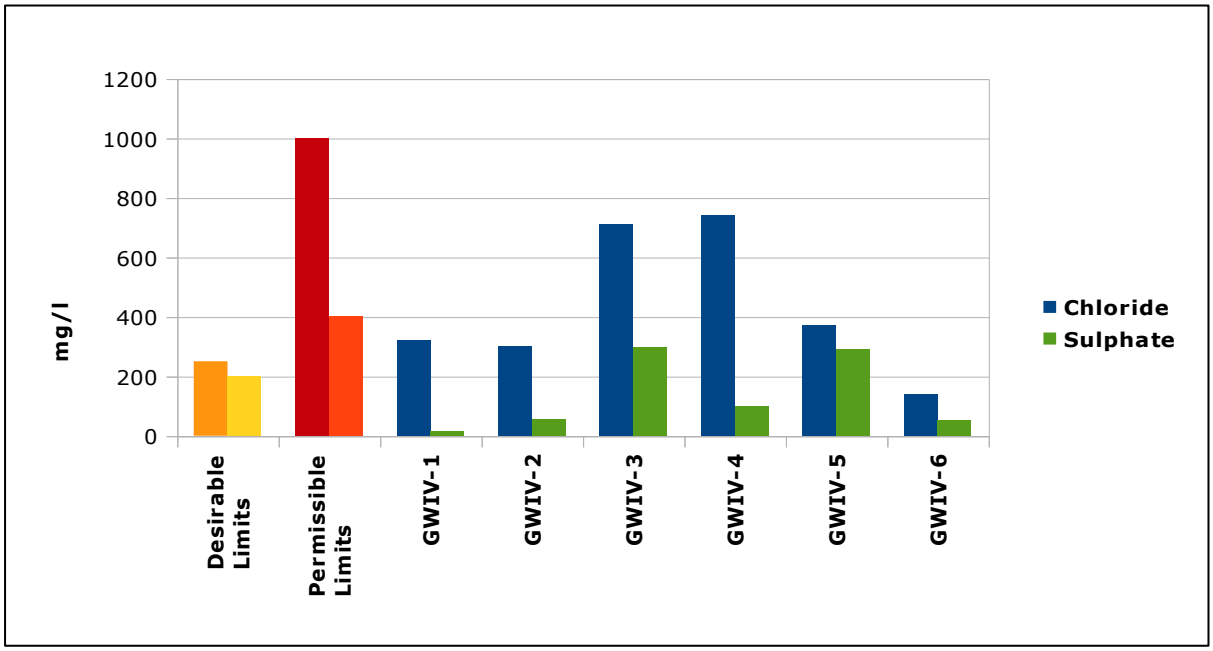



**Figure 6-96 Graph Showing the Chloride & Sulphate Concentrations in the Package –IV**

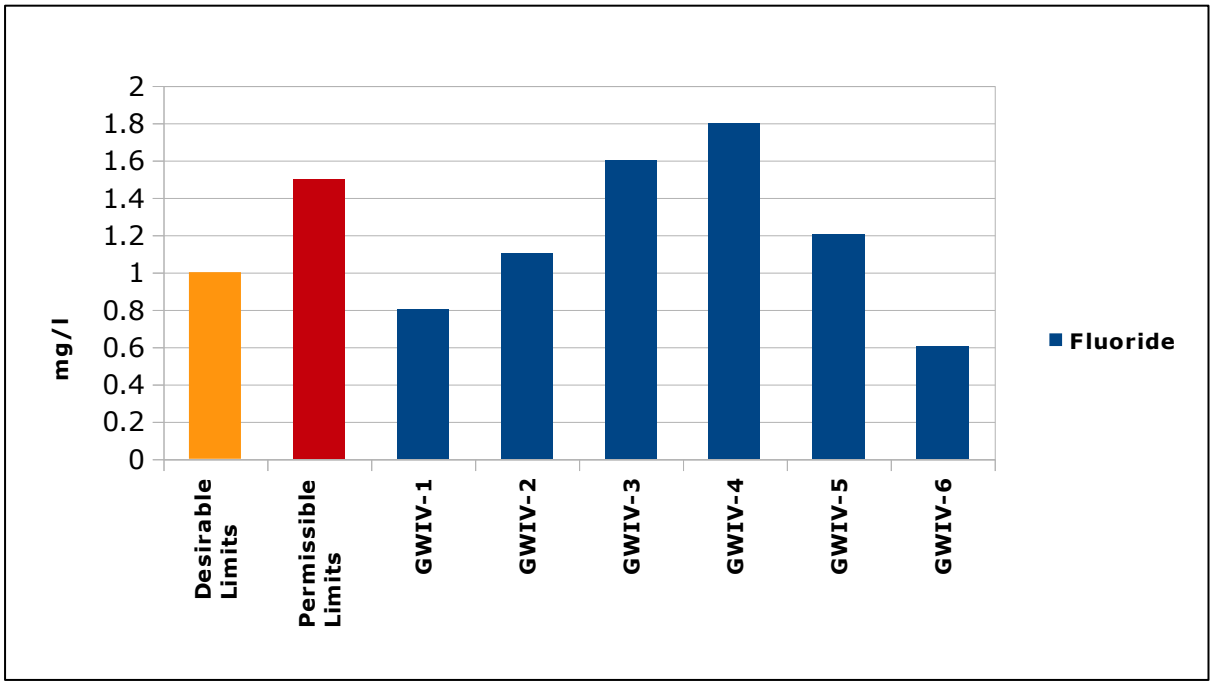



**Figure 6-97 Graph Showing the Fluorides Concentration in the Package –IV**

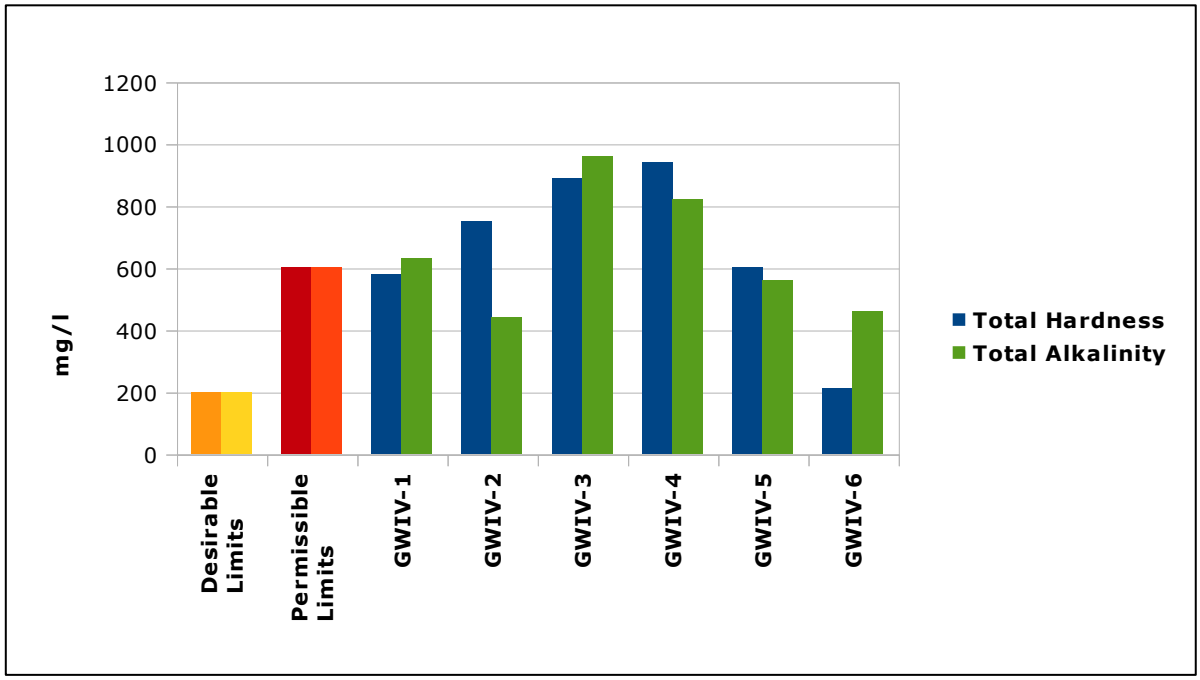



**Figure 6-98 Graph Showing the Total Hardness and Total Alkalinity Concentration in the Package –IV**

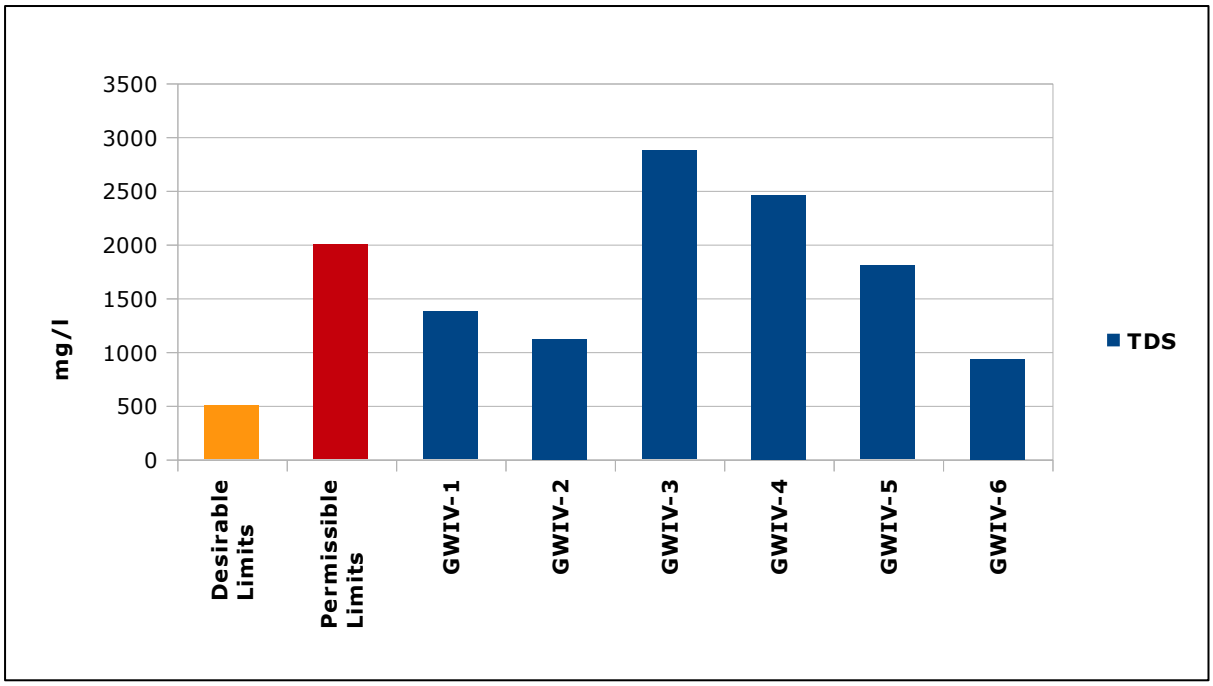



**Figure 6-99 Graph Showing the TDS Concentration in the Package –IV**

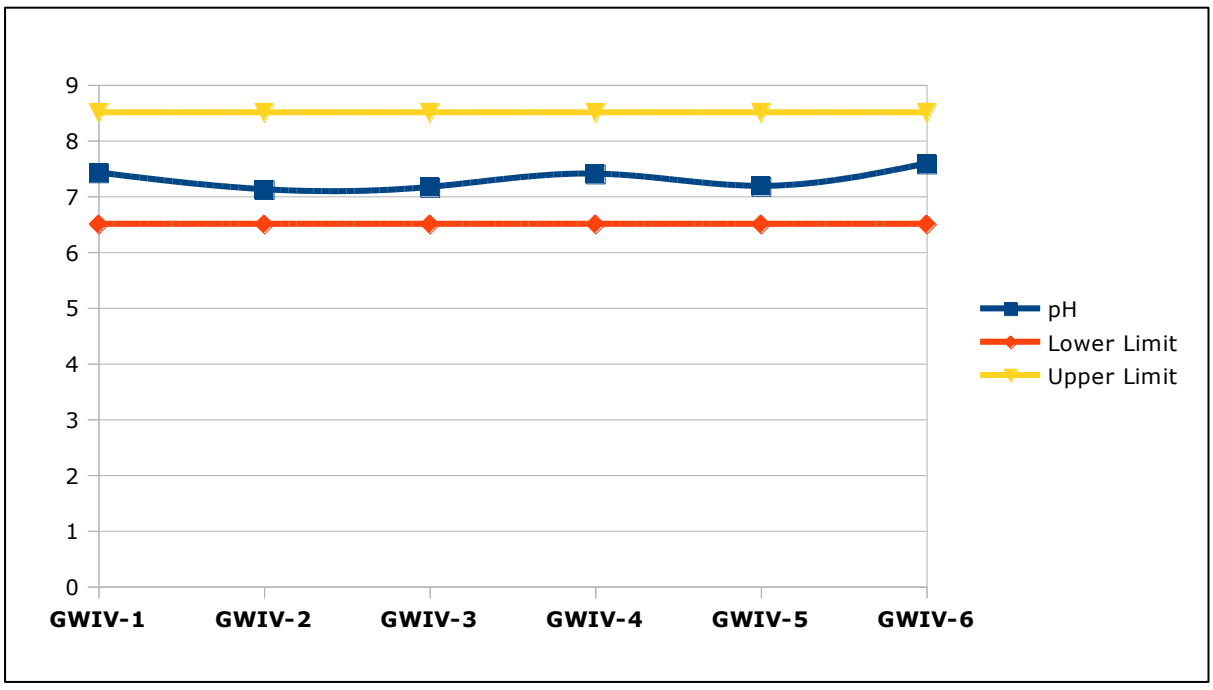



**Figure 6-100 Graph Showing the pH values in the Package –IV**

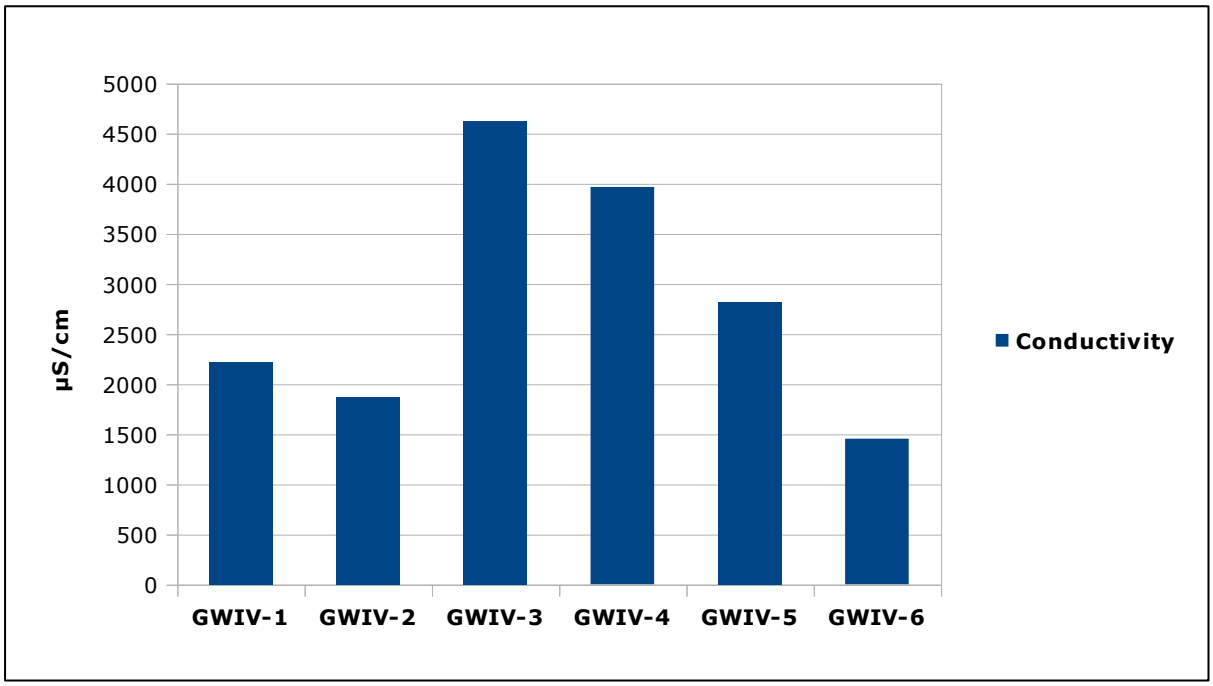



**Figure 6-101 Graph Showing the Conductivity values in the Package -IV**

### 6.4.2.5 Ground water quality for Package -V

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use, hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -V (E6) of 10 Priority roads, two (2) samples were collected from the identified bore wells/dug wells and given in Table -6.37. Selection of samples considered as per the utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.38.

**Table 6-37: Ground Water Sampling Locations in Package -V**

| Location Code | Bore Well Location |
|---|---|
| GWV-1 | Nelapadu |
| GWV-2 | Ananthavaram |

**Figure 6-102 : Ground Water Sample Collected at Ananthavaram and Nelapadu**

**Table 6-38 : Ground water quality analysis results for Package – V**

| S. No | Parameter | Units | IS:10500 | | GWV-1 | GWV-2 |
|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.46 | 7.33 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 |
| 3 | Taste | - | Agre | Agre | Agreeable | Agreeable |
| 4 | Odor | - | Agre | Agre | Unobjectionable | Unobjectionable |
| 5 | Conductivity | µS/cm | -- | -- | 4588 | 1616 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 3.2 | 1.8 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 2844 | 1024 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 1300 | 660 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 480 | 300 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 320 | 192 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 120 | 43.2 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 750 | 160 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 621.8 | 255.9 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 2.1 | 0.6 |
| 15 | Nitrates as $NO_3$ | mg/L | 45 | 100 | 28.9 | 19.4 |
| 16 | Sodium as Na | mg/L | -- | -- | 450.8 | 61.6 |
| 17 | Potassium as K | mg/L | -- | -- | 4.7 | 4.6 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.26 | 0.16 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.078 | 0.06 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 18.2 | 7.8 |
| 22 | Temperature | °C | 0.003 | NR | 26.2 | 26.5 |
| 23 | Total Suspended Solids | mg/L | 0.05 | NR | <0.1 | <0.1 |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 |
| 25 | Bio chemical oxygen | mg/L | -- | -- | <01 | <01 |

| S. No | Parameter | Units | IS:10500 | | GWV-1 | GWV-2 |
|---|---|---|---|---|---|---|
| | | | Desirable Limits | Permissible Limits | | |
| | Demand | | | | | |
| 26 | Phosphate as $PO_4$ | mg/L | -- | -- | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 |
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 |
| 29 | Residual sodium carbonate | mg/L | -- | -- | <0.02 | <0.02 |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 |
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 |
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as cr-6 | mg/L | -- | -- | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.05 | 0.034 |
| 37 | Total Plate Count | MPN/ml | -- | -- | ND | ND |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | ND | ND |

Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable

**Data analysis:**

The ground water collected from various sources are analyzed for Physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.33 - 7.46 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations
- Data on chemical characteristics:
    - The Total Hardness observed to be varying in all samples and is in the range of 660 - 1300 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the desirable limits and the permissible limits.
    - The Total Dissolved Solids are observed to be high and ranged between 1024 - 2488 mg/l as against the desirable limits 500 mg/l. Samples are exceeding the desirable limits but well within the permissible limits 2000 mg/l except at Ananthavaram.
    - The chlorides ranged between 160-750 mg/l. All samples are well within permissible limits of 1000 mg/l.
    - The Nitrates and Sulphates values observed to be ranged between 19.4-28.9 mg/l and 255.9-621.8 mg/l. Samples are exceeding the permissible limits for Sulphates.
    - The Fluoride values found are in the range of 0.6 – 2.1 mg/l as against the desirable limit of 1.0 mg/l. The samples are within the permissible limit of 1.5mg/l except at Nelapadu.
- Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after treatment. The Concentrations of Sulphate & Nitrate, Chloride, Total hardness & Total Alkalinity, pH, Conductivity Fluoride, Total Dissolved Solids in the Package -V are shown in the Figures -6.103, 6.104, 6.105, 6.106, 6.107, 6.108 & 6.109 respectively.

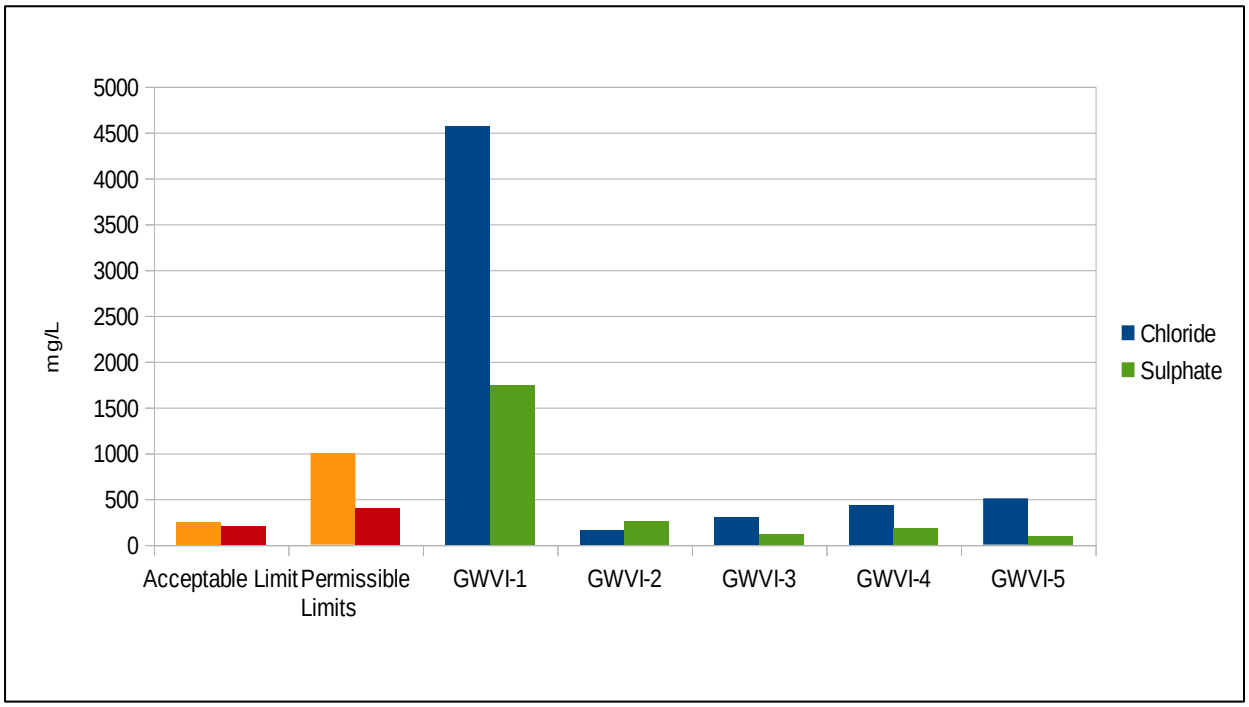



**Figure 6-103: Graph Showing the Sulphate and Chloride Concentrations in Package –V**

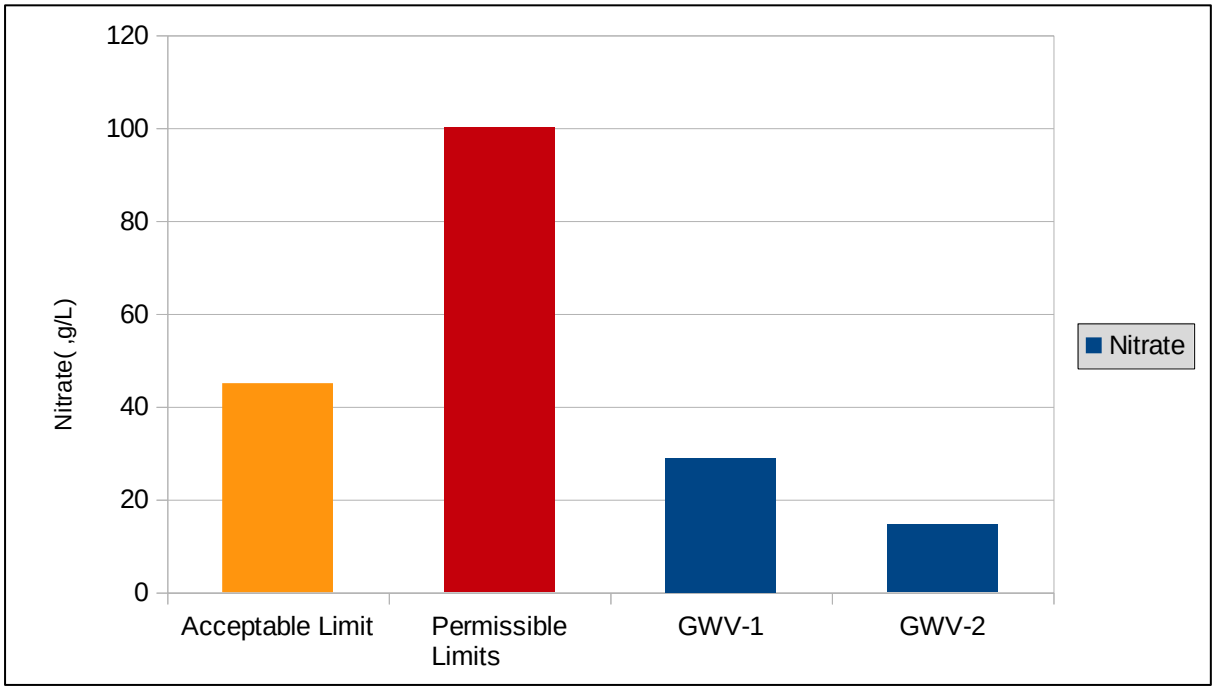



**Figure 6-104: Graph Showing the Nitrate Concentrations in Package -V**

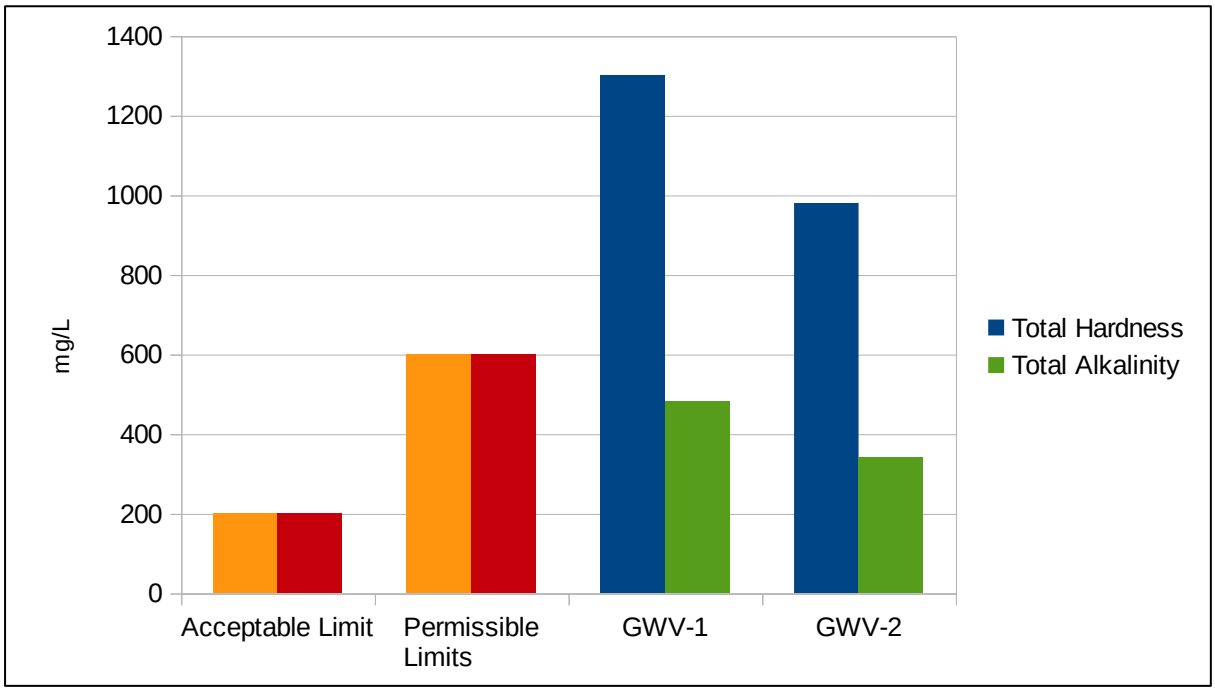



**Figure 6-105: Graph Showing the Hardness and Alkalinity values in the Package –V**

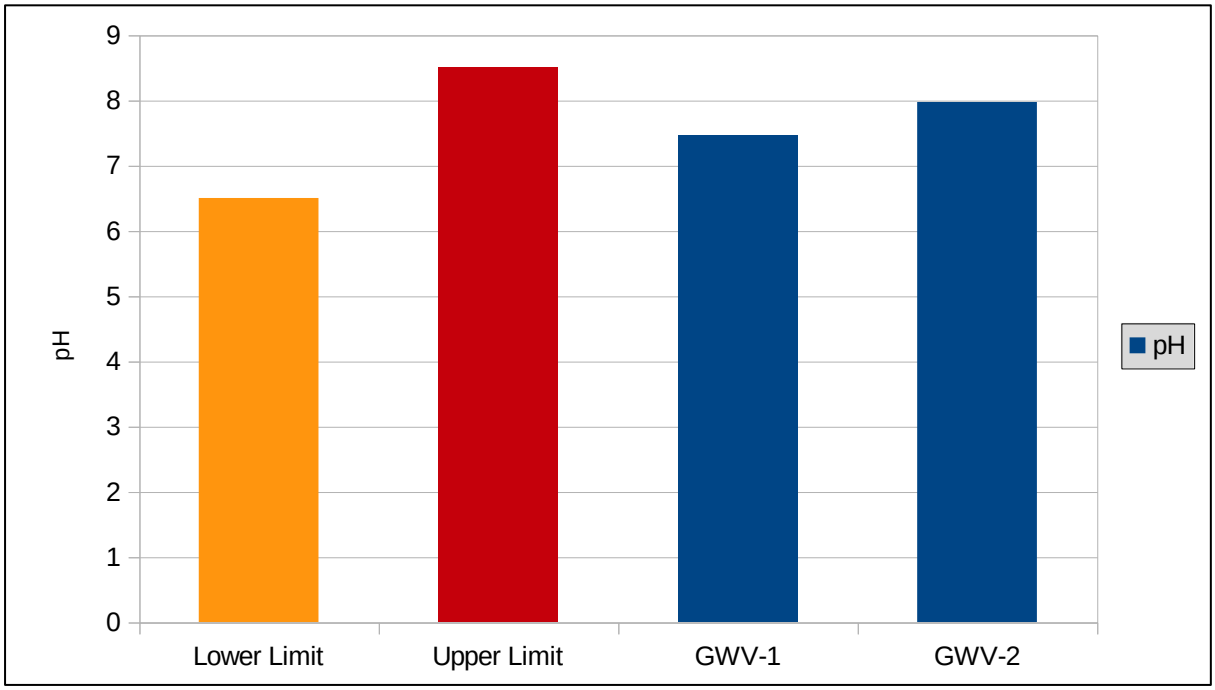



**Figure 6-106 : Graph Showing the pH values in the Package –V**

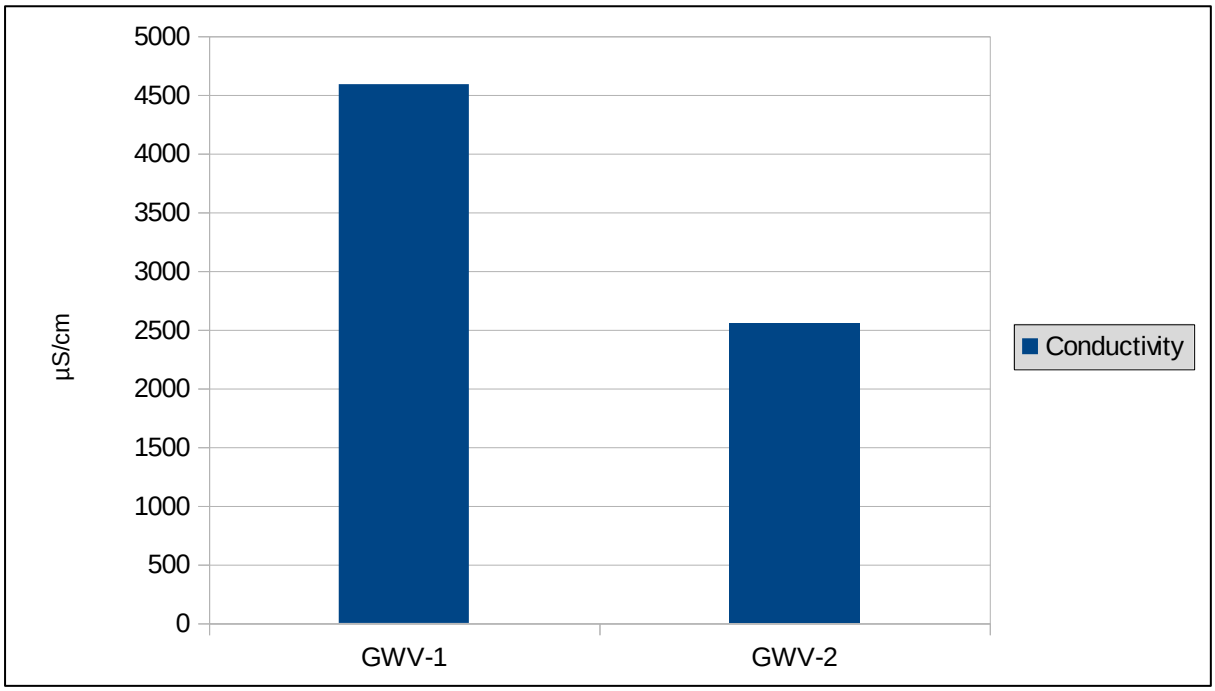



**Figure 6-107 : Graph Showing the Conductivity values in the Package -V**

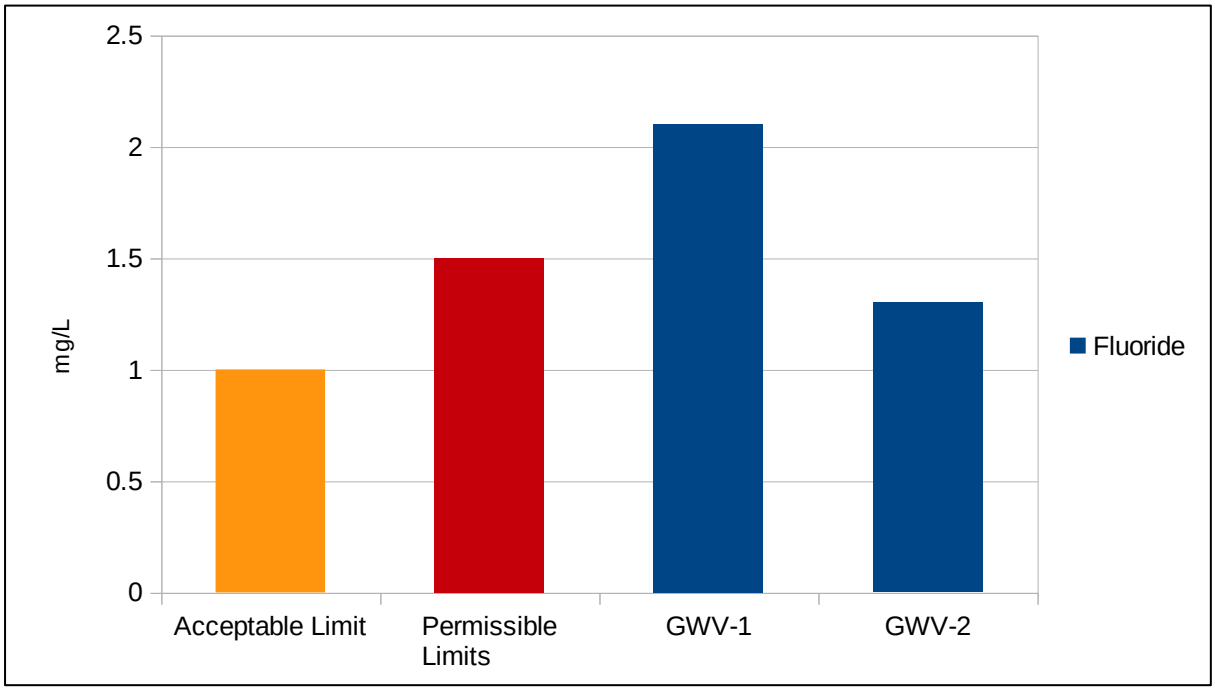



**Figure 6-108: Graph Showing the Fluoride values in the Package -V**

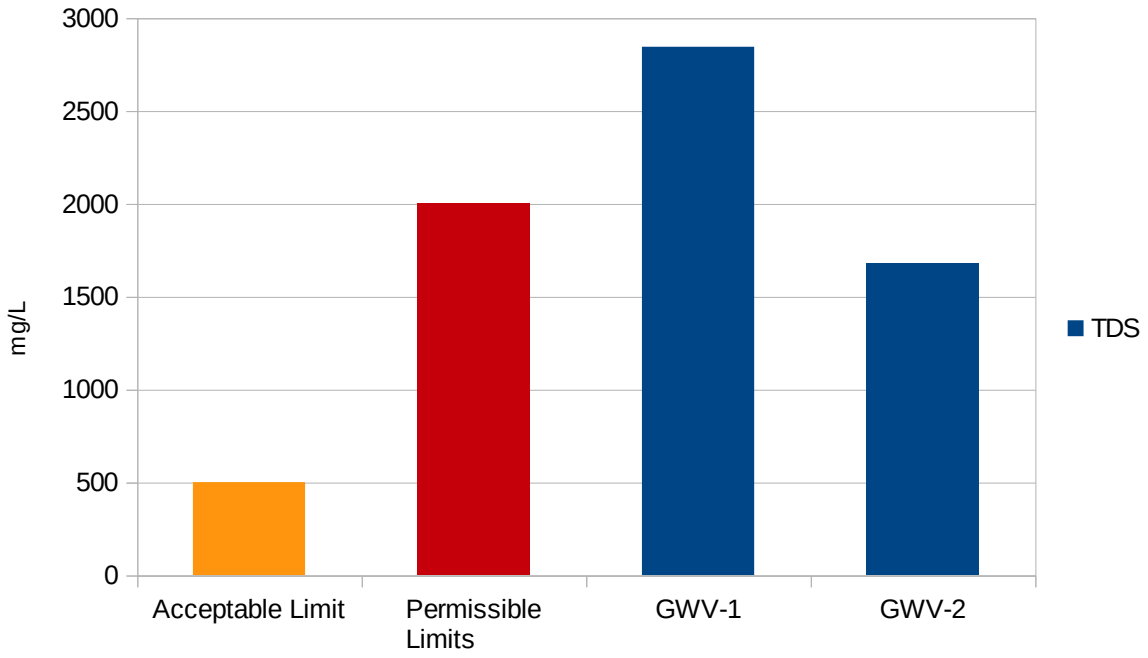



**Figure 6-109 : Graph Showing the TDS values in the Package -V**

### 6.4.2.6 Ground water quality for Package -VI

Ground Water is one of the main sources of water in the sub-project influence area for domestic, commercial and other irrigation use, hence the rate of extraction of ground water is at a moderate scale. For assessing the ground water quality in the Package -VI (N11, E12 ) of 10 Priority roads, five (05) samples were collected from the identified bore wells/dug wells and given in Table -6.39. Selection of samples considered as per the utilization of the people along the proposed road development projects. Mostly ground water is used for domestic, drinking, gardening, floor washing and industrial purposes. The ground water quality analysis results are given in Table -6.40.

**Table 6-39 : Ground Water Sampling Locations in Package -VI**

| Location Code | Bore Well Location |
|---|---|
| GWVI-1 | Ainavolu |
| GWVI-2 | Lingayapalem |
| GWVI-3 | Neerukonda |
| GWVI-4 | Kuragullu |
| GWVI-5 | Yerrabalem |

**Figure 6-110 : Ground Water Sample Collected at Neerukonda and Kuragullu**

**Table 6-40 : Ground water quality analysis results for Package - VI**

| S. No | Parameter | Units | IS:10500 | | GWVI-1 | GWVI-2 | GWVI-3 | GWVI-4 | GWVI-5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | Desirable | Permissible | | | | | |
| 1 | pH | - | 6.5 – 8.5 | NR | 7.2 | 7.33 | 7.15 | 7.2 | 7.82 |
| 2 | Color (Hazen units) | Hazen | 5 | 15 | <05 | <05 | <05 | <05 | <05 |
| 3 | Taste | - | Agre | Agre | Agreeable | Agreeable | Agreeable | Agreeable | Agreeable |
| 4 | Odor | - | Agre | Agre | Unobjectionable | Unobjectionable | Unobjectionable | Unobjectionable | Unobjectionable |
| 5 | Conductivity | µS/cm | -- | -- | 17694 | 1616 | 2150 | 2716 | 3607 |
| 6 | Turbidity (NTU) | NTU | 1 | 5 | 4.1 | 1.8 | 2 | 2.2 | 2.4 |
| 7 | Total Dissolve solids | mg/L | 500 | 2000 | 10970 | 1024 | 1334 | 1684 | 2236 |
| 8 | Total Hardness as $CaCO_3$ | mg/L | 200 | 600 | 2600 | 660 | 570 | 700 | 80 |
| 9 | Total Alkalinity | mg/L | 200 | 600 | 450 | 300 | 520 | 540 | 980 |
| 10 | Calcium as Ca | mg/L | 75 | 200 | 480 | 192 | 152 | 144 | 16 |
| 11 | Magnesium as Mg | mg/L | 30 | 100 | 136.8 | 43.2 | 45.6 | 81.6 | 9.6 |
| 12 | Chloride as Cl | mg/L | 250 | 1000 | 4570.8 | 160 | 300 | 435 | 505 |
| 13 | Sulphate as $SO_4$ | mg/L | 200 | 400 | 1743.2 | 255.9 | 112.1 | 178.6 | 94 |
| 14 | Fluorides as $F^-$ | mg/L | 1.0 | 1.5 | 2.9 | 0.6 | 0.8 | 1.1 | 1.8 |
| 15 | Nitrates as | mg/L | 45 | 100 | 84.4 | 19.4 | 19.2 | 11.3 | 8.2 |

| S. | Parameter | Units | IS:10500 | | GWVI-1 | GWVI-2 | GWVI-3 | GWVI-4 | GWVI-5 |
|---|---|---|---|---|---|---|---|---|---|
| | $NO_3$ | | | | | | | | |
| 16 | Sodium as Na | mg/L | -- | -- | 2865.3 | 61.6 | 226.3 | 296.5 | 787.7 |
| 17 | Potassium as K | mg/L | -- | -- | 6.2 | 4.6 | 4.3 | 4.7 | 3.5 |
| 18 | Iron as Fe | mg/L | 0.3 | NR | 0.32 | 0.16 | 0.18 | 0.2 | 0.22 |
| 19 | Zinc as Zn | mg/L | 5 | 15 | 0.09 | 0.06 | 0.54 | 0.64 | 0.82 |
| 20 | Chemical Oxygen Demand | mg/L | -- | -- | <02 | <02 | <02 | <02 | <02 |
| 21 | Silica as $SiO_2$ | mg/L | -- | -- | 36.4 | 7.8 | 9.4 | 10.6 | 10.5 |
| 22 | Temperature | °C | 0.003 | NR | 27.8 | 26.5 | 26.8 | 25.4 | 26.2 |
| 23 | Total Suspended Solids | mg/L | 0.05 | NR | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 24 | Dissolved Oxygen | mg/L | Absent | Absent | <01 | <01 | <01 | <01 | <01 |
| 25 | Bio chemical oxygen Demand | mg/L | -- | -- | <01 | <01 | <01 | <01 | <01 |
| 26 | Phosphate as $po_4$ | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 27 | Oil & grease | mg/L | -- | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 28 | Phenolic Compounds | mg/L | 0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 29 | Residual sodium carbonate | mg/L | -- | -- | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 30 | Lead as pb | mg/L | 0.01 | NR | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| 31 | Total Arsenic as As | mg/L | 0.01 | 0.05 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 32 | Mercury as Hg | mg/L | 0.001 | NR | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |

| S. | Parameter | Units | IS:10500 | | GWVI-1 | GWVI-2 | GWVI-3 | GWVI-4 | GWVI-5 |
|---|---|---|---|---|---|---|---|---|---|
| 33 | Cadmium as Cd | mg/L | 0.003 | NR | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| 34 | Hexavalent Chromium as cr-6 | mg/L | -- | -- | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 35 | Total Chromium | mg/L | 0.05 | NR | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| 36 | Copper as Cu | mg/L | 0.05 | 1.5 | 0.074 | 0.034 | 0.032 | 0.038 | 0.052 |
| 37 | Total Plate Count | MPN/ml | -- | -- | Not detected | Not detected | Not detected | Not detected | Not detected |
| 38 | Coli form Organisms | cfu/ ml | Absent | Absent | Not detected | Not detected | Not detected | Not detected | Not detected |

Note: Agre – Agreeable, UO – Unobjectionable, ND – Not Detected, NR – No Relaxation, NA – Not agreeable, Obj – Objectionable

**Data analysis:**

The ground water collected from various sources are analyzed for physico-chemical and bacteriological parameters. The results are compared with BIS: 10500 Drinking Water Standards. The detail description of sample analyzed is given as below:

- Data on physical characteristics indicated variations in pH ranged between 7.15 – 7.82 as against IS standard of 6.5 – 8.5. The physical Taste of water is agreeable and Odour of water found to be un-objectionable at all sampling locations.
- Data on chemical characteristics:
    - The Total Hardness observed to be varying in all samples and is in the range of 80-2600 mg/l as against the desirable limit of 200mg/l. Samples are exceeding the permissible limits at Ainavolu, Lingayapalem and Kurugallu.
    - The Total Dissolved Solids observed to be high and ranged between 1024-10970 mg/l as against the desirable limits 500 mg/l. Samples are well within the permissible limits of 2000 mg/l except at Ainavolu and Yerrabalem . TDS is found to be high in all locations.
    - The chlorides ranged between mg/l and are within permissible limits of 250 mg/l – 1000 mg/l except at Mandadam
    - The Nitrates and Sulphates values observed to be ranged between 7.6-58.6 mg/l and 21.4-254.3 mg/l. Samples are not exceeding the permissible limits for both Nitrates and Sulphates.
    - The Fluoride values found are in the range of 0.8-1.80 mg/l as against the desirable limit of 1.0 mg/l. Samples are well within the permissible limit of 1.5 mg/l except at Bethapudi and yerrabalem.
- Data on trace metal concentration found to be consistent in all the analyzed samples and very well within permissible limit.

The ground water quality in the study area is satisfactory as compared with BIS: 10500 standards. The water can be used for domestic, commercial and agriculture purposes. It can also be used for drinking after treatment. The Concentrations of Sulphate & Nitrate, Chloride, Total hardness & Total Alkalinity, pH, Conductivity Fluoride, Total Dissolved Solids in the Package -VI are shown in the Figures -6.111, 6.112, 6.113, 6.114, 6.115, 6.116 & 6.117 respectively.

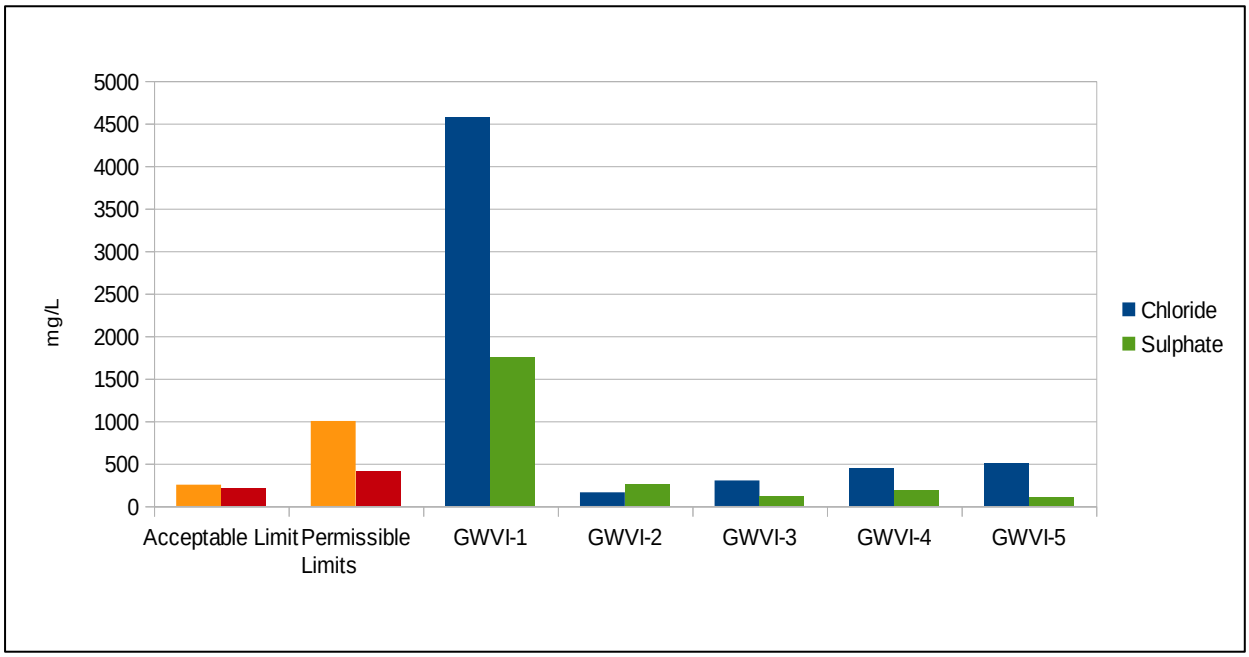



**Figure 6-111: Graph Showing the Sulphates and Chloride Concentrations in Package –VI**

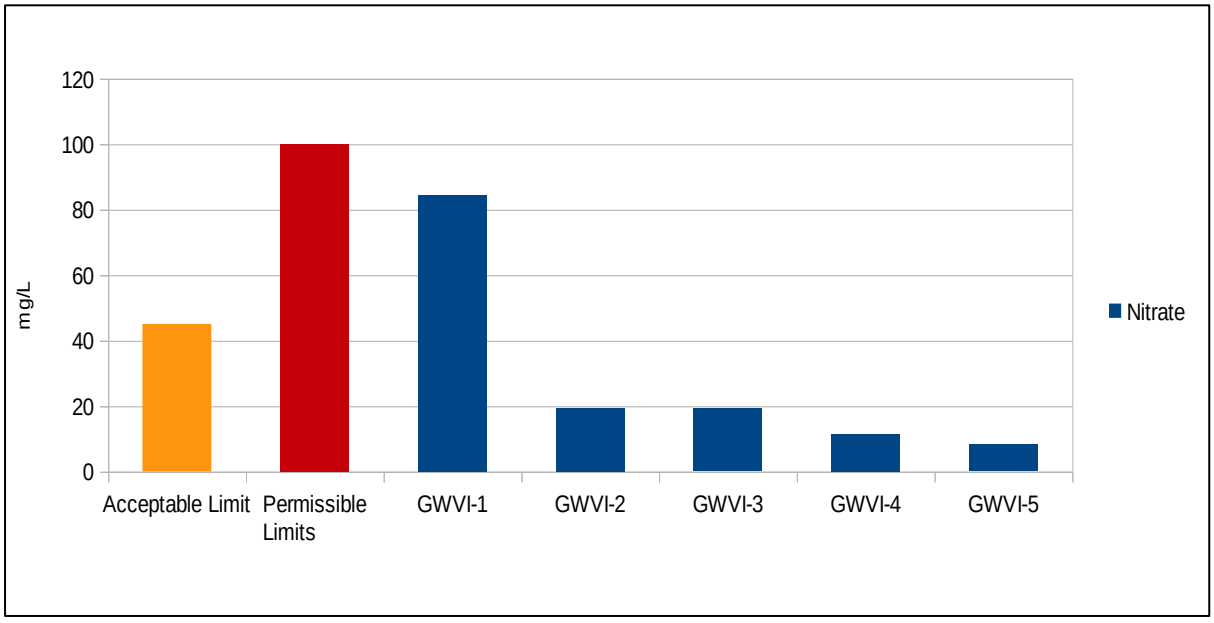



**Figure 6-112: Graph Showing the Nitrate Concentrations in Package -VI**

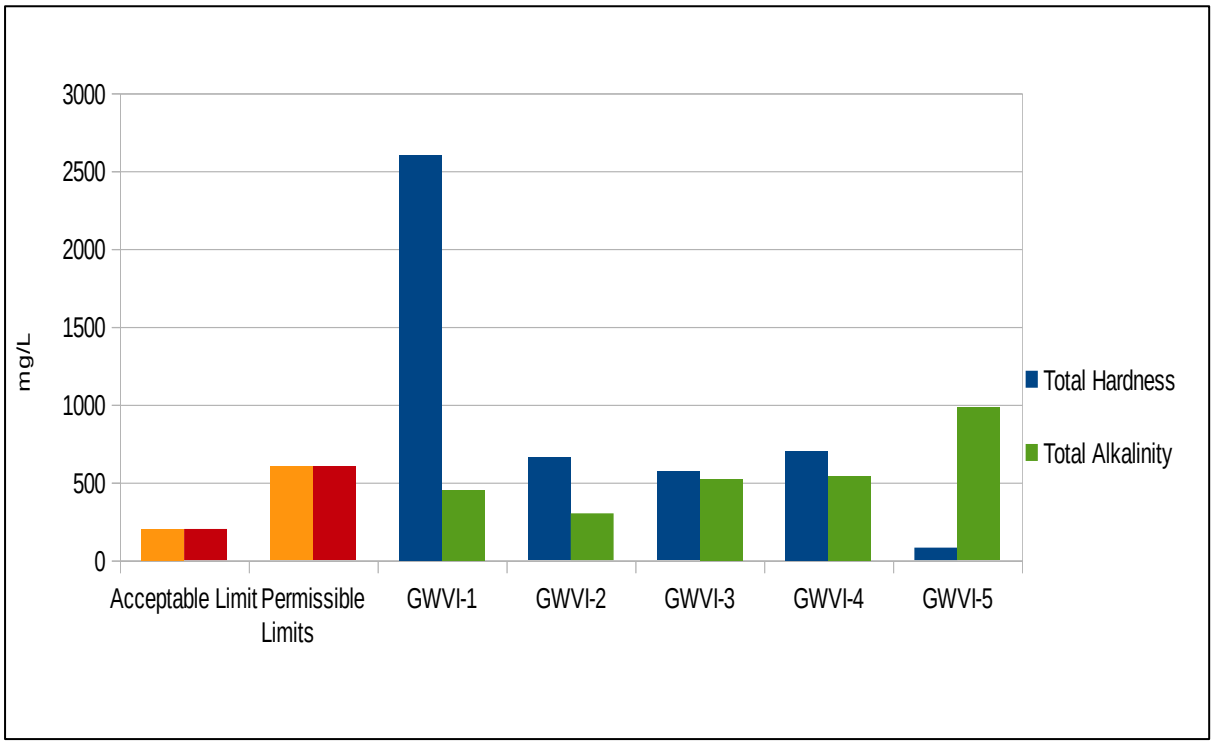



**Figure 6-113: Graph Showing the Hardness and Alkalinity values in the Package -VI**

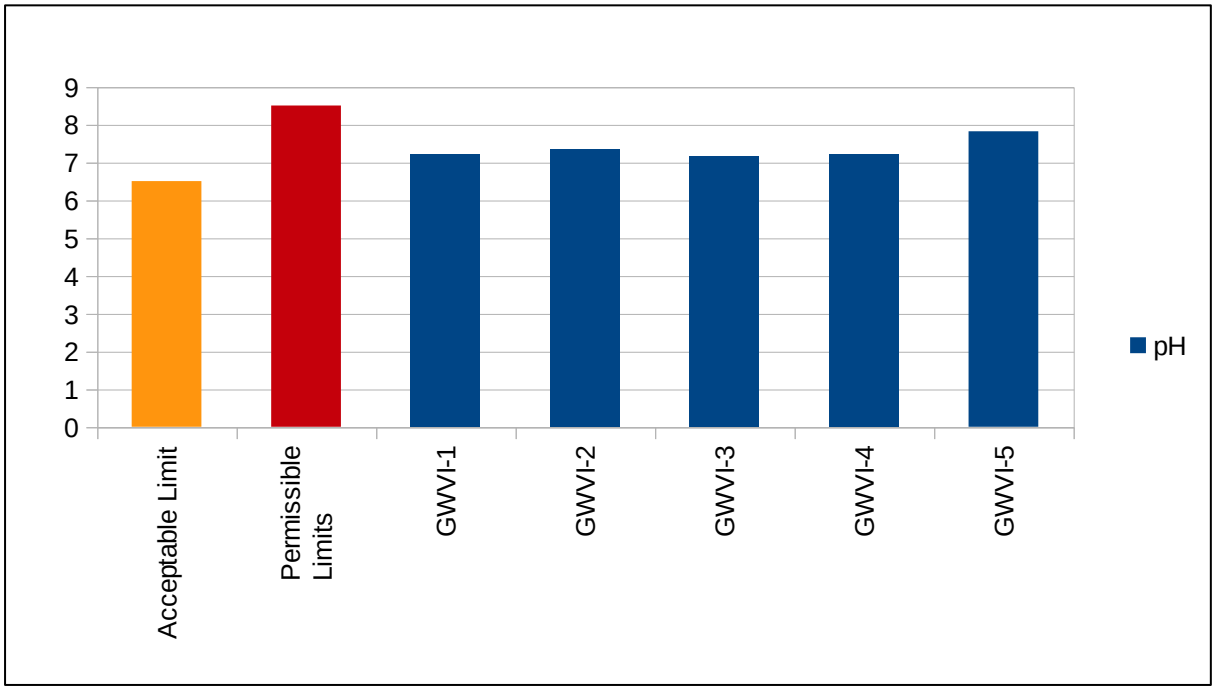



**Figure 6-114 : Graph Showing the pH values in the Package –VI**

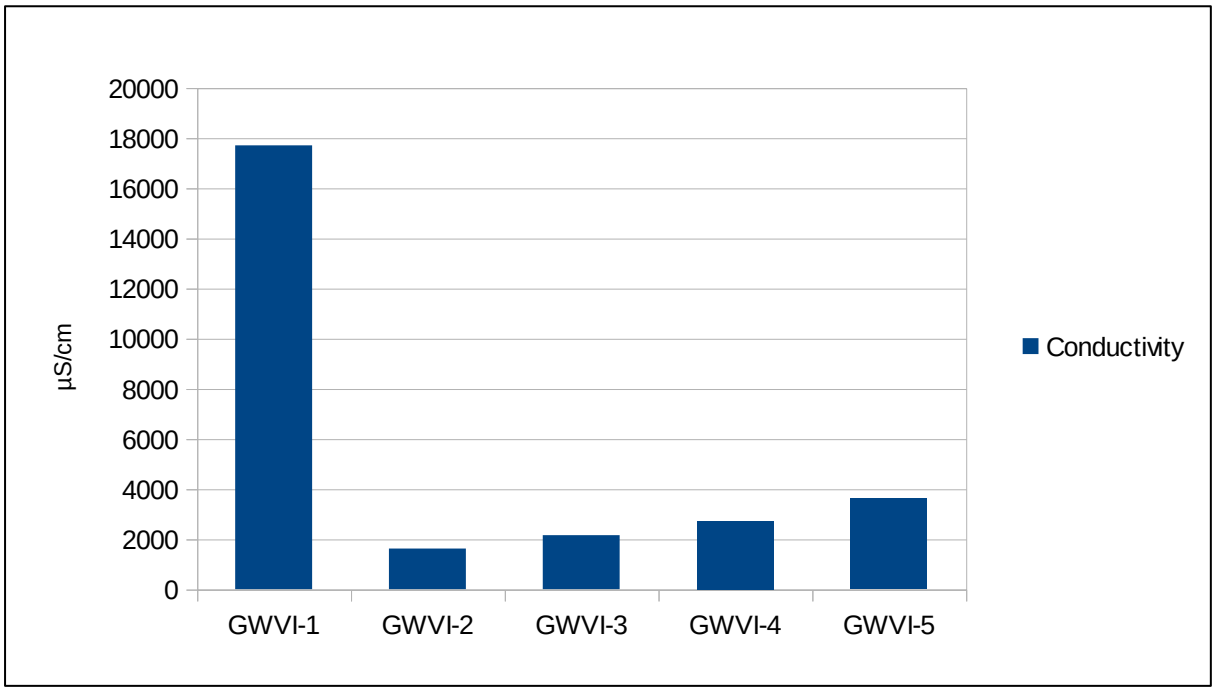



**Figure 6-115 : Graph Showing the Conductivity values in the Package -VI**

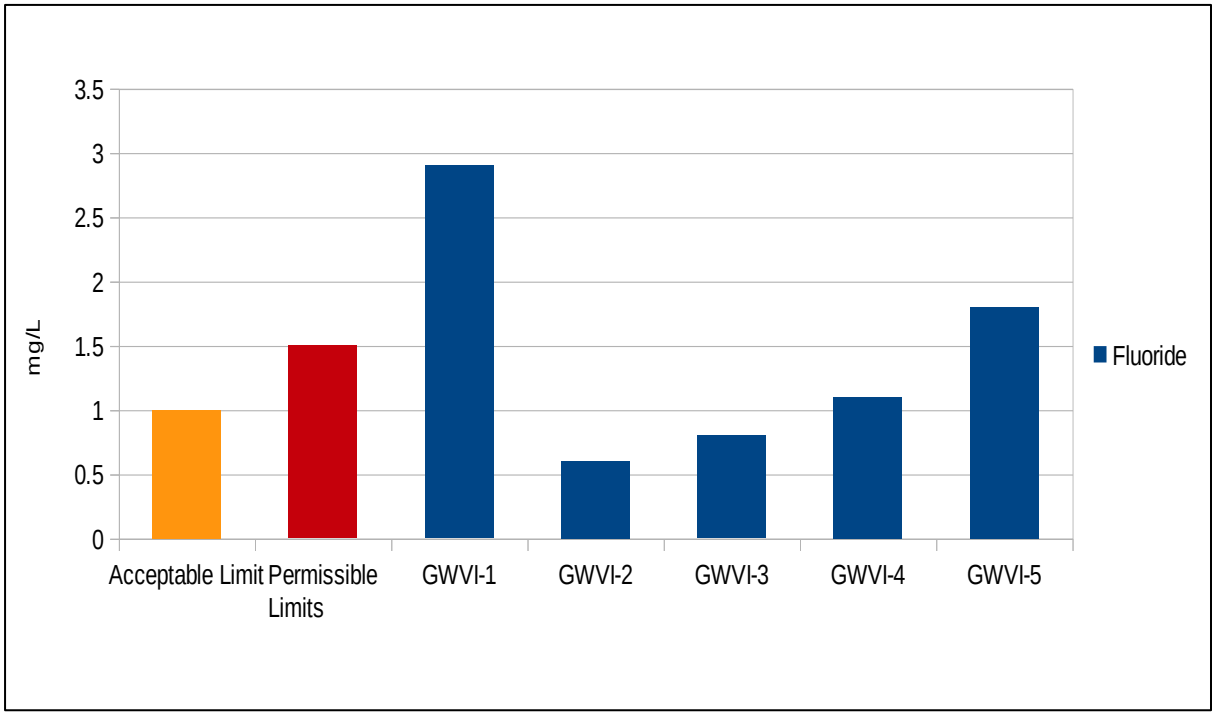



**Figure 6-116: Graph Showing the Fluoride values in the Package –VI**

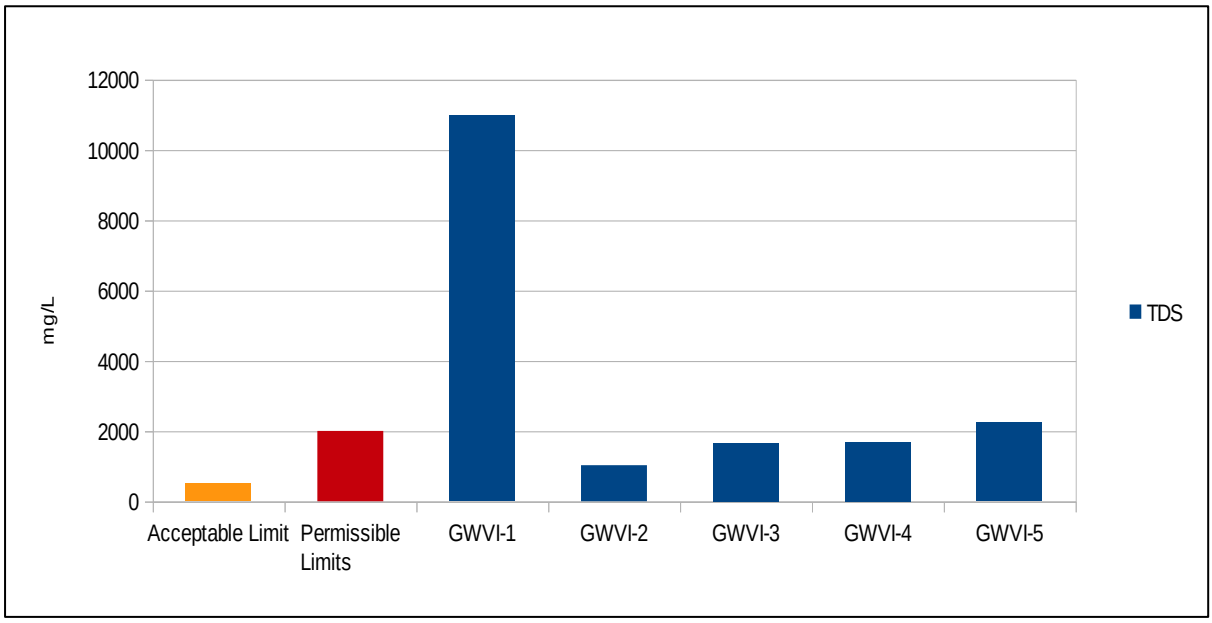



**Figure 6-117 : Graph Showing the TDS values in the Package -VI**

## 6.5 Noise Environment

### 6.5.1 Noise Environment for Package -I

#### 6.5.1.1 Primary Data

In view of the proposed road project, field monitoring was carried out at two (02) locations in Package -I (E8) as shown in Table -6.41. The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table - 6.42 and are show in Figure - 6.118.

**Table 6-41 Ambient Noise Monitoring Locations in Package -I**

| Location Code | Location Name |
|---|---|
| NI-1 | Nekkallu |
| NI-2 | Sakhamuru |

**Figure 6-118 Ambient Noise quality sampling at Nekkallu and Sakhamuru**

**Table 6-42 Noise Quality Status in the Package -I**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards & WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NI-1 | Nekkallu | Residential | 53.5 | 46.3 | 55 & 45 |
| NI-2 | Sakhamuru | Residential | 54.1 | 45.5 | 55 & 45 |

Note: Day monitoring is from 6:00 am to 9:00 pm and Night monitoring is from 9:00 pm to 6:00 am

**Data analysis**

**Residential Category:**

There are two residential locations i.e., Nekkallu and Sakhamuru monitored in the Package -I. The day and night noise levels are observed to be in the range of 53.5 to 54.1 dB (A) & 45.5 to 46.3 dB(A) as against the CPCB Standard/WB-EHS Guidelines of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the limits in all monitored locations. The Noise quality levels of the study are shown in the Figure -6.119.

**Noise Quality levels in Residential Category of Package -I**

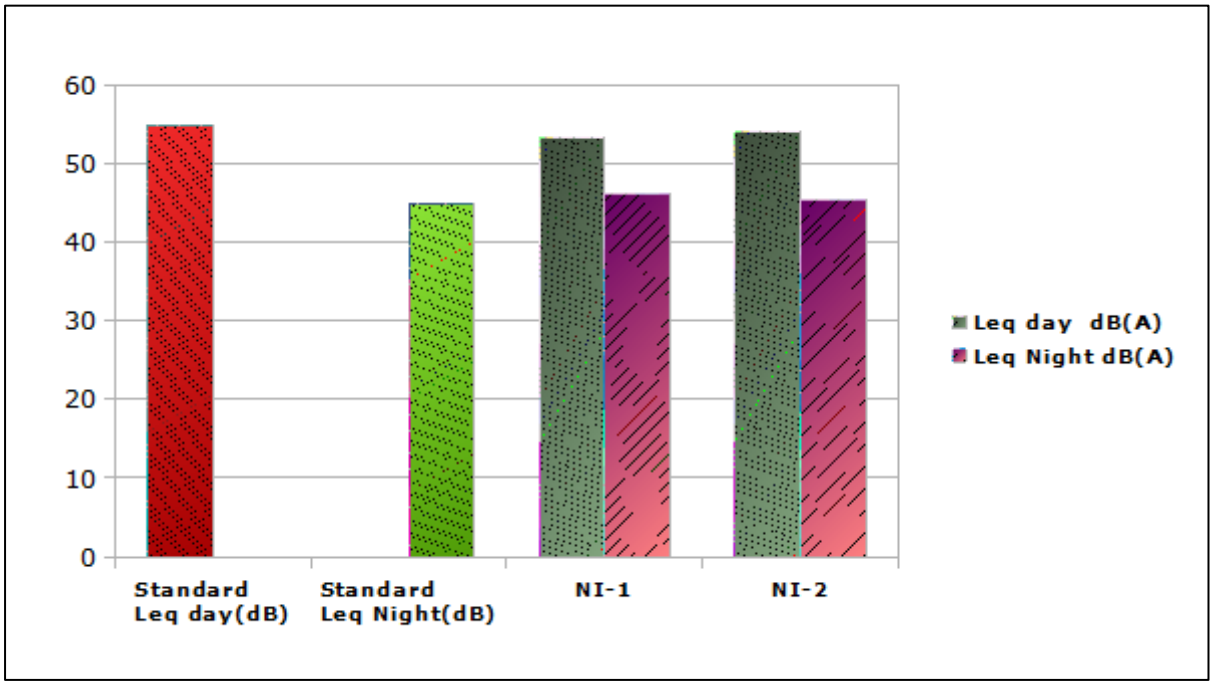



**Figure 6-119 Noise Quality levels in Residential Category of Package –I**

### 6.5.1.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons for Nekkallu and Sakhamuru are as follows for Package -I.

The day and night noise levels are observed to be in the range of 53.9 to 58.7 dB (A) & 40.0 to 54.6 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day & night noise levels are exceeding the limits in Sakhamuru because of temporal local agricultural activity at Nekkallu in summer season unlike post-mosoon season of primary data.

### 6.5.2 Noise Environment for Package -II
### 6.5.2.1 Primary Data

In view of the proposed road project, field monitoring was carried out at two (02) locations in Package -II as shown in Table -6.43. The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table -6-44 and are show in Figure -6.120.

**Table 6-43 Ambient Noise Monitoring Locations for Package -II**

| Location Code | Location Name |
|---|---|
| NII-1 | Malkapuram |
| NII-2 | Velagapudi |

**Figure 6-120 Ambient Noise quality sampling at Malkapuram and Velagapudi**

**Table 6-44 Noise Quality Status in the Package -II**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards & WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NII-1 | Malkapuram | Residential | 53.0 | 54.3 | 55 & 45 |
| NII-2 | Velagapudi | Residential | 43.8 | 45.7 | 55 & 45 |

Note: Day monitoring is from 6:00 am to 9:00 pm and Night monitoring is from 9:00 pm to 6:00 am

**Data analysis**

**Residential Category:**

There are two residential locations i.e., Malkapuram and Velagapudi monitored in the Package -II. The day and night noise levels are observed to be in the range of 43.8 to 53.0 dB (A) & 45.7 to 54.3 dB(A) as against the CPCB Standards/WB-EHS Guidelines of 55 & 45 dB(A) respectively. The day noise levels are found to be well within the limits in all monitored locations. Night time noise levels are slightly higher. The Noise quality levels of the study are shown in the Figure -6.121.

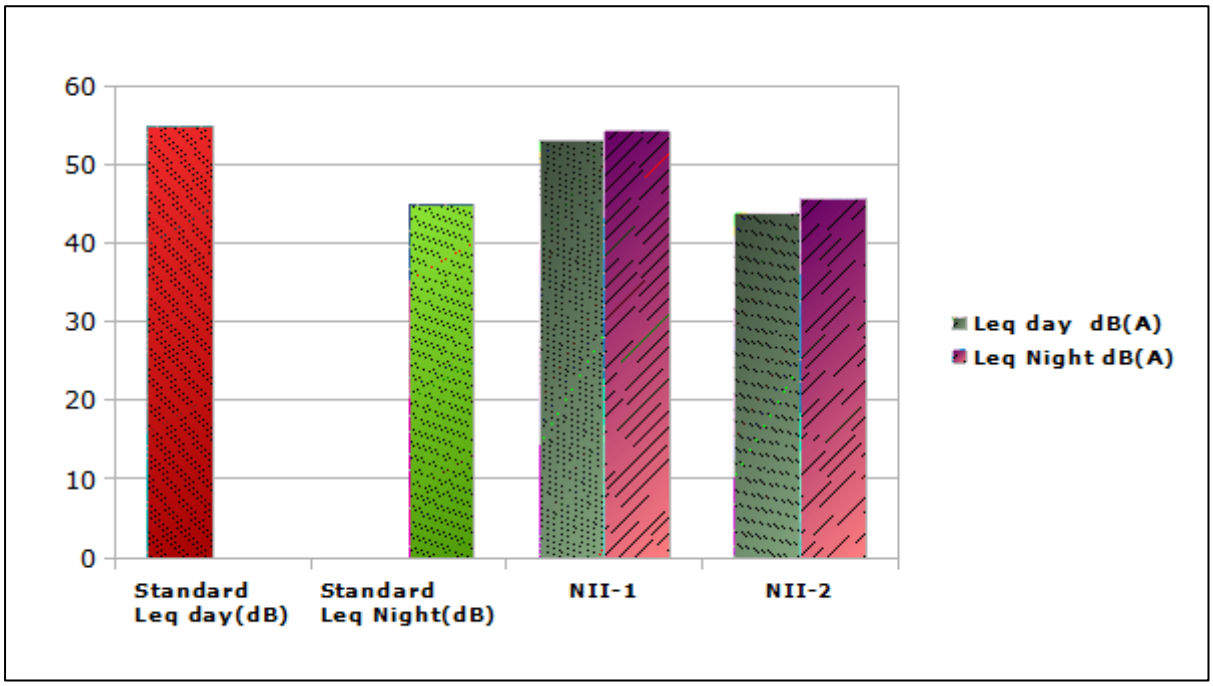



**Figure 6-121 Noise Quality levels in Residential Category of Package –II**

### 6.5.3 Noise Environment for Package -III

#### 6.5.3.1 Primary Data

In view of the proposed road project, field monitoring was carried out at four (04) locations in Package -III as shown in Table -6.45. The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table -6.46 and are show in Figure -6.122.

**Table 6-45 Ambient Noise monitoring Locations in Package -III**

| Location Code | Location Name |
|---|---|
| NIII-1 | Venkatapalem |
| NIII-2 | Krishnayapalem |
| NIII-3 | Thullur |
| NIII-4 | Abbarajupalem |

**Figure 6-122 Ambient Noise quality sampling at Thullur and Abbarajupalem**

**Table 6-46 Noise Quality Monitoring Status in the Package -III**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards / WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NIII-1 | Venkatapalem | Residential | 52.8 | 42.7 | 55 & 45 |
| NIII-2 | Krishnayapalem | Residential | 51.9 | 41.7 | 55 & 45 |
| NIII-3 | Thullur | Commercial | 63.4 | 54.0 | 65 & 55 / 70 & 70 |
| NIII-4 | Abbarajupalem | Residential | 53.3 | 45.1 | 55 & 45 |

**Data analysis**

**Residential Category:**

There are three residential locations i.e., Venkatapalem, Krishnayapalem and Abbarajupalem monitored in the Package -III. The day and night noise levels are observed to be in the range of 51.9 to 53.3 dB (A) & 41.7 to 45.1 dB(A) as against the CPCB Standards/WB-EHS Guidelines of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the limits in all monitored locations. The Noise quality levels of the study are shown in the Figure -6.123.

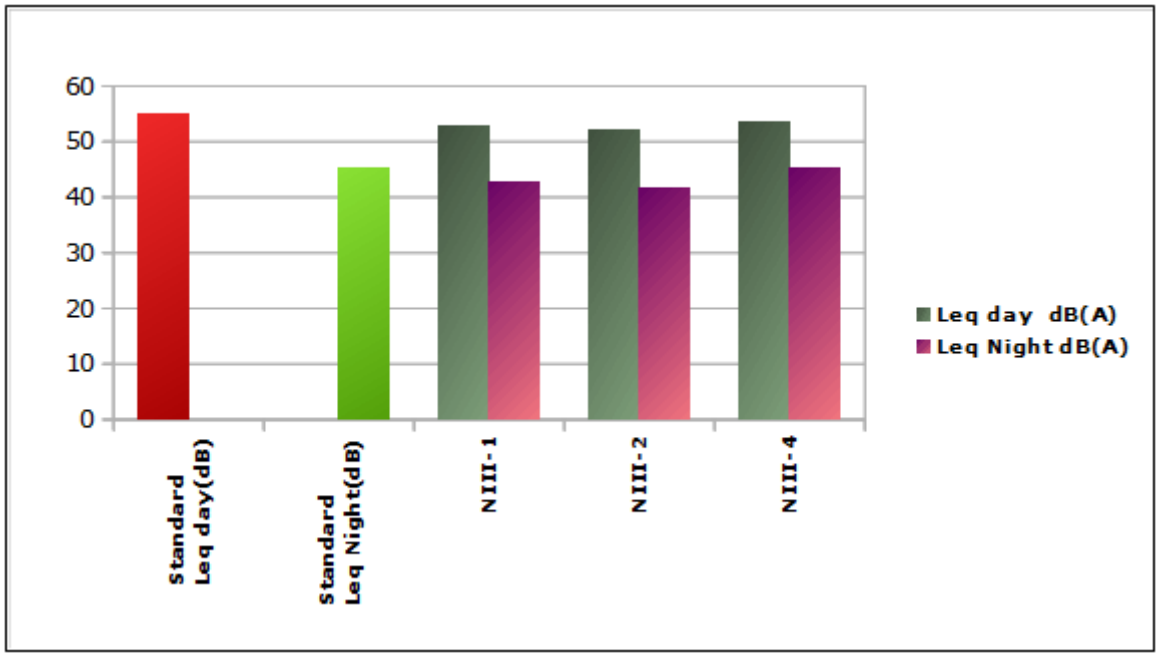



**Figure 6-123 Noise Quality levels in Residential Category of Package -III**

**Commercial Category:**

The location Thullur fall under commercial category. The day and night noise levels are observed to be 68.6 dB (A) & 58.1 dB(A) as against the CPCB Standard of 65.0 & 55.0 dB(A) and the noise levels are not found to be well within the limits at Thullur. This may be due to temporal local activity/commercial activities observed during the study period. However, when compared with WB-EHS guidelines, the noise values are well within the guidelines. The Noise quality levels of the study are shown in the Figure -6.124.

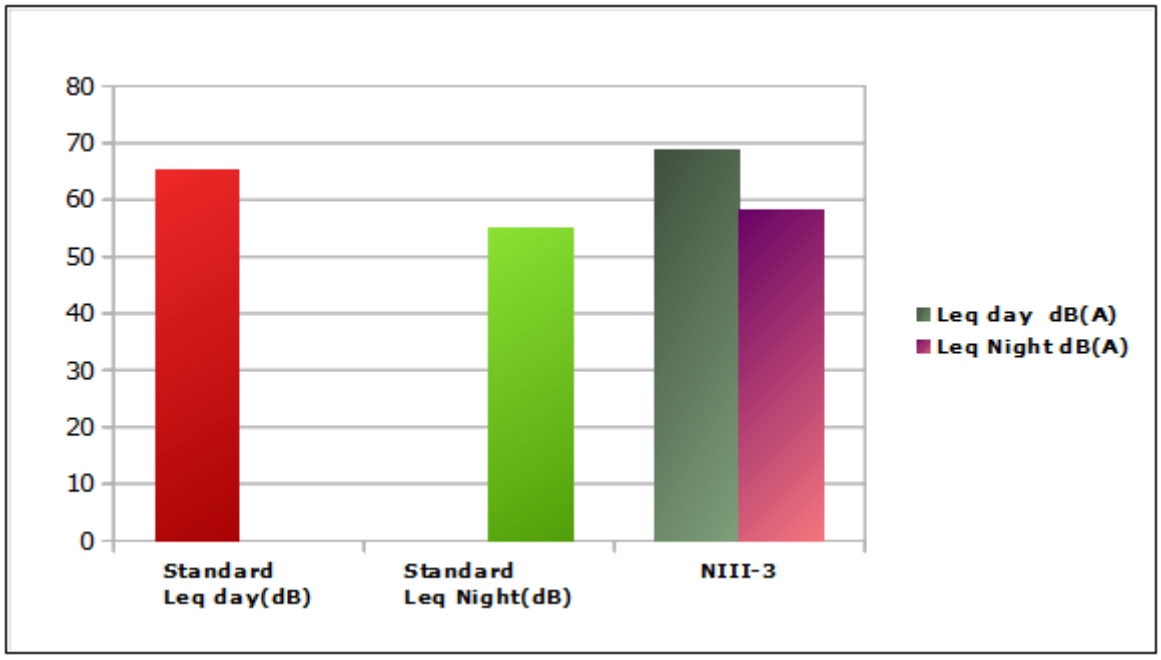



**Figure 6-124 Noise Quality levels in Commercial Category of Package -III**

### 6.5.3.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons for Venkatapalem, Thullur and Abbarajupalem are as follows for Package -III.

The day and night noise levels are observed to be in the range of 53.2 to 62.3 dB (A) & 38.6 to 41.8 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day noise levels are exceeding the limits in Venkatapalem because of temporal local agricultural activity at Venkatapalem in summer season unlike post-mosoon season of primary data.

### 6.5.4 Noise Environment for Package -IV
### 6.5.4.1 Primary Data

In view of the proposed road project, field monitoring was carried out at six (06) locations in Package -IV as shown in Table -6.47. The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table -6.48 and are show in Figure -6.125.

**Table 6-47 Ambient Noise Monitoring Locations in Package -IV**

| Location Code | Location Name |
|---|---|
| NIV-1 | Krishnayapalem |
| NIV-2 | Penumaka |
| NIV-3 | Navuluru |
| NIV-4 | Bethapudi |
| NIV-5 | Nekkallu |
| NIV-6 | Dondapadu |

**Figure 6-125 Ambient Noise quality sampling at Dondapadu and Nekkallu**

**Table 6-48 Noise Quality Status in the Package -IV**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards & WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NIV-1 | Krishnayapalem | Residential | 51.9 | 41.7 | 55 & 45 |
| NIV-2 | Penumaka | Residential | 53.9 | 44.2 | 55 & 45 |
| NIV-3 | Navuluru | Residential | 53.6 | 46.7 | 55 & 45 |
| NIV-4 | Bethapudi | Residential | 52.0 | 43.7 | 55 & 45 |
| NIV-5 | Nekkallu | Residential | 53.5 | 46.3 | 55 & 45 |
| NIV-6 | Dondapadu | Residential | 56.5 | 46.7 | 55 & 45 |

Note: Day monitoring is from 6:00 am to 9:00 pm and Night monitoring is from 9:00 pm to 6:00 am

**Data analysis**

**Residential Category:**

There are six residential locations i.e., Krishnayapalem, Penumaka, Navuluru, Bethapudi, Nekkallu and Dondapadu monitored in the project study area. The day and night noise levels are observed to be in the range of 51.9 to 56.5dB (A) & 41.7 to 46.7 dB(A) as against the CPCB Standards/WB-EHS Guidelines of 55 & 45 dB(A) respectively. The day & night noise levels are found to be well within the limits in all monitored locations except at Dondapadu. This may be due to temporal local activity/commercial activities observed during the study period. The Noise quality levels of the study are shown in the Figure -6.126.

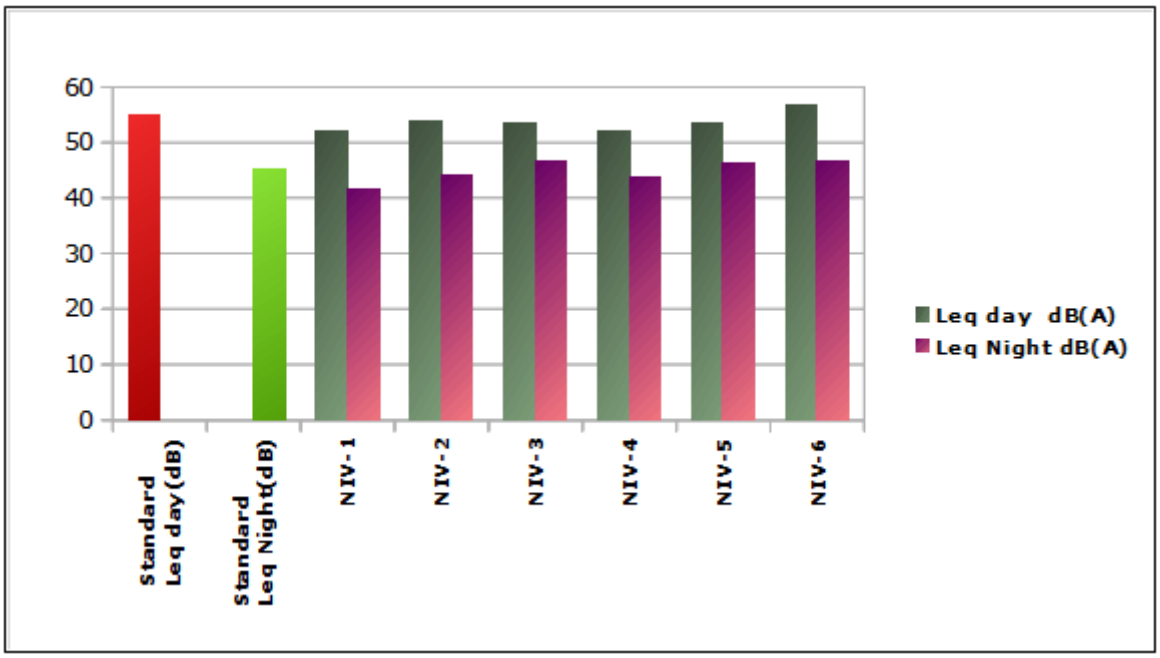



**Figure 6-126 Noise Quality levels in Residential Category of Package -IV**

### 6.5.4.2 Secondary Data

Secondary data is collected from "EIA & EMP of Amaravati Capital City" prepared for APCRDA by Tata Consulting Engineers limited and the baseline studies for this report were carried out during Summer season (May-June) of 2015. The comparisons for Navuluru and Nekkallu are as follows for Package -IV.

- The day and night noise levels are observed to be in the range of 53.9 to 55.4 dB (A) & 38.1 to 40.0 dB(A) as against the CPCB Standard of 55 & 45 dB(A) respectively. The day noise levels are slightly higher than the limits in Navuluru

because of temporal local agricultural activity at Navuluru in summer season unlike post-monsoon season of primary data.

### 6.5.5 Noise Environment for Package -V

#### 6.5.5.1 Primary Data

In view of the proposed road project, field monitoring was carried out at two (02) locations in Package -V (E6) as shown in Table -6.49 . The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table -6.50.

**Table 6-49 : Ambient Noise Monitoring Locations in Package -V**

| Location Code | Location Name |
|---|---|
| NV-1 | Nelapadu |
| NV-2 | Ananthavaram |

**Figure 6-127 : Ambient Noise quality sampling at Nelapadu and Ananthavaram**

**Table 6-50: Noise Quality Status in the Package -V**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards & WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NV-1 | Nelapadu | Residential | 50.2 | 43.5 | 55 & 45 |
| NV-2 | Ananthavaram | Residential | 51.6 | 43.7 | 55 & 45 |

Note: Day monitoring is from 6:00 am to 9:00 pm and Night monitoring is from 9:00 pm to 6:00 am

**Data analysis**

In Package V, all the monitored locations fall under residential category except Thullur, which falls under commercial category. The day time noise levels are found to be in the range of 50.2 dB(A) to 51.6 dB(A) and night time noise levels found to be in the range of 43.5 dB(A) to 43.7 dB(A) for residential category. The day & night noise levels are found to be well within the limits in all monitored locations. The Noise quality levels of the study are shown in the Figure 6.128 for residential category.

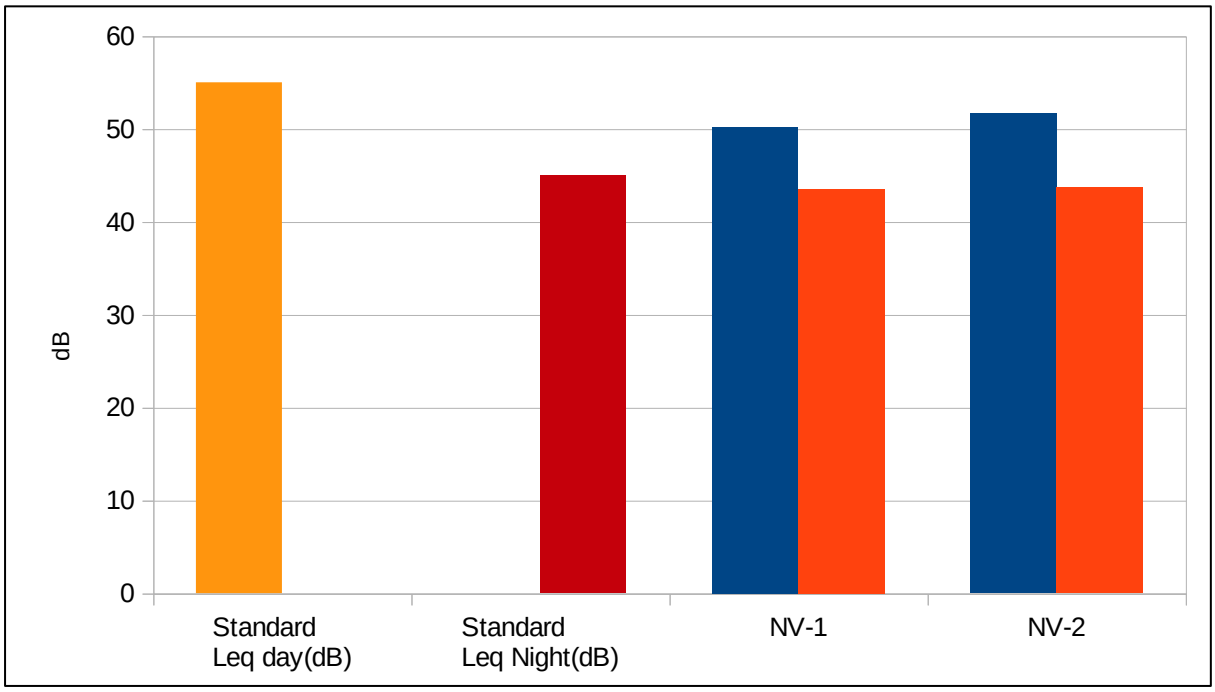



**Figure 6-128 :Noise Quality levels in Residential Category of Package -V**

**6.5.2 Noise Environment for Package -VI**

**6.5.2.1 Primary Data**

In view of the proposed road project, field monitoring was carried out at five (5) locations in Package -VI as shown in Table -6.51. The locations were selected based on the 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 ambient noise level monitoring in the present study. Noise monitoring was carried out for 24 hours at each location. Noise monitoring locations and noise levels recorded i.e., Leq day, Leq night, are presented in Table -6.51.

**Table 6-51 : Ambient Noise Monitoring Locations for Package -VI**

| Location Code | Location Name |
|---|---|
| NVI-1 | Ainavolu |
| NVI-2 | Lingayapalem |
| NVI-3 | Neerukonda |
| NVI-4 | Kuragallu |
| NVI-5 | Yerrabalem |

**Figure 6-129: Ambient Noise quality sampling at Neerukonda and Penumaka**

**Table 6-52: Noise Quality Status in the Package -VI**

| Station No. | Location | Category | Leq day dB(A) | Leq Night dB(A) | CPCB Standards & WB-EHS Guidelines dB(A) |
|---|---|---|---|---|---|
| NVI-1 | Ainavolu | Residential | 53.6 | 43.8 | 55 & 45 |
| NVI-2 | Lingayapalem | Residential | 53 | 45.3 | 55 & 45 |
| NVI-3 | Neerukonda | Residential | 48.4 | 42.5 | 55 & 45 |
| NVI-4 | Kuragallu | Residential | 52.8 | 44 | 55 & 45 |
| NVI-5 | Industrial Estate near Yerrabalem | Industry | 51.2 | 43.6 | 75 & 70 /70 & 70 |

Note: Day monitoring is from 6:00 am to 9:00 pm and Night monitoring is from 9:00 pm to 6:00 am

**Data analysis**

The day time noise levels are found to be in the range of 48.4 dB(A) to 53.6 dB(A) and night time noise levels found to be in the range of 42.5 dB(A) to 45.3 dB(A) for residential category. The day time noise level is found to be 51.2 dB(A) and night time noise level found to 43.6 dB(A) for industrial category. The day & night noise levels are

found to be well within the limits in all monitored locations, except at Ligayapalem. It is exceeding the noise limits at night time. Industrial estate near Yerrabalem falls under Industrial category. The Noise quality levels of the study are shown in the Figure -6.130, 6.131 for residential and industrial category respectively.

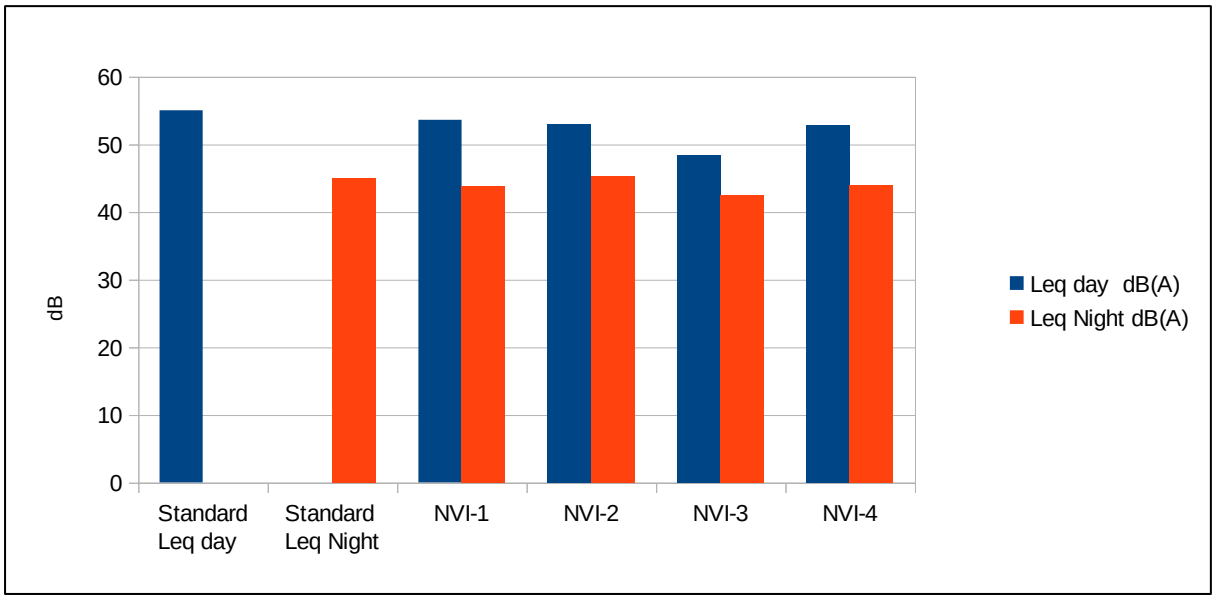



**Figure 6-130 :Noise Quality levels in Residential Category of Package -VI**

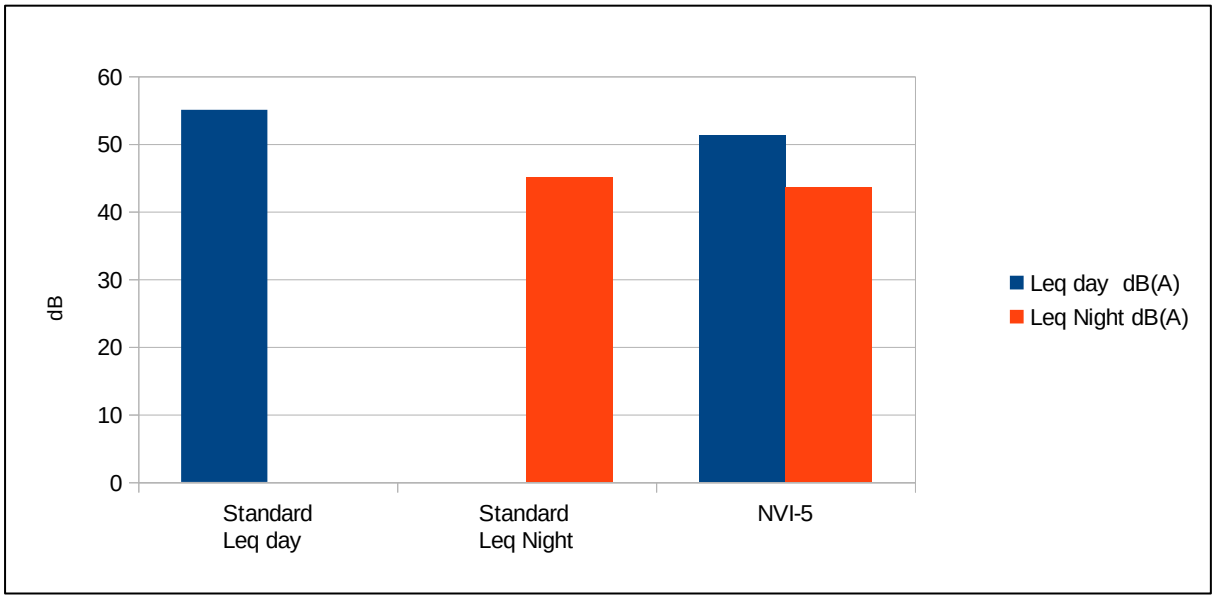



**Figure 6-131 :Noise Quality levels in Industrial Category of Package -VI**

**National Ambient Noise Standards/WB-EHS Guidelines**

The Central Pollution Control Board has specified ambient noise levels for different land use for day and night times. Importance was given to the timing of exposure and areas designated as sensitive. The World Bank EHS guidelines follow WB-EHS guidelines for Noise. The National ambient noise level standards are given in Table -6.53 along with WB-EHS guidelines.

**Table 6-53: National ambient noise level standards**

| Area Code | Category | Limits in Decibels (dB(A)) - CPCB | | Limits in Decibels (dB(A)) – WB-EHS Guidelines | |
|---|---|---|---|---|---|
| | | Day Time | Night Time | Day Time | Night Time |
| A | Industrial | 75 | 70 | 70 | 70 |
| B | Commercial | 65 | 55 | 70 | 70 |
| C | Residential | 55 | 45 | 55 | 45 |
| D | Silence Zones | 50 | 40 | - | - |

Note:

- Day Time is recorded in between

  6 a.m. and 9 p.m (CPCB)

  7 am and 10 p.m (WB-EHS)

- Night time is recorded in between

  9 p.m. to 6 a.m. (CPCB)

  10 p.m. to 7 a.m. (WB-EHS)

- Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority.
- Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
- Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.

**Source:** EPA Notification [G.S.R. 1063 (E) dt. 26.12.1989 published in the Gazette No. 643 dt. 26.12.1989].

## 6.6 Land Environment

The alignment of proposed project in Capital City is passing mostly in barren and fallow lands, majority of which were already acquired for construction of the road through land pooling. The project corridor lies in mostly plain and rolling and thus, no disfiguration of land is envisaged due to construction activities except for the opening of borrow pits.

The borrow pit locations have already been identified and will be restricted to those areas only.

### 6.6.1 Geology

The study area is underlain by various geological formations of different age groups ranging from Archaean to Recent. The Archaean basement complex comprising the granite-gneisses, Schists, Khondalites, Charnockites and basic dykes of dolerites form the predominant rock types in the central part. The fringe of the Archaeans in the central part is represented by Cuddapah basin, namely Nallamalai group of Upper Cuddapahs. In a sequential order, the younger Kurnools occurring in the Cuddapahs and those in the western parts of the district are thrust over by the Cuddapahs and these in turn by the Archaean granite-gneisses. The Upper Gondwana group of sandstones and shales out crop are seen at Guntur. The youngest rock types of the district appear to be of Mio – Pliocene age followed by the alluvial deposits of Recent to Sub-Recent age.

### 6.6.2 Soil

#### 6.6.2.1 Soil for Package -I

For land environment two (02) samples were selected from different villages in the study area to understand the Physico-chemical properties of the soil. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table -6.54 & 6.55 and are shown in Figure -6.132 respectively.

**Figure 6-132 Soil sampling near Sakhamuru and Nekkallu using Crowbar**

**Table 6-54 Soil Quality Location for Package -I**

| Location Code | Soil Sampling Location |
|---|---|
| SI-1 | Nekkallu |
| SI-2 | Sakhamuru |

**Table 6-55 Soil Quality Analysis for Package -I**

| S.No | Parameter | Units | SI-1 | SI-2 |
|---|---|---|---|---|
| 1 | Texture | | Silty Clay | Silty Clay |
| | Sand (%) | % | 08 | 28 |
| | Silt (%) | % | 50 | 30 |
| | Clay (%) | % | 42 | 42 |
| 2 | pH at 25 °C | - | 8.02 | 7.99 |
| 3 | Conductivity at 25 °C | µs/cm | 166 | 466 |
| 4 | Bulk Density | g/cc | 1.18 | 1.21 |
| 5 | Available Nitrogen | kg/ha | 498 | 536 |
| 6 | Available P as $PO_4$ | kg/ha | 62 | 44 |
| 7 | Available K | kg/ha | 234 | 252 |
| 8 | Exchangeable Ca | meq/100gr | 5.68 | 5.54 |
| 9 | Exchangeable Mg | meq/100gr | 0.88 | 0.76 |
| 10 | Exchangeable Na | meq/100gr | 2.72 | 2.32 |
| 11 | Organic Carbon | % | 0.96 | 0.94 |
| 12 | Manganese | meq/100gr | 0.20 | 0.12 |
| 13 | Zinc | meq/100gr | 5.84 | 8.64 |
| 14 | Boron | meq/100gr | 0.12 | 0.26 |

**Data analysis**

As it can be seen from the Table -6.55:

- The soil along the study area is classified as silty- clay in nature.
- Characterized by pH, the values are in the range of 7.99 – 8.02.
- If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 166 – 466 µS/cm.
- The available Nitrogen in the soil is 498 – 536 mg/Kg, found to be average/sufficient requirement for the plantation.
- The available Phosphorous in the soil is 44 – 62 mg/Kg, found to be average requirement for the plantation and agricultural purposes.
- The available Potassium in the soil is 234 – 252 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes.
- Trace metal concentrations found to be low.

### 6.6.2.2 Soil for Package -II

For land environment two (02) samples were selected from different villages in the Package -II to understand the Physico-chemical properties of the soil. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table -6.56 & 6.57 and are shown in Figure -6.133 respectively.

**Figure 6-133 Soil sampling near Velagapudi and Malkapuram using Crowbar**

**Table 6-56 Soil Quality Location in Package -II**

| Location Code | Soil Sampling Location |
|---|---|
| SII-1 | Malkapuram |
| SII-2 | Velagapudi |

**Table 6-57 Soil Quality Analysis for Package -II**

| S. No | Parameter | Units | SII-1 | SII-2 |
|---|---|---|---|---|
| 1 | Texture | | **Silty Clay** | **Silty Clay** |
| | Sand (%) | % | 22 | 30 |
| | Silt (%) | % | 40 | 46 |
| | Clay (%) | % | 38 | 24 |
| 2 | pH at 25 °C | - | 8.02 | 8.14 |
| 3 | Conductivity at 25 °C | µs/cm | 398 | 316 |
| 4 | Bulk Density | g/cc | 1.22 | 1.19 |
| 5 | Available Nitrogen | kg/ha | 546 | 612 |
| 6 | Available P as $PO_4$ | kg/ha | 54 | 46 |
| 7 | Available K | kg/ha | 264 | 228 |
| 8 | Exchangeable Ca | meq/100gr | 6.60 | 5.82 |
| 9 | Exchangeable Mg | meq/100gr | 1.24 | 1.02 |
| 10 | Exchangeable Na | meq/100gr | 2.80 | 2.68 |
| 11 | Organic Carbon | % | 1.30 | 0.90 |
| 12 | Manganese | meq/100gr | 0.42 | 0.20 |
| 13 | Zinc | meq/100gr | 9.16 | 7.74 |
| 14 | Boron | meq/100gr | 0.24 | 0.18 |

**Data analysis**

As it can be seen from the Table -6.57:

- The soil along the study area is classified as silty- clay in nature.
- Characterized by pH, the values are in the range of 8.02 – 8.14.
- If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 316 – 398 µS/cm.
- The available Nitrogen in the soil is 546 – 612 mg/Kg, found to be average/sufficient requirement for the plantation.
- The available Phosphorous in the soil is 46 – 54 mg/Kg, found to be average requirement for the plantation and agricultural purposes.
- The available Potassium in the soil is 228 – 264 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes.
- Trace metal concentrations found to be low.

#### 6.6.2.3 Soil for Package -III

For land environment four (04) samples were selected from different villages in the Package -III to understand the Physico-chemical properties of the soil. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table -6.58 & 6.59 and are shown in Figure -6.134 respectively.

**Figure 6-134 Soil sampling near Thullur and Abbarajupalem using Crowbar**

**Table 6-58 Soil Quality Location in Package -III**

| Location Code | Soil Sampling Location |
|---|---|
| SIII-1 | Venkatapalem |
| SIII-2 | Krishnayapalem |
| SIII-3 | Thullur |
| SIII-4 | Abbarajupalem |

**Table 6-59 Soil Quality Analysis for Package -III**

| S.No | Parameter | Units | SIII-1 | SIII-2 | SIII-3 | SIII-4 |
|---|---|---|---|---|---|---|
| 1 | Texture | | Silty Clay | Silty Clay | Silty Clay | Silty Clay |
| | Sand (%) | % | 20 | 20 | 16 | 16 |
| | Silt (%) | % | 30 | 42 | 44 | 36 |
| | Clay (%) | % | 50 | 38 | 40 | 48 |
| 2 | pH at 25 °C | - | 8.12 | 8.12 | 7.98 | 8.09 |
| 3 | Conductivity at 25 °C | µs/cm | 570 | 866 | 124 | 220 |
| 4 | Bulk Density | g/cc | 1.16 | 1.22 | 1.14 | 1.06 |
| 5 | Available Nitrogen | kg/ha | 456 | 468 | 596 | 524 |
| 6 | Available P as $PO_4$ | kg/ha | 47 | 56 | 66 | 53 |

| S.No | Parameter | Units | SIII-1 | SIII-2 | SIII-3 | SIII-4 |
|---|---|---|---|---|---|---|
| 7 | Available K | kg/ha | 239 | 244 | 242 | 264 |
| 8 | Exchangeable Ca | meq/100gr | 5.86 | 5.64 | 5.90 | 5.48 |
| 9 | Exchangeable Mg | meq/100gr | 1.36 | 0.72 | 1.02 | 1.02 |
| 10 | Exchangeable Na | meq/100gr | 2.24 | 4.20 | 2.30 | 2.30 |
| 11 | Organic Carbon | % | 1.02 | 1.20 | 0.86 | 0.96 |
| 12 | Manganese | meq/100gr | 0.42 | 0.42 | 0.10 | 0.24 |
| 13 | Zinc | meq/100gr | 8.84 | 12.4 | 3.86 | 6.02 |
| 14 | Boron | meq/100gr | 0.34 | 0.38 | 0.08 | 0.12 |

**Data analysis**

As it can be seen from the Table -6.59:

- The soil along the study area is classified as silty- clay in nature.
- Characterized by pH, the values are in the range of 7.98 – 8.12.
- If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 124 – 866 µS/cm.
- The available Nitrogen in the soil is 456 – 596 mg/Kg, found to be average/sufficient requirement for the plantation.
- The available Phosphorous in the soil is 47 – 66 mg/Kg, found to be average requirement for the plantation and agricultural purposes.
- The available Potassium in the soil is 239 – 264 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes.
- Trace metal concentrations found to be low.

### 6.6.2.4 Soil for Package -IV

For land environment six (06) samples were selected from different villages in the Package -IV to understand the Physico-chemical properties of the soil. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table -6.60 & 6.61 and are shown in Figure -6.135 respectively.

**Figure 6-135 Soil sampling near Dondapadu and Rayapudi using Crowbar**

**Table 6-60 Soil Quality Location for Package -IV**

| Location Code | Soil Sampling Location |
|---|---|
| SIV-1 | Krishnayapalem |
| SIV-2 | Penumaka |
| SIV-3 | Navulur |
| SIV-4 | Bethapudi |
| SIV-5 | Nekkallu |
| SIV-6 | Dondapadu |

**Table 6-61 Soil Quality Analysis in Package -IV**

| S.No | Parameter | Units | SIV-1 | SIV-2 | SIV-3 | SIV-4 | SIV-5 | SIV-6 |
|---|---|---|---|---|---|---|---|---|
| 1 | Texture | | Silty Clay | Silty Clay | Silty Clay | Silty Clay | Silty Clay | Silty Clay |
| | Sand (%) | % | 20 | 16 | 16 | 20 | 08 | 24 |
| | Silt (%) | % | 42 | 30 | 38 | 37 | 50 | 40 |
| | Clay (%) | % | 38 | 44 | 46 | 43 | 42 | 36 |
| 2 | pH at 25 °C | - | 8.12 | 8.11 | 7.78 | 8.02 | 8.02 | 7.90 |
| 3 | Conductivity at 25 °C | µs/cm | 866 | 235 | 136 | 86 | 166 | 178 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | Bulk Density | g/cc | 1.22 | 1.11 | 1.24 | 1.09 | 1.18 | 1.08 |
| 5 | Available Nitrogen | kg/ha | 468 | 524 | 488 | 542 | 498 | 498 |
| 6 | Available P as $PO_4$ | kg/ha | 56 | 54 | 44 | 58 | 62 | 44 |
| 7 | Available K | kg/ha | 244 | 268 | 258 | 254 | 234 | 259 |
| 8 | Exchangeable Ca | meq/100gr | 5.64 | 5.80 | 5.40 | 5.12 | 5.68 | 5.62 |
| 9 | Exchangeable Mg | meq/100gr | 0.72 | 1.04 | 0.84 | 0.84 | 0.88 | 0.86 |
| 10 | Exchangeable Na | meq/100gr | 4.20 | 2.82 | 1.56 | 2.14 | 2.72 | 2.34 |
| 11 | Organic Carbon | % | 1.20 | 1.04 | 0.92 | 1.02 | 0.96 | 0.92 |
| 12 | Manganese | meq/100gr | 0.42 | 0.32 | 0.14 | 0.11 | 0.20 | 0.20 |
| 13 | Zinc | meq/100gr | 12.4 | 8.2 | 5.40 | 5.68 | 5.84 | 4.86 |
| 14 | Boron | meq/100gr | 0.38 | 0.30 | 0.14 | 0.10 | 0.12 | 0.08 |

**Data analysis**

As it can be seen from the Table -6.59:

- The soil along the study area is classified as silty- clay in nature.
- Characterized by pH, the values are in the range of 7.78 – 8.12.
- If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 86 – 866 µS/cm.
- The available Nitrogen in the soil is 468 – 542 mg/Kg, found to be average/sufficient requirement for the plantation.
- The available Phosphorous in the soil is 44 – 62 mg/Kg, found to be average requirement for the plantation and agricultural purposes.
- The available Potassium in the soil is 234 – 268 mg/Kg, found to be sufficient requirement for the plantation and agricultural purposes.
- Trace metal concentrations found to be low.

### 6.6.2.5 Soil for Package -V

For land environment two (02) samples were selected from different villages in the study area to understand the Physico-chemical properties of the soil. The activities around the

sampling sites were also taken into consideration to understand the sources of pollution if any, and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table - 6.62 & 6.63 respectively.

**Figure 6-136: Soil sampling near Abbarajupalem and Velagapudi using Crowbar**

**Table 6-62: Soil Quality Location for Package -V**

| Location Code | Soil Sampling Location |
|---|---|
| SV-1 | Nelapadu |
| SV-2 | Ananthavaram |

**Table 6-63 : Soil Quality Analysis for Package -V**

| SL.No | Parameters | Unit | SV-1 | SV-2 |
|---|---|---|---|---|
| 1 | Texture | | **Silty Clay** | **Silty Clay** |
| | Sand (%) | % | 24 | 12 |
| | Silt (%) | % | 36 | 34 |
| | Clay (%) | % | 40 | 54 |
| 2 | pH at 25 °C | - | 8.09 | 8.14 |
| 3 | Conductivity at 25 °C | µs/cm | 105 | 248 |

| SL.No | Parameters | Unit | SV-1 | SV-2 |
|---|---|---|---|---|
| 4 | Bulk Density | g/cc | 1.16 | 1.13 |
| 5 | Available Nitrogen | kg/ha | 528 | 544 |
| 6 | Available P as $PO_4$ | kg/ha | 68 | 54 |
| 7 | Available K | kg/ha | 244 | 268 |
| 8 | Exchangeable Ca | meq/100gr | 6.44 | 6.10 |
| 9 | Exchangeable Mg | meq/100gr | 0.46 | 1.24 |
| 10 | Exchangeable Na | meq/100gr | 1.60 | 3.02 |
| 11 | Organic Carbon | % | 0.84 | 1.14 |
| 12 | Manganese | meq/100gr | 0.12 | 0.24 |
| 13 | Zinc | meq/100gr | 5.28 | 7.32 |
| 14 | Boron | meq/100gr | 0.06 | 0.26 |

**Data analysis**

As it can be seen from the Table -6.61:

- The soil along the study area is classified as silty- clay in nature.
- Characterized by pH, the values are in the range of 8.09-8.14.
- If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 105 - 248 µS/cm.
- The available Nitrogen in the soil is 528 - 544 Kg/ha, found to be average/sufficient requirement for the plantation.
- The available Phosphorous in the soil is 54-68 Kg/ha, found to be average requirement for the plantation and agricultural purposes.
- The available Potassium in the soil is 244-268 Kg/ha, found to be sufficient requirement for the plantation and agricultural purposes.
- Trace metal concentrations found to be low.

### 6.6.2.6 Soil for Package -VI

For land environment five (05) samples were selected from different villages in the Package - VI to understand the Physico-chemical properties of the soil. The activities around the sampling sites were also taken into consideration to understand the sources of pollution if any, and all other factors governing the Physico-chemical properties of the soil. Meticulous attention was paid to collect adequate amount of composite soil samples at three depths for analysis. The samples were collected in dependable, waterproof containers marking the samples accurately, distinctly and brought to the laboratory for analysis. The soil sampling locations and results of the analysis are presented in Table - 6.64 & 6.65 and are shown in Figure -6.137 respectively.

**Figure 6-137: Soil sampling near Nidamarru and Penumaka using Crowbar**

**Table 6-64: Soil Quality Location in Package -VI**

| Location Code | Soil Sampling Location |
|---|---|
| SVI-1 | Ainavolu |
| SVI-2 | Linayapalem |
| SVI-3 | Neerukonda |
| SVI-4 | Kurugallu |
| SVI-5 | Yerrabalem |

**Table 6-65 : Soil Quality Analysis for Package -VI**

| SL.No | Parameters | Unit | SVI-1 | SVI-2 | SVI-3 | SVI-4 | SVI-5 |
|---|---|---|---|---|---|---|---|
| 1 | Texture | | **Silty Clay** | **Silty Clay** | **Silty Clay** | **Silty Clay** | **Silty Clay** |
| | Sand (%) | % | 24 | 14 | 22 | 26 | 20 |
| | Silt (%) | % | 32 | 46 | 36 | 30 | 32 |

| SL.No | Parameters | Unit | SVI-1 | SVI-2 | SVI-3 | SVI-4 | SVI-5 |
|---|---|---|---|---|---|---|---|
| | Clay (%) | % | 44 | 40 | 42 | 44 | 48 |
| 2 | pH at 25 °C | - | 8.13 | 8.04 | 7.96 | 8.14 | 8.06 |
| 3 | Conductivity at 25 °C | µs/cm | 96 | 136 | 124 | 158 | 90 |
| 4 | Bulk Density | g/cc | 1.02 | 1.10 | 1.13 | 1.20 | 1.04 |
| 5 | Available Nitrogen | kg/ha | 542 | 548 | 544 | 528 | 484 |
| 6 | Available P as $PO_4$ | kg/ha | 44 | 58 | 48 | 56 | 53 |
| 7 | Available K | kg/ha | 266 | 228 | 242 | 266 | 264 |
| 8 | Exchangeable Ca | meq/ 100gr | 6.2 | 5.22 | 5.40 | 5.66 | 5.88 |
| 9 | Exchangeable Mg | meq/ 100gr | 0.62 | 0.64 | 1.44 | 1.16 | 0.48 |
| 10 | Exchangeable Na | meq/ 100gr | 2.60 | 1.72 | 1.96 | 2.24 | 1.28 |
| 11 | Organic Carbon | % | 1.14 | 0.82 | 1.02 | 1.14 | 0.86 |
| 12 | Manganese | meq/ 100gr | 0.26 | 0.14 | 0.18 | 0.26 | 0.24 |
| 13 | Zinc | meq/ 100gr | 7.60 | 5.26 | 5.24 | 7.48 | 6.42 |
| 14 | Boron | meq/ 100gr | 0.30 | 0.06 | 0.10 | 0.18 | 0.18 |

**Data analysis**

As it can be seen from the Table -6.65:

The soil along the study area is classified as silty- clay in nature.

Characterized by pH, the values are in the range of 7.96-8.14

If the soil's Electrical Conductivity (EC) falls below 1000 micro Siemens, the soil can be classified as normal. In analyzed samples EC is found to be in the range between 90-158 µS/cm.

The available Nitrogen in the soil is 528 - 548 Kg/ha, found to be average/sufficient requirement for the plantation.

The available Phosphorous in the soil is 44-58 Kg/ha, found to be average requirement for the plantation and agricultural purposes.

The available Potassium in the soil is 228-266 Kg/ha, found to be sufficient requirement for the plantation and agricultural purposes.

Trace metal concentrations found to be low.

**Environmental Baseline Map for all the monitoring locations in 6 Packages of 10 Priority Roads of Capital City (Air, Noise, Surface water, Ground water and Soil) is attached separately in Annexure -III**

## 6.7 Biological Environment

### 6.7.1 Land use

The proposed project of construction of roads in Capital City is passing through Plain terrain and rolling terrain. The land utilization pattern of the Guntur district is given in Table – 6-66.

**Table 6-66: Land Utilization Pattern of the Study District (Hectare)**

| S. No. | Land Utilization Particulars | Guntur |
|---|---|---|
| 1 | Forest Area | 161.9 |
| 2 | Land under non-agricultural use | 156.8 |
| 3 | Permanent Pastures | 18.9 |
| 4 | Cultivable Waste Land | 31.0 |
| 5 | Land under miscellaneous crops and groves | 32.3 |
| 6 | Barren and unclutivable land | 34.4 |
| 7 | Current Fallows | 41.5 |
| 8 | Other Fallows | 38.4 |
| 9 | Total Geographical Area | 1139.1 |

Source: Agriculture contingency plans of Guntur, Andhra Pradesh State (2008-09)

#### 6.7.1.1 Existing Land-use

Project area general terrain condition is plain, hilly near The Rock cut Cave Temple, Undavalli area and near Ananthavram village area and gently sloping towards of Krishna river basin area. The project area covered by Amaravati capital city is 217.23 sq. km. Existing land use distribution for sub-project influence area is given in Table 6-67.

**Table 6-67: Existing Land-use distribution for Sub-Project Influence Area**

| S. No | Land Use | Capital City | | 10 Roads | |
|---|---|---|---|---|---|
| | | Area (Ha) | % | Area (Ha) | % |
| 1 | Developable Land | 16302.2 | 75 | 419.4 | 97.6 |
| 2 | Hills | 426.5 | 2 | 0.0 | 0.0 |
| 3 | Islands | 1750.9 | 8 | 0.0 | 0.0 |
| 4 | Village Settlements | 1449.4 | 7 | 5.1 | 1.2 |
| 5 | Water Bodies | 497.5 | 6 | 3.1 | 0.7 |
| 6 | River | 1277.7 | 2 | 1.9 | 0.4 |
| **Total** | | **21704.2** | **100** | 429.6 | 100 |

### 6.7.2 Proposed Land-use

The Capital city Detailed Master plan integrates the various city layers as one comprehensive land use plan that will guide future developments within the city The Zoning Map is an implementable plan which identifies specific zoning districts within the Capital city based on their predominant land use, and the desired intensity and building height for that area. As illustrated in the Capital city zoning map, the following zoning districts are proposed for the Capital city:

- Residential (R1, R1A, R2 and R3)
- Commercial (C1, C2, C2a, C3, C4 and C5)
- Industrial (i1, L1)
- Parks and Open Spaces (P1, P2, P3)
- Special Areas (SP1 , SP2)
- Reserved Sites (RS1, RS2)

To enable successful implementation of the Capital City Master Plan, a development phasing has been proposed for guiding the implementation and government budget requirements for the immediate and future projects. With this intention, the Capital City Detailed Master Plan proposes 3 development phases catering to the city's short, medium and long-term requirements.

- **Phase 1** will span for the first 10 years for catalyzing urban developments within the Capital City. This phase will include a large number of infrastructure projects to create the critical base for development.
- **Phase 2** will focus on the medium-term development (2025-2035) to momentize urban development within the Capital City.

- **Phase 3** will focus on the long-term development (2035-2050) to complete the vision and goals for the Capital city.

The phase wise prime categorization of the land use is given in Table –6.68.

**Table 6-68 Proposed Phase Wise Prime Categorization of the Land Use**

| S.No. | Landuse | Phase -1:2015-2025 (Catalyze) | | Phase -2: 2025-2035 (Momentize) | | Phase -3: 2035-2050 (Sustain) | |
|---|---|---|---|---|---|---|---|
| | | Area (Sq.Km) | % | Area (Sq.Km) | % | Area (Sq.Km) | % |
| 1 | Primary Green | 39.2 | 25.68% | 7.9 | 10.96% | 25.74 | 7.00% |
| 2 | River | 31.6 | 20.68% | 0.0 | 0.0% | 0.01 | 0.01% |
| 3 | Roads | 13.4 | 8.79% | 7.7 | 10.74 | 17.77 | 10.65% |
| 4 | Industries | 10.6 | 6.94% | 3.9 | 5.39% | 23.06 | 13.83% |
| 5 | Village Settlements | 13.7 | 8.97% | 3.5 | 4.86% | 3.93 | 2.36% |
| 6 | Medium Density Residential | 12.92 | 8.0% | 15.05 | 21.0% | 16.67 | 10.00% |
| 7 | Secondary Green | 5.1 | 3.34% | 5.5 | 7.61% | 8.57 | 6.00% |
| 8 | High Density Residential | 3.9 | 2.53% | 15.05 | 21.0% | 16.90 | 10.14% |
| 9 | Seed | 4.7 | 3.07% | 3.0 | 4.23% | 2.93 | 1.76% |
| 10 | Commercial | 6.50 | 4.0% | 5.62 | 8.0% | 5.92 | 4.00% |
| 11 | Others | 11.18 | 8.0% | 4.78 | 6.21% | 45.29 | 34.25% |
| | **Total** | **152.8** | **100.00%** | **72** | **100%** | **166.79** | **100.00%** |

Source: APCRDA Master Plan

**Passive, Active and Protected Zones:**

Passive, Active and Protected Zones are demarcated as P1, P2 and P3 in the CRDA Masterplan. The definition of the areas are given below:

**Passive Recreational Zone (P1)**: P1 zoning are established to provide recreational and leisure facilities and activities in selected areas that have unique features (including visual corridors, environmentally sensitive areas, buffer areas, or along significant routes).

**Active Recreational Zone (P2)**: P2 zoining is established to provide parks that offer active recreational and sporting activities. While structures within the parks are allowed, the general character of the Active Recreational Zone should remain as green and recreational.

**Protected Area (P3)**: P3 zoning districts have been established to conserve and protect the environmentally sensitive areas such as rivers which are rich in nature and

biodiversity. These areas are non-developable for other strategic purposes. In the case of highly sensitive areas like forests and rivers the zoning for the protected areas shall supersede.

As of now, the key features of these zones are not finalized and the permitted zone wise features as mentioned in Zoning Regulations of Amaravati City, 2016 are given below:

***Passive zone features**:* Botanical gardens, arboretums, conservatories, Outdoor recreational facilities, such as hiking and bicycle trails, greens and commons, sitting areas and picnic areas.

***Active Zone features**:* Sports Complexes, Theme Parks, Resort Hotels, Golf Courses, Recreational Clubs, Zoo and Stadiums.

***Protected Zone features**:* River Krishna, Kondaveeti Vagu, Pala Vagu, Lakes etc.

Proposed land use map of Amaravati city is given in Figure -6.138.

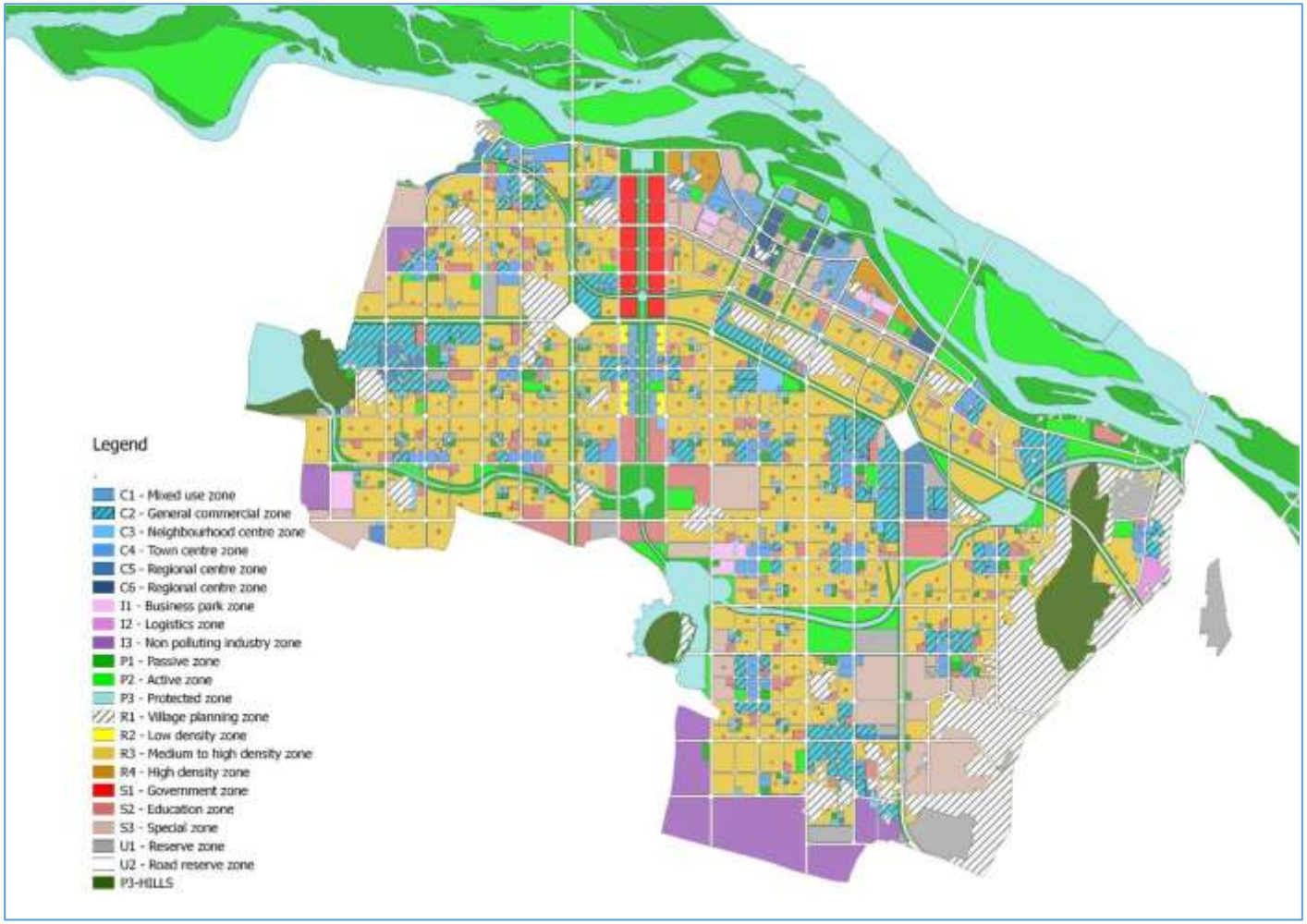



**Figure 6-138: Proposed Land-use Map**

### 6.7.3 Forests, Biosphere and Sanctuary

According to Champion and Seth classification of forests 1968, the forest type in study area falls in dry deciduous forests and the area falls in hot arid climatic zone. The study area mainly falls under Guntur district of Andhra Pradesh State. The forests, flora and fauna data was collected from the Forest Department and given below.

**Forests in the Study Area:**

There is no forest area falling under the Corridor of Impact(CoI) area and there are no rare and endangered species present in the study area.

### 6.7.4 Flora and Fauna in the Study Area

The structure and type of vegetation depends on climatic conditions and physiography of an area. Climate of the study area is much suited for the variety of vegetation because of 921mm cumulative annual rainfall. Because of humus and fertile nature of soil, the big trees are supported. The silt percentage of soil is less which is another reason for more vegetation. A floral enlistment of trees, shrub & herbs with their scientific names, common names and the family to which they belong are presented in a tabular format. The floral species and their status with reference to IUCN Red data book has been placed in the Table -6.69. The contents of this subsection are based primarily on reconnaissance survey carried out by the team of AARVEE associates during the month of November 2016 & available information collected from secondary data.

**Table 6-69: List of Floral Species Along with Family Names**

| S.No | Name of the plant | Local name | Family | Classification as per IUCN Redbook |
|---|---|---|---|---|
| 1 | *Acacia nilotica* | Nalla tumma | Mimosaceae | Not assessed |
| 2 | *Emblica officinalis* | Usiri | Euphorbiaceae | Not assessed |
| 3 | *Aegle marmelos* | Maredu | Rutaceae | Not assessed |
| 4 | *Butea monosperma* | Modugu | Fabaceae | Not assessed |
| 5 | *Acacia catechu* | Nalla sundra | Mimosaceae | Not assessed |
| 6 | *Annogeissus latifolia* | Chiru manu | Combretaceae | Not assessed |
| 7 | *Prosopis cineraria* | Jammi | Fabaceae | Not assessed |
| 8 | *Tectona grandis* | Teku | Verbenaceae | Not assessed |

| S.No | Name of the plant | Local name | Family | Classification as per IUCN Redbook |
|---|---|---|---|---|
| 9 | *Calotropis* | Jilledu | Apocyanaceae | Not assessed |
| 10 | *Ficus religiosa* | Ravi | Moraceae | Not assessed |
| 11 | *Azadirachta indica* | Neem | Meliaceae | Not assessed |
| 12 | *Bougainvillea sp.* | Paper flower | Nyctaginacear | Not assessed |
| 13 | *Bilanites aegyptica* | Gara | Balanitaceae | Not assessed |
| 14 | *Thevitea peruviana* | Paccha ganneru | Apocyanaceae | Not assessed |
| 15 | *Nerium indicum* | Ganneru | Apocyanaceae | Least concern |
| 16 | *Zizyphus jujube* | Regu | Rhamnaceae | Not assessed |
| 17 | *Boswellia serrata* | Guggilam | Burseraceae | Not assessed |
| 18 | *Aristida setacea* | Paraka gaddi | Poaceae | Not assessed |
| 19 | *Eragrostis tenella* | Garika gaddi | Poaceae | Not assessed |
| 20 | *Mangifera indica* | Mango | Anacardiaceae | Data deficient |
| 21 | *Diospyrous sp.* | Ullinda | Ebenaceae | Not assessed |
| 22 | *Bombax ceiba* | Buruga | Malvaceae | Not assessed |
| 23 | *Carica papaya* | Papaya | Caricaceae | Not assessed |
| 24 | *Terminalia alata* | Nalla Maddi | Combretacear | Not assessed |
| 25 | *Madhuca indica* | Ippa | Sapotaceae | Not assessed |
| 26 | *Zizyphus nimmularia* | Jittaregi | Rhamnaceae | Not assessed |
| 27 | *Strychnous nuxvomica* | Musti | Loganiaceae | Not assessed |
| 28 | *Polyalthia longifolia* | Naramamidi | Annonaceae | Not assessed |
| 29 | *Ficus bengalensis* | Banyan | Moraceae | Not assessed |
| 30 | *Achyranthus aspera* | Uttareni | Amaranthaceae | Not assessed |
| 31 | *Ocimum sanctum* | Tulasi | Lamiaceae | Not assessed |
| 32 | *Cassia auriculata* | Tangedu | Fabaceae | Not assessed |

| S.No | Name of the plant | Local name | Family | Classification as per IUCN Redbook |
|---|---|---|---|---|
| 33 | *Clitoria ternatea* | Sankupushpam | Fabaceae | Not assessed |
| 34 | *Rhizophora mucronata* | Uppuponna | Rhizophoraceae | Least concerned |
| 35 | *Opuntia vulgaris* | Nagajemudu | Cactaceae | Data deficient |
| 36 | *Buchanania axillaris* | Sarapapu | Anacardiaceae | Not assessed |
| 37 | *Bambusa arundanacea* | Veduru | Cyperaceae | Not assessed |

**Measures to compensate removed plants during construction**

There are 1388 nos. of plants needs to be removed from roadsides in the alignment of the proposed 10 priority roads because of the Construction. The types of plants to be removed are *neem, mango, tamarrind, pipal, karanj* etc. The short-term impact due to felling of plants will be compensated in long term through the proposed plantation programme. The local plant varieties will be identified and the same will be planted along the aqueduct and surrounding areas.

***Mitigation Measures:***

- Plantation programme shall be promptly adopted to restore and further enrich the loss of vegetation.
- Plantation with an appropriate mix of indigenous and specially suited species shall be carried out along the corridor. The number of plants proposed to be planted is 1,44,891 with avenue and median plantation in the proposed 10 priority roads.
- Local plant varieties especially, soil bounding species will be planted near to the constructed aqueduct and also in the surroundings in order to hold the soil tightly.

**Field study on Fauna in sub-project influence area**

Since the animals except for a few sedentary species and a few residents move from place to place either for feeding or breeding or for shelter etc., it may not be possible to prepare separate lists of fauna for core and buffer zones unless the core area is very large as in case of a reservoir. The mere absence of a species at the time of sampling does not rule out its presence. One may not have seen a cobra in a particular place for years but it could still visit that place. To overcome such problems, a list based on both

primary survey and secondary data is prepared. The primary survey takes in to account both direct evidence and indirect evidence including the circumstantial evidence.

All relevant scientific documents such as the scientific publications, documents and reports are a good source of information provided they are site, area and location specific. Further, they have to be recent but not decades old. In the absence of such data and information, reports of eye witness accounts and information from local non-Governmental organizations shall also be considered. Due attention should be paid to rare or endangered or endemic or threatened (REET) species. In order to find out whether a species comes under any of the REET categories, references are made to IUCN Red Data, Indian Wildlife (Protection) Act 1972 and its amendments thereof, Botanical survey of India (BSI) and Zoological Survey of India (ZSI). The details of the fauna present in the study area are given in Table -6.70.

**Table 6-70: List of Fauna Species along with Family Names and Status as Per IUCN And Wildlife Act Schedules**

| S. No | Name of the animal | Local name | Family | Status in Schedule of Wildlife Protection Act, 1972 | IUCN classification |
|---|---|---|---|---|---|
| 1 | *Vulpes benghalensis* | Fox | Canidae | II | NA |
| 2 | *Felis chaus* | Jungle cat | Felidae | II | Least concerned |
| 3 | *Herpestes auropunctatus* | Mongoose | Herpestidae | IV | NA |
| 4 | *Lepus nigricollis* | Indian Hare | Leporidae | - | Least concerned |
| 5 | *Canis lupus pallipes* | Wolf | Canidae | I | Not assessed |
| 6 | *Viverricula indica* | Civet | Viverridae | II | Least concerned |
| 7 | *Varanus griseus* | Indian monitor | Varanidae | I | NA |
| 8 | *Calotes versicolor* | Garden lizard | Agamidae | - | NA |
| 9 | *Pitas mucosus* | Rat snake | Colubridae | II | NA |
| 10 | *Vipera russelli* | Viper | Viperidae | II | NA |
| 11 | *Terpsiphone paradisi* | Fly catcher | Monarchidae | - | Least concerned |
| 12 | *Prinia buchanani* | Warbler | Muscicapidae | - | Least concerned |
| 13 | *Pavo cristatus* | Pea Fowl | Phasianidae | I | NA |
| 14 | *Ardeola grayii* | pond heron | Ardeidae | | Least concerned |
| 15 | *Lanius cristatus* | Shrieks | Laniidae | - | Least concerned |
| 16 | *Streptopelia orientalis* | Doves | Columbidae | - | Least concerned |
| 17 | *Patronia xanthocollis* | Yellow throatedsparrow | Plocidae | - | NA |
| 18 | *Astrilda sp.* | Munia | Plocidae | - | NA |
| 19 | *Pycnonotus sp.* | Bulbul | Pycnonotidae | - | Least concerned |

| S. No | Name of the animal | Local name | Family | Status in Schedule of Wildlife Protection Act, 1972 | IUCN classification |
|---|---|---|---|---|---|
| 20 | *Drycopus javensis* | Woodpecker | Picidae | - | NA |
| 21 | *Tephrodornis pondicerianus* | Wood shrike | Tephrodornithidae | - | Least concerned |
| 22 | *Dendrocygna autumnalis* | Duck | Anatidae | | Least concerned |
| 23 | *Psittacula krameri* | Parrot | Psittaculidae | | Least concerned |
| 24 | *Mycteria leucocephala* | Painted stork | Ciconiidae | IV | Near threatened |

**Study of Aquatic flora and Fauna:**

The major aquatic species identified in the study area are i.e., Carps, cat fish, murrel, prawns, barbus etc. It is very much important to take care that developments as per master plan and zonal developmental plan activities show least impact on the aquatic life otherwise, increasing sediment load due to the recipient water bodies i.e. ponds and Krishna River will restrict the penetration of solar energy in the water body. This will affect photosynthesis of the aquatic flora, which in turn will have adverse impacts on the aquatic fauna. Since most of the water bodies remain dry during the non-monsoon months, this impact will be negligible. But the implementation of the following measures will help to avoid soil erosion and further minimize the impacts of the aquatic fauna.

### 6.8 Cultural and Sensitive Receptors:

As per the World Bank norms schools/hospitals/worship places, which fall within the the Corridor of Impact (CoI), ie. 20 m either side of the construction area are treated as sensitive receptors. Special care has to be taken during construction phase of the project in case of these receptors. As a matter of abundant precaution, receptors falling within the 100m either side of the roads are identified and given in Table 6-71.

**Table 6-71: Summary of identified Cultural & Sensitive Receptors within 100m of Proposed Roads**

| S.No | Name of the Road | Chainage | Name of the Cultural & Sensitive Receptors | RHS/ LHS |
|---|---|---|---|---|
| 1 | E8 | -- | -- | -- |
| 2 | E6 | 5000 | Temple near Thulluru village | RHS |
| | | 9300.00 to 9400.00 | School near Ananthavaram village | LHS |
| 3 | N11 | -- | -- | -- |
| 4 | E10 | -- | -- | -- |
| 5 | E12 | -- | -- | -- |
| 6 | E14 | 700 | School near Navalluru village | RHS |

| S.No | Name of the Road | Chainage | Name of the Cultural & Sensitive Receptors | RHS/ LHS |
|---|---|---|---|---|
| 7 | N16 | -- | -- | -- |
| 8 | N14 | 3400.00 to 3500.00 | School near Thulluru village | LHS |
| | | 700 to 800 | Bodduraji near Abbarajupalem village | LHS |
| | | 700 to 800 | School near Abbarajupalem village | LHS |
| 9 | N9 | -- | -- | -- |
| 10 | N4 | 300.00 to 400.00 | Hospital near Venkatapalem village | LHS |

### 6.9 Socio-economic Environment

Socio-economic characteristics of the sub-project influence area would normally have a bearing on the present traffic and would further influence the traffic levels in the future. Given this, the socio-economic profile of the sub-project influence area has been studied and presented in brief in the ensuing sections. The Project stretch passes through Guntur district of Andhra Pradesh, located in Southern India. Guntur lies between 15° 18'and 16° 50' North latitude and 70° 10'and 80° 55'East longitude. The district has a coastline of 42 kms. The total geographical area of the district is 11328 sq kms. Guntur district lies at an elevation of 33m from sea level. The district is mainly plain, with a few hill ranges. The average rainfall in the district is 830mm, through South-West monsoon. Major crops grown are paddy, chilli, cotton, red gram, black gram, among pulses, cereals like jowar and maize, sorghum, jute, fodder grass, subabul and commercial crops like turmeric, guar gum. It is bounded by Krishna & Nalgonda districts on the North, by Prakasam and Mahabubnagar districts on the West, by Prakasam district on the South and by Krishna district, and the Bay of Bengal on the East. Krishna is the main river, which traverses 250 kms in the district, irrigating an area of nearly 5 lakh Ha. Chandravanka, Naguleru and Gundlakamma are the 3 major rivulets.

#### 6.9.1 Socio-economic Status of the Study area

**A. Study District Profile:**

Guntur district is an administrative district in the Coastal Andhra region of the Indian state of Andhra Pradesh. The administrative seat of the district is located at Guntur, which is also the largest city of the district in terms of area and population. It has a coastline of approximately 100km and is situated on the right bank of Krishna River that separates it from Krishna district and extends till it empties into the Bay of Bengal. It is bounded on the south by Prakasam district and on the west by the state of Telangana. It

has an area of 11,391 km2 (4,398 sq. mi) and is the 2nd most populous district in the state a population of 4,889,230 as per 2011 census of India.

**Population:** In 2011, Guntur had population of 4,887,813 of which male and female were 2,440,521 and 2,447,292 respectively. In 2001 census, Guntur had a population of 4,465,144 of which males were 2,250,279 and remaining 2,214,865 were females. Guntur District population constituted 5.78 percent of total Maharashtra population. In 2001 census, this figure for Guntur District was at 5.86 percent of Maharashtra population.

**Population Growth Rate:** There was change of 9.47 percent in the population compared to population as per 2001. In the previous census of India 2001, Guntur District recorded increase of 8.72 percent to its population compared to 1991.

**Density of Population:** The initial provisional data released by census India 2011, shows that density of Guntur district for 2011 is 429 people per sq. km. In 2001, Guntur district density was at 392 people per sq. km. Guntur district administers 11,391 square kilometers of areas.

**Literacy Rate:** Average literacy rate of Guntur in 2011 were 67.40 compared to 62.54 of 2001. If things are looked out at gender wise, male and female literacy were 74.79 and 60.09 respectively. For 2001 census, same figures stood at 71.24 and 53.74 in Guntur District. Total literate in Guntur District were 2,960,441 of which male and female were 1,634,726 and 1,325,715 respectively. In 2001, Guntur District had 2,455,965 in its district.

**Sex Ratio:** With regards to Sex Ratio in Guntur, it stood at 1003 per 1000 male compared to 2001 census figure of 984. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 945 girls per 1000 boys compared to figure of 959 girls per 1000 boys of 2001 census data.

**Urban Population:** Out of the total Guntur population for 2011 census, 33.81 percent lives in urban regions of district. In total 1,652,738 people lives in urban areas of which males are 819,030 and females are 833,708. Sex Ratio in urban region of Guntur district is 1018 as per 2011 census data. Similarly, child sex ratio in Guntur district was 947 in 2011 census. Child population (0-6) in urban region was 162,968 of which males and females were 83,713 and 79,255. This child population figure of Guntur district is 10.22 % of total urban population. Average literacy rate in Guntur district as per census 2011 is 78.03 % of which males and females are 83.97 % and 72.25 % literates respectively.

In actual number 1,162,507 people are literate in urban region of which males and females are 617,432 and 545,075 respectively.

**Rural Population:** As per 2011 census, 66.19 % population of Guntur districts lives in rural areas of villages. The total Guntur district population living in rural areas is 3,235,075 of which males and females are 1,621,491 and 1,613,584 respectively. In rural areas of Guntur district, sex ratio is 995 females per 1000 males. If child sex ratio data of Guntur district is considered, figure is 945 girls per 1000 boys. Child population in the age 0-6 is 332,761 in rural areas of which males were 171,120 and females were 161,641. The child population comprises 10.55 % of total rural population of Guntur district. Literacy rate in rural areas of Guntur district is 61.95 % as per census data 2011. Gender wise, male and female literacy stood at 70.14 and 53.77 percent respectively. In total, 1,797,934 people were literate of which males and females were 1,017,294 and 780,640 respectively.

**B. Study Area Profile**

**Demography:** As per the 2011 census the total population of the project area is 97906. Out of the total population of the project area male population is 48677 and female population is 49229. Sex ratio 1011 is higher than the state level which is 940 females per 1000 male. The mandal wise demographic details are given in Table -6.72 and the details of land holders in the capital city area.

**Table 6-72: Demographic details of the project area**

| S. No | Demographic details | Project Area |
|---|---|---|
| 1 | Number of Houses | 27271 |
| 2 | Total Population | 97906 |
| 3 | Total Male population | 48677 |
| 4 | Total Female population | 49229 |
| 5 | Sex ratio (Per 1000 Male) | 1011 |
| 6 | Total Population (0-6yrs) | 9786 |
| 7 | SC population | 29051(29.67%) |
| 8 | ST Population | 4275(4.36%) |

Source: Census , 2011 of Andhra Pradesh

**Literacy:** As per the table the literacy rate for the project area is 62% which is lower than the state literacy level which is 67%. However, there is a significant gap between

male (33%) and female (28%) literacy rate. The details of the literacy rates are given in the Table -6.73 below.

**Table 6-73: Literacy rate in the project area**

| Sl.No | Literacy details | Project Area |
|---|---|---|
| 1 | Total No. of Literates | 60706 |
| 2 | No. of Male Literates | 33075 |
| 3 | No. of Female Literates | 27631 |
| 4 | Total Literacy Rate | 62 % |
| 5 | Male Literacy Rate | 33.78% |
| 6 | Female Literacy Rate | 28.22 % |

Source: Census, 2011 of Andhra Pradesh

**Economic Activity:** The major economic source of the area is agriculture and allied activities, and the major crops grown are paddy, cotton, chilly, corn, maize, vegetables, etc. Jasmine flower is the major source of income in the area, the income from the jasmine flower will be mainly impacted from the proposed project activity (as per discussion with locals).

**Work participation:** Work participation in the project area is only 50.47%. From that main workers are 46.45%, from the main worker's cultivators are (5.96%) & other allied activity workers are 12.86% and rest is marginal workers which are 4.01%, the non-worker population covered the major portion of the population which is 49.52%. In the study area, total main worker population is 45%, from that cultivators are 7%, main allied activity workers are 26%, and household and OT workers are 0.63% & 11%, the marginal population of the area is 5% and the major portion covers the non-worker population which is 49%.the details of the work participation given in the Table –6.74.

**Table 6-74: Work force details in the project area.**

| Sl.No | Work participation | Project Area |
|---|---|---|
| 1 | Total Worker | 49415 (50.47%) |
| 2 | Main Workers | 45483 (46.45%) |
| 3 | Cultivators | 5840 (5.96%) |
| 4 | Main AL | 26276 (26.83%) |
| 5 | HH Industry | 772 (0.78%) |
| 6 | OT Workers | 12595 (12.86%) |
| 7 | Marginal Workers | 3932 (4.01%) |
| 8 | Non-workers | 48491 (49.52%) |
| 9 | Male non-worker | 18785 (19.18%) |

| Sl.No | Work participation | Project Area |
|---|---|---|
| 10 | Female non-worker | 29706 (30.34%) |

Source: Census. 2011 of Andhra Pradesh

### 6.9.2 Public Consultations

The APCRDA has notified the Draft Master Plan for Capital City on 26th December 2015 and sought objections /suggestions from the public for a period of 30 days from the date of Notification. All the objections/ suggestions received from the public from various sources were compiled in Minutes of the Technical Committee Meeting held on 7th February, 2016 at APCRDA on scrutiny of objections /suggestions received from public on the draft Master Plan of Capital City – Amaravati. The members in the Technical Committee are Directors of Planning, Development Control, Chief Planning Officer, Principal Planner, Planning Officer of APCRDA and Director - Town & Country planning, AP. Village wise objections and suggestions received on draft Master Plan related to road sub-project are given in Table -6.75. About 4000 objections/suggestions have been received, which were considered and about 3600 structures were avoided from getting displaced by construction of roads.

**Table 6-75: Village wise objections / suggestions on Draft Mater Plan**

| Village | Objections/Suggestions | Technical Committee's Recommendation |
|---|---|---|
| Abbarajupalem | Existing burial ground (Survey no 9 & 10) is marked in Commercial Zone (C4) | Burial ground may be retained. |
| | Major arterial road is cutting across Survey no 96 (Shivalayam temple). | The Shivalayam temple is excluded from from the right of way of N14 road. |
| Velagapudi | Survey no 163 contains 1 acre of graveyard/cemetery | May be considered. R3 to be rezoned. |
| Venkatapalem | Road is passing on the bund, on Manthena Sathyanarayana Raju Ashramam. | May be considered. Road is marked on the bund and no proposal to shift the bund exists in the stretch. |
| | Proposed road alignment falls on Survey no 180/2 (Global school). | May not be considered. School falls under expressway alignment. |
| Krishnayapalem | Request to realign the major arterial road and proposed vaagu that is passing through village grama kantam. | May be agreed for road and vaagu realignment, in view of the proposed reservoir which is suggested as part of the flood management (500m length / 6.2 acres area / 103 no. of structures are being affected (under road) |
| Penumaka | Don't disturb natural heritage<br><br>for construction of roads | May not be considered. Heritage will not be disturbed as it is beyond 300 m from caves. |

| Village | Objections/Suggestions | Technical Committee's Recommendation |
|---|---|---|
| | (tunnel construction). | Tunnel will act as a feature for the city. |
| | Major arterial is passing through the Survey no's 257,254,256 (Rama mandir). | May not be considered as it is a minor arterial road. |
| Thullur | Request for changing the alignment of road that is passing through Survey no 172 which is a petrol bunk. | May not be considered |
| Sakhamuru | Aterial Road is hitting village to be exempted | Major Arterial Road and hence cannot be diverted |
| Anantavaram | Request to realign the major arterial road that is passing through village grama kantam. | May agree for realignment, as it is on the edge of the village. Realignment will connect the TTD Temple development. |

#### 6.9.2.1 Stakeholder's Consultation Meeting

Proceedings & Minutes of Meetings for the Public Consultation Meetings Conducted from 19th to 22nd July 2017 at Navalluru, Abbarajupalem, Thulluru, Ananthavarm, Rayapudi, Penumaka and Yerrabalem Villages of Guntur District in Amaravati Capital City Area.

**1. Participants**

1. At each village between 15 to 25 members Consisting of:
    a. farmers who have - participated in LPS, Focused Group i.e., affected by land acquisition, affected by roads passing through their sites in village sites
    b. Main representatives from associations / NGOs
    c. Public Representatives
    d. Aarvee Associates
    e. Representatives from Print and Electronic Media.
2. Line department officials: 6

    Competent Authorities from revenue units, Officials of - CRDA, ADC, Urban Development, etc.
3. Observers:

Sr. Social Expert from the World Bank

The participants included women representatives as well. The list of Public Consultation participants consisting of name, mobile number and signature are filed in the Project dossiers and can be accessed by interested stakeholders.

## 2. Introduction

Draft Environmental Assessment & Environmental Management Plan (EA-EMP) reports for 7 & 11 Priority Roads were prepared and disclosed at various villages and on the website of CRDA under the World Bank supported "Amaravati Sustainable Capital City Development Project (ASCCDP)" section. Comments and suggestions on the draft documents were invited.

The public consultations on Draft EA-EMP reports for 7 & 11 Priority Roads are conducted for accomplishing wider awareness, share contents of the documents and seek feedback from the participants leading to finalization of the documents and adopting for the Bank supported project - ASCCDP. The details of the Public Consultations carried out are given in Table 6-76.

**Table 6-76:Details of the Public Consultations carried out**

| S.No. | Date | Name of the Village | Duration (hrs.) |
|---|---|---|---|
| 1 | 19.07.2017 (Hrs. 10.00 to 12.30 ) | Navalluru Village | 2.30 |
| 2 | 19.07.2017 (Hrs. 14.00 to 16.00 ) | Abbarajupalem | 2.00 |
| 3 | 19.07.2017 (Hrs. 16.30 to 18.30 ) | Thulluru | 2.00 |
| 4 | 20.07.2017 (Hrs. 11.00 to 13.30 ) | Ananthavaram | 2.30 |
| 5 | 20.07.2017 (Hrs. 14.30 to 16.30 ) | Rayapudi | 2.00 |
| 6 | 21.07.2017 (Hrs. 17.00 to 19.00 ) | Penumaka | 2.00 |
| 7 | 22.07.2017 (Hrs. 11.00 to 13.00 ) | Yerrabalem | 2.00 |

CRDA official chaired the Public Consultations and briefed the agenda of Consultations at each village and encouraged participants to voice their feedback after a brief presentation on Draft EA-EMP reports of 7 & 11 Priority Roads for addressing them and incorporating the same into EA-EMP reports duly adopting the World Bank norms.

### 3. Public Suggestions and Feedback

Public consultations were held with large number of people in villages of Amaravati i.e., Navalluru, Abbarajupalem, Thulluru, Ananthavaram, Rayapudi, Penumaka and Yerrabalem affected villages, the suggestions and comments of public related to the Environment have been incorporated in the EA & EMP Report. Village wise objections and suggestions received during Public Consultations are given in Table 6-77.

**Table 6-77:Village wise objections and suggestions received during Public Consultations Vs Technical Committee Recommendations**

| Name of the Village(s) | Comments | Responses to the Comments given by APCRDA/Consultant |
|---|---|---|
| Navalluru | Extension of the E14 road till NH-5 Highway (Vijayawada - Guntur) for the better connectivity. | The roads are proposed duly adopting the Master Plan and E14 is ending near Railway line and not feasible to extend under this project. |
| | The locations such as Nagamayyaputta temple, Government Elementary school and Masjid are near to E14 Road. | These locations are already noted and adequate mitigation measures will be suggested in the EA &EMP Report. |
| | Along the E14 Road, there are few houses are partially falling and how the compensation will be made to them. | Full acquisition will be done and the compensation will be made accordingly. |
| | How the compensation will be made for some of the houses falling under non patta lands of E14 Road. | Compensation will be made to them as per the Government norms. |
| Abbarajupalem | How the compensation will be made for Isolated house is present outside the village | Compensation will be made to them as per the Government norms. |
| | Traffic Congestion will raise during construction phase of the project will affect the movement of the villagers | Adequate provisions for diversion of the traffic without affecting the local traffic will be made by the contractor and the same is also put under the contractor conditions. |
| | Are there any provisions from the Government for assistance in development of the domestic dairy farms? | In the capital city region, Government is giving special loan assistance upto 25 lakhs without interest for the development of the domestic/ household/ small scale industries. |
| | There are some trees such as vepa, | Avenue & median plantation is proposed |

| Name of the Village(s) | Comments | Responses to the Comments given by APCRDA/Consultant |
|---|---|---|
| | thumma, chinta are cutting in the proposed projects. How will you compensate the same? | duly adopting IRC SP 21-2009: Guidelines on Landscaping and Tree Plantation in the proposed project. |
| | Plots allocated to us are having Thulluru Lift Irrigation pipeline underneath. When will you remove the same?. | Action will be taken by the AP CRDA after having consultation with Minor Irrigation Department. |
| **Thulluru** | Construction jobs shall be allocated to the locals or Prioritisation for petty labour contracts in the construction of the road shall be given to the locals. | ADC/ AP CRDA is going for National Competitive Bidding process. The successful bidders will be mandated to employ locals as per contract. |
| | Site clearance for the proposed road activities is obstructing the existing peramvagu and other streams around the Thulluru. | Adequate mitigation measures already suggested in EMP and the same will be asked to strictly implement by the Contractors. |
| | Are there any provisions from the Government for assistance in development of livelihood of women and household petty works? | In the capital city region, Government is giving special loan assistance upto 25 lakhs without interest for the development of the domestic/ household/ small scale industries. |
| | Heavy vehicle movement is damaging the roads around the Thulluru and traffic congestion may be more during construction phase of the roads. | Adequate maintenance of the existing road will be taken care by AP CRDA /ADC. Provisions for diversion of the traffic without affecting the local traffic will be made by the contractor and the same is also put under the Contract conditions. |
| | Houses falling under Project will be vacated after construction of the new house only. | As per the guidelines of the AP CRDA, the time duration of 6 months will be given to the owners for the construction of the new houses or equivalent amount of rent will be paid to them. In case project affected persons want more time they can request the AP CRDA during negotiation process. |
| | Considerably traffic around the village is increased and damaging the roads and obstructing the movement of vehicles temporarily. | Adequate maintenance of the existing road will be taken care by AP CRDA /ADC. Provisions for diversion of the traffic without affecting the local traffic will be made by the Contractor and the same is also put under the Contract conditions. |

| Name of the Village(s) | Comments | Responses to the Comments given by APCRDA/Consultant |
|---|---|---|
| **Ananthavaram** | Dust pollution issue is raising day by day in all the roads leading to Village. | Adequate environmental mitigation measures are already suggested in EMP with budgetary provisions to take care of the construction phase of Roads project. |
| | For project Affected Persons (House loosers) Rental Allowance for Rs. 5000/- shall be given for eight months instead of six months. | As per the guidelines of the AP CRDA, the time duration for 6 months will be given to the owners for the construction of the new houses or equivalent amount of rent will be paid to them. In case project affected persons want more time and compensation, they can request the AP CRDA during negotiation process. |
| | Government is organising Skill Development activities for the people of Capital City and after the completion of the same will they provide any financial assistance. | Government is organising the Skill Developmental activities i.e., sewing, jute bag manufacturing, car driving, mobile repairs, computer courses horticulture, poultry forms development etc.<br><br>In the capital city Government is giving special loan assistance upto 25 lakhs without interest for the development of the domestic/ household/ small scale industries. |
| **Rayapudi** | Kalpana fabrics representation to the AP CRDA is discussed | The point was noted and the same will be brought to the notice of higher officials of AP CRDA/ADC. |
| | Health schemes offered by the Government are not covered for all the diseases. It would be better that a corporate level Multi-specialty hospital to be established within the Capital City Region. | The same will be brought to the notice of the AP CRDA/ADC higher officials. |
| | Plantation shall be removed where-ever the developmental activity is proposed instead of clearing all. | The plantation is being removed on the proposed developmental activities i,e., Roads, Govt. Buildings, institutions etc. There is no plantation removed other than developmental area. |
| | Sand tippers/ heavy vehicles are disturbing the vehicle movement of the villagers. | Provisions for diversion of the traffic without affecting the local traffic will be made by the Contractor and the same is also put under the Contract conditions of 7 & 11 Roads projects. |

| Name of the Village(s) | Comments | Responses to the Comments given by APCRDA/Consultant |
|---|---|---|
| **Penumaka** | As of now dust pollution is very less. During construction of the roads adequate measures to be taken. | The provision for the water sprinkling in construction of Roads is already made in the EA & EMP Report with budgetary provision as well as enforcing the same in Contractor conditions. Hence, the issue will be taken care. |
| | Majority of the group members raised the issue that the education fees reimbursement is not yet started. They are expecting it to be started so that they will be benefited. | The same will be brought to the notice of the AP CRDA/ADC higher officials. |
| | Majority expressed that some the people participated in the Skill development programme but the opportunities they got are not as per the training received. | At Skill Development Centre training will be given on i.e., sewing, jute bag manufacturing, car driving, mobile repairs, computer courses horticulture, poultry forms development etc. However, the trained applicants have to be worked as per the requirements of the Employer. |
| | Villagers are Demanding for a corporate hospital in their area and the provision to accept this health card will be of great help. | The same will be brought to the notice of the AP CRDA/ADC higher officials. |
| **Yerrabalem** | Majority said that the existing fees reimbursement can be extended to KL University<br><br>Regarding skill development center, some people already undergone training in Nowluru-1 training center. About 20 to 30 women participated in Job mela and 3 got employment. | The same will be brought to the notice of the AP CRDA/ADC higher officials. |
| | Some of the farmers constructed their houses with building permission/approvals. Now they realized that they need to get permission and requested AP CRDA for the exemption. | The same will be brought to the notice of the AP CRDA/ADC higher officials. |
| | Mr. R Sambasiva Rao said that no water bodies are affected because of the roads project and the present pollution levels are too low. | The provision for the water sprinkling in construction of 7 & 11 Roads is already made in the EA & EMP Report with budgetary provision as well as enforcing |

| Name of the Village(s) | Comments | Responses to the Comments given by APCRDA/Consultant |
|---|---|---|
| | However, During the construction phase of the road project dust pollution may arise. | the same in Contractor conditions. Hence, the issue will be taken care. |
| | Traffic Management to be taken care during the construction of the roads project. | Provisions for diversion of the traffic without affecting the local traffic will be made by the Contractor and the same is also put under the Contract conditions of 7 & 11 Roads projects. |

**4. Closing Remarks**

The Public Consultations concluded with the receipt and acknowledgement of the comments and views expressed by the participants for which suitable measures will be taken to resolve in the context of the EA-EMP reports of 7 & 11 Priority Roads documents.

Proceedings and Minutes of meeting for Stakeholder's Consultation is given in **Annexure -IV.**

**6.9.2.2 Stakeholder's Consultation Workshop**

Draft Environmental Assessment & Environmental Management Plan (EA-EMP) reports for 7 & 11 Priority Roads were prepared and disclosed on 04-03-2017 on the website of CRDA under the World Bank supported "Amaravati Sustainable Capital City Development Project (ASCCDP)" section. The public is notified through public notice on news. Comments and suggestions on the draft documents were invited. Proceedings and Minutes of meeting for Stakeholder's Consultation Workshop is given in **Annexure -IV.**

The public consultation Workshop on Draft EA-EMP reports for 7 & 11 Priority Roads is conducted on 04-04-2017 for accomplishing wider awareness, share contents of the documents and seek feedback from the participants leading to finalization of the documents and adopting for the Bank supported project - ASCCDP.

A Public Notice in both Telugu and English was published well before the workshop date and wide publicity was undertaken within the capital city about the workshop by CRDA.

B.L. Chennakesava Rao, Director-Lands of APCRDA chaired the workshop and welcomed all the participants. J.S.R.K. Sastry, Director-Strategy of APCRDA briefed the day's agenda of workshop and encouraged participants to voice their feedback after a brief presentation on Draft EA-EMP reports of 7 & 11 Priority Roads for addressing them and incorporating the same into EA-EMP reports duly adopting the World Bank norms.

**Members Present:**

The following participants voiced their suggestions during the consultation workshop which are summarized below.

1. 32 members consisting of

    a. farmers who have – participated in LPS, affected by land acquisition, affected by roads passing through their sites in village sites

    b. main representatives from associations / NGOs –

        i. Rajadhani Rytu Parirakshana Samiti

        ii.Thullur Educational Society

    c. Public Representatives

    d. Aarvee Associates

    e. Representatives from Print and Electronic Media

2. Line department officials: 16

    Competent Authorities from revenue units, Officials of – CRDA, ADC, PHED, Irrigation, Urban Development, Forests, etc.

3. Observers:

    Sr. Environmental Expert from The World Bank

The participants included women representatives as well. The list of Public Consultation participants consisting of name, mobile number and signature are filed in the Project dossiers and can be accessed by interested stakeholders.

**Issue - wise suggestions /feedback is precisely minuted below:**

**A. Environmental**

1. Due to road construction water flow to the existing farm ponds will be stopped and tanks/farm ponds will not be filled. Due to this ground water level will be reduced after certain period and necessary mitigation measures to be adopted during the design stage and ensure better water storage/supply.
2. Requested to check the idea of planting the saplings before commencement of construction activity. Requested for affected trees transplantation. Suggested to encourage citizen participation in every village in maintenance of avenue plantation.
3. Existing Land use pattern- Showed that agricultural area as %. Shall be reworked. CRDA suggested considering the project area as vacant land as the

land was already acquired by CRDA under Land Pooling scheme two years before the study period.

4. Monitoring of Air pollution. Mr J.S.R.K. Sastry suggested incorporating the method followed, sampling protocol, transportation method, accreditation lab details etc. Limitations and assumptions to be discussed. Suggested to consider other than the vehicular pollution in the capital city area.
5. Impact on water spread area. Suggested to categorize the water spread area as natural and manmade ponds separately with usage and depth.
6. Avenue plantation - Suggested providing more no of plants inconsideration with Forest Department Guidelines.
7. Monitoring of Air, Water Noise quality, baseline data. Suggested to monitor the pre-monsoon at sample locations (approx. 10 locations) and analyse in capital city area.
8. Water spread area for 11 roads need to be corrected. Suggested to categorize natural, manmade ponds area and need to discuss road wise farm ponds, tanks etc.
9. Need to show the water flow details to existing ponds and restoration plan of ground water levels in the ponds. Suggested to show the water flow details to existing ponds in maps and discuss the restoration mechanism of ground water levels in pond areas especially Thulluru tank and Chakalicheruvu tank areas.
10. Need to discuss major challenges faced during preparation of EIA

**B. Engineering**

1. Requested for extension of E-6 road from Thulluru to Nelapadu for a length of 2.10 km.
2. Impact on farm ponds should be minimal and suggested to conduct the consultations during design preparation to avoid farm ponds, provision of under passes and service road
3. Need to provide underpasses whenever crossing is required. To continue the access to the existing road network to the villages, they are requested to construct the underpasses as priority.

**C. Social**

1. Thullur education society school will be affected due to proposed N-14 road. Requested to avoid the education centre.
2. Replacement cost for the affected structures. Requested for more compensation.
3. Need to discuss the project benefits and suggested to discuss the project benefits such as social, economic growth and population will be benefited etc., by each road for every 10 years.

**Closing Remarks**

The consultation workshop concluded with the receipt and acknowledgement of the comments and views expressed by the participants for which suitable measures will be taken to resolve in the context of the EA-EMP reports of 7 & 11 Priority Roads documents.

Those issues which are outside the scope of the EA-EMP documents have been compiled and circulated to the respective authorities for taking necessary further steps.

Further it is intimated that feedback by email or telephone to APCRDA or Aarvee is also accepted till 15th April 2017. Respective contacts were shared during the end of presentation. (none received)

The issues raised during the Public Consultation are addressed in EA & EMP report and Photographs showing Stakeholder's Consultation Workshop are given in Figure -6.139 below.

**Figure 6-139: Photographs showing stakeholder's consultation workshop**

### 6.9.2.2 Disclosure of EA & EMP Report

Draft EA & EMP report was prepared and disclosed on APCRDA website on 4th March 2017, subsequently advertised both in leading Telugu and English daily News papers inviting public, NGO's and other interested groups for public consultation workshop, and the same was held on 4th April 2017. Additional time was announced for submission of suggestions on the EA & EMP report by Email, post or by hand (none resceived). Additional public consultations were held at seven distributed villages from 19th to 22nd July 2017. The latest EA and EMP report was prepared duly incorporating all the minutes of meeting of public consultations/workshop and The World Bank comments issued in the month of June 2017. This report will be disclosed and once again presented at the proposed public consultation meeting to be held in the last week of August 2017. Upon receiving the comments if any, the final EA & EMP report will be delivered.

# Chapter 7
# ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

## 7.0 Anticipated Environmental Impacts and Mitigation Measures

The Urban Road development projects exhibit a symbiotic relationship between the environment and development with both positive and negative and reversible and irreversible impacts. The present chapter gives the analysis of the environmental impacts in the proposed project corridor and suggested suitable mitigative measures.

Matrix method will be adopted as methodology for assessment of cumulative impacts on the project. Based on the scoping of the areas and the work being proposed the following key issues were assessed for this project.

- Preservation of aesthetic and landscape of the area to the possible extent
- Effective restoration of borrow area and quarries
- Noise and air quality
- Tree removal and tree plantation
- Sanitation and waste disposal
- Road safety
- Protection of flora and fauna

Road development projects can have impacts or cause impacts in four specific situations as follows:

- Impacts of Location
- Impacts of Project Design
- Impacts during Construction, and
- Impacts when the Road become Operational.

## 7.1 Impacts of Location

The road stretch has no specific impacts from the location. During this phase, those impacts, which are likely to take place due to the layout of the project, have been assessed. These impacts are:

1. Project Affected People (PAPs)
2. Change of Land use
3. Loss of trees/forest
4. Utility/Drainage Problems
5. Impact on Historical and Cultural Monuments
6. Impact on Local Transport Facilities

## 7.2 Impacts Due to Project Design

The engineering design of the road is being prepared incorporating all environmental safeguards. The basic design criteria have been covered in Project Description. The side drains, stone pitching near high embankments, up gradation of structures and protection with the crash barriers near high embankments are being taken care in the design of the project to ensure the construction of 4 lane/ 4 lane + 2 lane BRT in Capital City of Andhra Pradesh in Guntur district.

### 7.2.1 Avoidance of adverse impacts during Design Stage:

The environmental resources which get covered as sensitive receptors as per Bank guidelines that have been conserved in Corridor of Impact (CoI) through continued interaction between the design and environmental teams, package wise in 10 Priority roads are given below in Table -7.1 using the road wise maps generated for Corridor of Impact (CoI) area which are attached separately as **Annexure -V**.

**Table 7-1 : Avoidance of adverse impacts on environmental resources in 10 Priority Roads roads**

| Package | Trees avoided in Corridor of Impact (CoI) | Farm ponds avoided in Corridor of Impact (CoI) | Ground water sources in Corridor of Impact (CoI) | Cultural properties in Corridor of Impact (CoI) |
|---|---|---|---|---|
| I | 275 | 20 | Nil | Nil |
| II | 289 | 4 | Nil | Nil |
| III | 365 | 18 | Nil | Nil |
| IV | 621 | 16 | Nil | Nil |
| V | 67 | 2 | Nil | Nil |
| VI | 126 | 18 | Nil | Nil |

## 7.3 Impacts During Construction

Since the construction is dependent on the quality and properties of the available material, the choice of material, particularly the management of borrow pits, assumes importance during construction.

### 7.3.1 Borrow Areas / Stone Quarries / Sand Quarries

The proposed project corridor requires raw materials from borrow areas, metal quarries and sand quarries. Borrow Areas with large quantity of earth/ gravel material is required for widening of formation and embankment, necessitating earth / gravel from borrow pits.

- **Borrow Areas:** Large quantity of earth / gravel material is required for widening of formation and embankment, necessitating earth / gravel from borrow pits. Borrow earth shall be taken from in & around the study area as per the requirement of sub-project (road) component. 10 nos. of operational licensed borrow areas are allotted for APCRDA for the proposed 10 Priority roads by Department of Mines & Geology, GoAP.
- **Metal Quarries:** 4 nos. of operational licensed metal quarries are allotted for the proposed roads for APCRDA by Department of Mines & Geology, GoAP.
- **Sand Quarries:** Assuming 8 nos. of sand quarries will be used for the proposed roads, one each for each package of 10 Priority roads with concerned approval from Directorate of Mines & Geology, AP.

***Proposed Mitigation Measures:***

- To avoid any embankment slippage, the borrow areas will not be dug continuously, and the size and shape of borrow pits will be decided by the Site Engineer. Redevelopment of the borrow areas to mitigate the impacts will be the responsibility of the Contractor. The Contractor shall evolve site-specific redevelopment plans for each borrow area location, which shall be implemented after the approval of the Supervision Consultant.
- Precautionary measures as the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills, which might result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day-time only. The unpaved surfaces used for the haulage of borrow materials

will be maintained properly. Borrowing of earth shall be carried out at locations recommended as follows:

- Non-Cultivable Lands: Borrowing of earth will be carried out up to a depth of 2.0m from the existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than "1 vertical" in "4 horizontal".
- Productive Lands: Borrowing of earth shall be avoided on productive lands. However, in the event of borrowing from productive lands, under circumstances as described above, topsoil shall be preserved in stockpiles. The conservation of topsoil shall be carried out as per the standard procedures. At productive land locations, the depth of borrow pits shall not exceed 45cm and it may be dug out to a depth of not more than 30cm after stripping the 15cm topsoil aside.
- Elevated Lands: At locations where private owners desire their fields to be leveled, the borrowing shall be done to a depth of not more than 2m or up to the level of surrounding fields. Borrow pits along Roadside: Borrow pits shall be located 5m away from the toe of the embankment. Depth of the pit should be such that the bottom of the pit shall not fall within an imaginary line of slope 1 vertical to 4 horizontal projected from the edge of the final section of the bank. Borrow pits should not be dug continuously. Ridges of not less than 8m width should be left at intervals not exceeding 300m. Small drains should be cut through the ridges to facilitate drainage.
- Borrow pits on the riverside: The borrow pit should be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood.
- Community / Private Ponds: Borrowing can be carried out at locations, where the private owners (or in some cases, the community) desire to develop lands (mostly low-lying areas) for pisciculture purposes and for use as fish ponds.

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

- Quarries and borrow pits will be back filled with rejected construction wastes and will be given a vegetative cover. If this is not possible, then slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.
- During works execution, the Contractor shall ensure preservation of trees during piling of materials; spreading of stripping material to facilitate water percolation and allow natural vegetation growth; re-establishment of previous natural drainage flows; improvement of site appearance; digging of ditches to collect runoff; and maintenance of roadways where a pit or quarry is declared useable water source for livestock or people nearby. Once the works are completed, and at own expense of the Contractor, he shall restore the environment around the work site to its original splits.
- To create a safe environment under the terms of The Mines and Quarries Act the faces should be reduced to a naturally stable slope or be adequately fenced to prevent access to the top and bottom of the faces. Such a fence must be of a height as prescribed under The Mines Act with a barbed wire top strand designed to exclude the public from the quarry area. Depending on the location of the site presence of a permanent lake is considered to be as at is factory alternative to a fence.
- As per the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc., attract the following guidelines.

    1. The activity associated with borrowing for construction of roads, embankments etc. shall not involve blasting.
    2. The borrowing/ excavation activity shall be restricted to a maximum depth of 2m below general ground level at the site.
    3. The borrowing/ excavation activity shall not alter the natural drainage pattern of the area.
    4. The borrowed/ excavated pit shall be restored by the project proponent for useful purpose (s).

5. Appropriate fencing all around the borrowed/ excavated pit shall be made to prevent any mishap.
6. Measures shall be taken to prevent dust emission by covering of borrowed/ excavated earth during transportation.
7. Safeguards shall be adopted against health risks on account of breeding of vectors in the water bodies created due to the borrowing/ excavation of earth.

- Appropriate plant species for the planting programme should be selected in consultation with ecological consultant and local forest department. Depending on the limitations on the availability of appropriate plant material, harsh growing conditions (lack of irrigation and hot summer) and ongoing quarry rehabilitation operations there may be substantial loss of plantation and the planting programme may have to be continued for over 3–5 years. As plantings are progressively established they should be monitored before undertaking the next stage to ensure maximum plant survival rates.

### 7.3.2 Utilization of Fly Ash

Appreciating the overall concern for environmental and management issues pertaining to fly ash, which otherwise is a very useful by-product of thermal power plants, the Technology Information, Forecasting & Assessment Council (TIFAC), Department of Science & Technology (DST), and Ministry of Environment and Forests (MoEF), Government of India identified "Safe Disposal and Gainful Utilization of Fly Ash" identified the Highways as one of the thrust area.

There are two Thermal Power Stations identified which falls within 300 Km from the project corridor. The lists of thermal power stations identified are mentioned in table - 7.2.

**Table 7-2: List of thermal power stations which fall within 300 Km radius**

| S.No | Name of the power plant | Capacity (MW) | Location | District | State | Distance from Rayapudi (Km) |
|---|---|---|---|---|---|---|
| 1 | Narla Tatarao Thermal Power Station | 1760 | Ibrahimpatnam | Krishna | Andhra Pradesh | 37 |
| 2 | Kothagudem Thermal Power Station | 1720 | Paloncha | Khammam | Telangana | 169 |

Hence, Provision for Utilization of Fly Ash is to be made as per the IRC SP:58 – 2001 and Fly Ash Notification 2007 and the subsequent amendments in 25th January, 2016. The same shall also be put under the BoQs. Utilization of Fly ash in the highways shows the positive impact on the environment. Utilization of fly ash will not only minimize the disposal problem but will also help in utilizing precious land in a better way. Construction of road embankments using fly ash, involves encapsulation of fly ash in earthen core or with RCC facing panels. Since there is no seepage of rain water into the fly ash core, leaching of heavy metals is also prevented. When fly ash is used in concrete, it chemically reacts with cement and reduces any leaching effect. Even when it is used in stabilization work, a similar chemical reaction takes place which binds fly ash particles. Hence, chances of pollution due to use of fly ash in road works are negligible. As per the designs, the proposed pavement crust for all the priority roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the priority roads. Hence, It is not feasible to use fly ash in the proposed roads which has no embankments.

### 7.3.3 Borrow Pit Restoration

Arrangements for opening and using material from borrow pits shall contain enforceable provisions for the extraction and restoration of the borrow area, and their surroundings, in an environmentally sound manner to the satisfaction of the Site Engineer. Areas shall be graded to ensure drainage and visual uniformity, and arrangements shall be made to collect and preserve top soil for use in the excavated borrow pit sides and bottom to make it green area alternatively, these borrow areas would be sited as far as possible on high grounds or hillocks. Top soil shall be replaced and the area will be re-vegetated to the satisfaction of the Engineer. The top soil can also be used for side slope, median covering for the growth of shrubs and grass. Additional borrow pits will not be opened without restoration of those areas no longer in use.

### 7.3.4 Surplus Earth/ Muck/ Construction & Demolition Waste

The total quantity of surplus earth/ muck generated from the 10 Roads during the construction phase is about 4832192$m^3$. This includes the muck generated from various utilities passing beneath the road ROW. The muck produced from various utilities other than roads are storm water, Water Supply, Power, Gas, Waste Water, and ICT. The amount of Construction and demolition waste generated due to the construction of the road is about 2686.84 m3. An amount of Rs 4063.33 Lakhs is provided in the EMP for the disposal of the same. Details of surplus earth/ muck generated and C&D waste for various packages is given in Table -7.3.

**Table 7-3 : Details of Surplus Earth/ Muck and C&D waste**

| S. No | Type of road | Surplus Earth/ Muck (in Cum) | | C&D waste (in Cum) | |
|---|---|---|---|---|---|
| | | Quantities | EMP Cost (Rs in Lakhs) | Quantities | Remarks |
| 1 | Package -I (E8) | 655470.54 | 552.19 | 58.80m3 | Construction & Demolition dump site is identified near Tadepalli. This is designated dump site as identified in master plan. |
| 2 | Package -II (N9) | 511576.30 | 429.83 | 121.29m3 | Construction & Demolition dump site is identified near Tadepalli. This is designated dump site as identified in master plan. |
| 3 | Package -III (N4 & N14) | 629898.73 | 530.65 | 1241.42m3 | Construction & Demolition dump site is identified near Tadepalli. This is designated dump site as identified in master plan. |
| 4 | Package -IV (E10, E14 & N16) | 1195908.97 | 1004.96 | 474.15m3 | Construction & Demolition dump site is identified near Tadepalli. This is designated dump site as identified in master plan. |
| 5 | Package -V (E6) | 1093818.23 | 919.38 | 686.28 m3 | Construction & Demolition dump site is identified near Tadepalli. This is the designated dumpsite as identified in master plan |
| 6 | Package - VI (N11, E12) | 745518.75 | 626.32 | 104.90 $m^3$ | Construction & Demolition dump site is identified near Tadepalli. This is the designated dumpsite as identified in master plan |

Source: Assessed by M/s. Aarvee Associates, Hyderabad

To dispose the C&D waste generated from Package -I a low-lying land (3m deep) of 19.60 m2 is required. Similarly, for Package -II, Package –III, Package –IV, Package -V and Package VI of the proposed roads 40.43 m2, 413.80 m2, 157.05 m2, 228.76 m2 and 34.96 m2 of land is required respectively. As per the Solid Waste Draft Master Plan, Construction & Demolition dump site is identified near Tadepalli duly adopting Construction & Demolition (Management & Handling) Rules, 2016 and Solid waste landfill site is identified in the outskirts of Mangalagiri duly adopting Solid Waste (Management & Handling) Rules, 2016. These are the designated dumpsites as identified in master plan. Details of areas identified for proposed landfill and tentative Construction & Demolition dump site are given in Figure -7.1.

**Figure 7-1 : Areas identified for proposed landfill and tentative Construction & Demolition dump site**

### 7.3.5 Soil Quality

The problems of soil erosion exist in the stretch due to varying topography, erratic rainfall and swift velocities of water in the drains during monsoon.

Top Soil Loss: The loss of fertile topsoil / humus may occur because of the extension of carriageway along the proposed corridor, hence care and precaution need to be taken to preserve the layer and reuse the soil as it contains the humus.

Soil Erosion: It may occur due to the uneven topography and intensity of rainfall. A major problem of erosion may occur due to the removal of age-old trees along the roadside within ROW. The removal will result in the instability of soil binding and soil structure, as uprooting will make the soil loose. Erosion may occur due to the swift velocities of drains in monsoon. Since the terrain is mostly plain there may not be an issue of erosion and sediment in sub-project influence area. However, there are 17 nos. of major and minor bridge crossings and 162 nos. of culverts proposed at vagus/streams that are prone for soil erosion and sedimentation. An adequate provision of stone pitching on embankments is already made in civil contract near high embankments close to water bodies and grass turfing provision is made for the remaining stretches. During construction activity there may be some sort of sediment issue might arise, already mitigation measure that muck should not be disposed in 500m close proximity to water bodies/ drainage system is suggested.

Mitigation measures include periodic maintenance of drains to check scouring of soil and limiting construction activities of culverts and bridges to dry seasons. Measures should be taken to prevent contamination of soil by bituminous material and other chemicals utilized during construction. No agricultural land would be used for borrow areas. The excavated top soil will be properly stored for reuse. In addition to the engineering design the corridor will be planted with trees to support and strengthen the soil binding capacity.

### 7.3.6 Impact on water resources and water quality

To prevent accumulation of water by the road side, adequate cross drainage (CD) structures in the form of culverts with adequate discharge and dream along the road capacity will be constructed. During reconstruction of old cross drainage structures and construction of new ones, diversion is required to aid uninterrupted movement of traffic.

Material will not be put in the drainage to avoid blockage and prevent the erosion. This will help in protecting the aquatic ecology.

17 bridges (proposed) and 162 culverts (proposed) are operated for adequate discharge of cross drainage in the project and the details of culverts for the proposed roads are mentioned in Table –7.4 and Table - 7.5 for Package I-IV and Package V-VI roads respectively. For the said cross drainage structures, every care has been taken to the safe flow of water towards the downstream.

No permanent impact is anticipated on water quality due to the project. The construction of the project needs partial filling of the farm ponds roadside which remain dry during non-monsoon. The details of water bodies/ lakes abutting within 500m radius from the project road are given in Table –7.6.

Construction activities may temporarily deteriorate surface water quality in terms of increased turbidity as well as oil and grease. The mitigation measures to protect the water quality include proper disposal of water and other liquid wastes arising from construction. Also, stream courses and drains will be kept free from dumping of solid wastes and earth material.

**Table 7-4: Details of Cross Drainage Structures for the proposed roads – Package I-IV**

| S.No. | Chainage (km.) | Span/ Dia Arrangement (proposed) | Proposal |
|---|---|---|---|
| **Package I** | | | |
| **E08** | | | |
| 1 | 0+440 | 3 x 2 | New |
| 2 | 0+920 | 3 x 1.5 | New |
| 3 | 1+120 | 3 x 1.5 | New |
| 4 | 1+640 | 3 x 1.5 | New |
| 5 | 2+360 | 3 x 1.5 | New |
| 6 | 3+220 | 3 x 1.5 | New |
| 7 | 4+320 | 3 x 1.5 | New |
| 8 | 4+820 | 3 x 1.5 | New |
| 9 | 5+440 | 3 x 1.5 | New |
| 10 | 6+160 | 3 x 1.5 | New |
| 11 | 6+640 | 3 x 1.5 | New |
| 12 | 8+300 | 3 x 1.5 | New |
| 13 | 8+800 | 3 x 1.5 | New |
| 14 | 9+380 | 3 x 1.5 | New |
| 15 | 10+500 | 3 x 2 | New |
| 16 | 12+980 | 3 x 1.5 | New |
| 17 | 14+860 | 3 x 1.5 | New |

| S.No. | Chainage (km.) | Span/ Dia Arrangement (proposed) | Proposal |
|---|---|---|---|
| **E10** | | | |
| 1 | 0+320 | 3 x 2 | New |
| 2 | 0+920 | 3 x 1.5 | New |
| 3 | 1+420 | 3 x 1.5 | New |
| 4 | 1+860 | 3 x 2 | New |
| 5 | 2+360 | 3 x 1.5 | New |
| 6 | 3+180 | 3 x 2 | New |
| 7 | 3+740 | 3 x 1.5 | New |
| 8 | 4+580 | 3 x 1.5 | New |
| 9 | 5+040 | 3 x 1.5 | New |
| 10 | 5+600 | 3 x 1.5 | New |
| 11 | 6+100 | 3 x 1.5 | New |
| 12 | 6+620 | 3 x 1.5 | New |
| 13 | 7+120 | 3 x 1.5 | New |
| 14 | 7+620 | 3 x 1.5 | New |
| **E14** | | | |
| 1 | 0+860 | 3 x 1.5 | New |
| 2 | 1+030 | 1.20 | New |
| 3 | 1+045 | 1.20 | New |
| 4 | 1+700 | 1.20 | New |
| 5 | 2+560 | 3 x 2 | New |
| 6 | 3+050 | 1.20 | New |
| 7 | 3+065 | 1.20 | New |
| 8 | 3+350 | 3 x 1.5 | New |
| 9 | 3+515 | 2 x 1.5 | New |
| 10 | 3+645 | 1.20 | New |
| 11 | 3+730 | 1.20 | New |
| 12 | 4+120 | 1.20 | New |
| 13 | 4+135 | 1.20 | New |
| 14 | 4+420 | 3 x 1.5 | New |
| 15 | 5+490 | 3 x 1.5 | New |
| 16 | 5+600 | 3 x 1.5 | New |
| 17 | 6+905 | 1.20 | New |
| **N4** | | | |
| 1 | 0+100 | 3 x 2 | New |
| 2 | 0+700 | 3 x 1.5 | New |
| 3 | 1+280 | 3 x 1.5 | New |
| 4 | 1+700 | 3 x 1.5 | New |
| 5 | 2+120 | 3 x 2.5 | New |
| 6 | 3+080 | 3 x 1.5 | New |
| 7 | 3+600 | 3 x 2 | New |
| 8 | 4+880 | 3 x 1.5 | New |

| S.No. | Chainage (km.) | Span/ Dia Arrangement (proposed) | Proposal |
|---|---|---|---|
| 9 | 5+380 | 3 x 1.5 | New |
| 10 | 5+900 | 3 x 2 | New |
| 11 | 6+400 | 3 x 1.5 | New |
| 12 | 7+060 | 3 x 1.5 | New |
| **N09** | | | |
| 1 | 0+820 | 3 x 2.5 | New |
| 2 | 1+690 | 3 x 1.5 | New |
| 3 | 2+570 | 3 x 4 | New |
| 4 | 3+360 | 3 x 1.5 | New |
| 5 | 3+840 | 3 x 1.5 | New |
| 6 | 4+400 | 3 x 1.5 | New |
| 7 | 4+900 | 3 x 1.5 | New |
| 8 | 5+220 | 3 x 1.5 | New |
| 9 | 5+740 | 3 x 1.5 | New |
| 10 | 6+240 | 3 x 1.5 | New |
| 11 | 6+700 | 3 x 1.5 | New |
| 12 | 7+220 | 3 x 1.5 | New |
| 13 | 7+800 | 3 x 1.5 | New |
| 14 | 8+360 | 3 x 1.5 | New |
| 15 | 9+640 | 3 x 1.5 | New |
| **N14** | | | |
| 1 | 0+260 | 3 x 1.5 | New |
| 2 | 1+460 | 3 x 1.5 | New |
| 3 | 2+000 | 3 x 1.5 | New |
| 4 | 2+590 | 3 x 1.5 | New |
| 5 | 3+220 | 3 x 1.5 | New |
| 6 | 3+830 | 3 x 1.5 | New |
| 7 | 4+240 | 3 x 1.5 | New |
| **N16** | | | |
| 1 | 0+300 | 3 x 1.5 | New |
| 2 | 0+890 | 3 x 1.5 | New |
| 3 | 1+240 | 3 x 1.5 | New |
| 4 | 1+780 | 3 x 1.5 | New |
| 5 | 2+600 | 3 x 1.5 | New |
| 6 | 3+160 | 3 x 4 | New |
| 7 | 3+580 | 3 x 1.5 | New |
| 8 | 5+560 | 3 x 2.5 | New |
| 9 | 6+820 | 3 x 2.5 | New |
| 10 | 7+960 | 3 x 1.5 | New |
| 11 | 8+460 | 3 x 1.5 | New |
| 12 | 8+740 | 3 x 1.5 | New |

**Table 7-5 : Details of Cross Drainage Structures for Package V-VI**

| Sl.No | Chainage | Type of Structure | Span Arrangement (No.*L*H/Dia.) |
|---|---|---|---|
| **Package V** | | | |
| **E06** | | | |
| 1 | 76 | Box Culvert | 1 x 6.0 x 1.5 |
| 2 | 1169 | Box Culvert | 1 x 1.5 x 1.5 |
| 3 | 1236 | Pipe Culvert | 1 x 1.20 |
| 4 | 1247 | Pipe Culvert | 1 x 1.20 |
| 5 | 1558 | Pipe Culvert | 1 x 1.20 |
| 6 | 1648 | Pipe Culvert | 1 x 1.20 |
| 7 | 1682 | Pipe Culvert | 1 x 1.20 |
| 8 | 2349 | Box Culvert | 1 x 5.0 x 1.5 |
| 9 | 2565 | Major Bridge | 2x25+3x37+2x25 |
| 10 | 3233 | Pipe Culvert | 1 x 1.20 |
| 11 | 3329 | Pipe Culvert | 1 x 1.20 |
| 12 | 3340 | Pipe Culvert | 1 x 1.20 |
| 13 | 3765 | Pipe Culvert | 1 x 1.20 |
| 14 | 3775 | Pipe Culvert | 1 x 1.20 |
| 15 | 4025 | Minor Bridge | 1 x 10.0 x 1.5 |
| 16 | 4064 | Box Culvert | 1 x 5.0 x 1.5 |
| 17 | 4200 | Minor Bridge | 1 x 30.0 x 1.5 |
| 18 | 4370 | Pipe Culvert | 1 x 1.20 |
| 19 | 4823 | Box Culvert | 1 x 5.0 x 1.5 |
| 20 | 5923 | Pipe Culvert | 1 x 1.20 |
| 21 | 5939 | Pipe Culvert | 1 x 1.20 |
| 22 | 6931 | Box Culvert | 1 x 5.0 x 1.5 |
| 23 | 7440 | Major Bridge | 30+37+30 |
| **Package VI** | | | |
| **E12** | | | |
| 1 | 77 | Box Culvert | 1 x 2.5 x 2.0 |
| 2 | 375 | Box Culvert | 1 x 2.0 x 1.5 |
| 3 | 973 | Box Culvert | 1 x 5.0 x 1.5 |
| 4 | 1135 | Box Culvert | 1 x 2.5 x 1.5 |
| 5 | 1158 | Box Culvert | 1 x 3.0 x 1.5 |
| 6 | 1348 | Box Culvert | 1 x 2.0 x 1.5 |
| 7 | 1789 | Box Culvert | 1 x 3.0 x 1.5 |
| 8 | 2194 | Box Culvert | 1 x 5.0 x 1.5 |
| 9 | 2382 | Box Culvert | 1 x 5.0 x 1.5 |
| 10 | 3085 | Box Culvert | 1 x 5.0 x 1.5 |
| 11 | 3230 | Box Culvert | 1 x 2.5 x 3.0 |
| 12 | 3337 | Box Culvert | 1 x 5.0 x 1.5 |
| 13 | 3495 | Box Culvert | 1 x 1.5 x 1.5 |
| 14 | 3550 | Box Culvert | 1 x 2.0 x 1.5 |
| 15 | 4140 | Box Culvert | 1 x 1.5 x 1.5 |
| 16 | 4290 | Box Culvert | 1 x 2.5 x 1.5 |

| | | | |
|---|---|---|---|
| 17 | 4700 | Box Culvert | 1 x 2.5 x 2.0 |
| 18 | 4776 | Box Culvert | 1 x 2.0 x 1.5 |
| 19 | 4967 | Pipe Culvert | 1 x 1.20 |
| 20 | 4974 | Pipe Culvert | 1 x 1.20 |
| 21 | 5193 | Box Culvert | 1 x 5.0 x 1.5 |
| 22 | 5337 | Box Culvert | 1 x 1.5 x 1.5 |
| 23 | 5740 | Pipe Culvert | 1 x 1.20 |
| 24 | 6600 | Major Bridge | 12X37 |
| **N11** | | | |
| 1 | 491 | Box Culvert | 1 x 1.5 x 1.5 |
| 2 | 1088 | Box Culvert | 1 x 2.5 x 1.5 |
| 3 | 1575 | Box Culvert | 1 x 2.5 x 1.5 |
| 4 | 1741 | Box Culvert | 1 x 6.0 x 1.5 |
| 5 | 2148 | Box Culvert | 1 x 1.5 x 1.5 |
| 6 | 2228 | Box Culvert | 1 x 1.5 x 1.5 |
| 7 | 2555 | Pipe Culvert | 1 x 1.20 |
| 8 | 2636 | Box Culvert | 1 x 1.5 x 1.5 |
| 9 | 3027 | Box Culvert | 1 x 1.5 x 1.5 |
| 10 | 3230 | Major Bridge | 3x37 |
| 11 | 3336 | Box Culvert | 1 x 2.5 x 1.5 |
| 12 | 4338 | Box Culvert | 1 x 1.5 x 1.5 |
| 13 | 4570 | Pipe Culvert | 1 x 1.20 |
| 14 | 5052 | Box Culvert | 1 x 1.5 x 1.5 |
| 15 | 5308 | Box Culvert | 1 x 1.5 x 1.5 |
| 16 | 5390 | Box Culvert | 1 x 1.5 x 1.5 |
| 17 | 5796 | Box Culvert | 1 x 2.5 x 1.5 |
| 18 | 5957 | Box Culvert | 1 x 2.5 x 1.5 |
| 19 | 6530 | Pipe Culvert | 1 x 1.20 |
| 20 | 6846 | Box Culvert | 1 x 2.5 x 1.5 |
| 21 | 7000 | Box Culvert | 1 x 2.5 x 2.0 |
| 22 | 7340 | Pipe Culvert | 1 x 1.20 |
| 23 | 8096 | Box Culvert | 1 x 2.0 x 1.5 |
| 24 | 8250 | Box Culvert | 1 x 1.5 x 1.5 |
| 25 | 8635 | Box Culvert | 1 x 2.5 x 1.5 |

**Table 7-6 : Details of the Major Water Bodies Abutting the Project Roads**

| Name of the Water Body/Package abutting 10 Priority roads | Chainage | Side | Remarks |
|---|---|---|---|
| **E-10** | | | |
| Stream | 4750+00 to 5000+00 | NE-South | RHS |
| Stream | 5100+00 to 5200+00 | NE-South | Crossing |
| Stream | 5200+00 to 5500+00 | NE-South | LHS |
| Farm Pond | 6700+00 to 7500+00 | - | RHS |
| Stream | 8800+00 | NE-South | Crossing |
| Stream | 8800+00 9050+00 | NE-South | LHS |
| Stream | 8900+00 to 9600+00 | NE-South | RHS |

| Name of the Water Body/Package abutting 10 Priority roads | Chainage | Side | Remarks |
|---|---|---|---|
| River Krishna | 9800+00 to 9900+00 | West to South | North |
| **E-8** | | | |
| Farm Pond | 12050+00 to 12550+00 | - | LHS |
| Farm Pond | 5750+00 to 6250+00 | - | RHS |
| Farm Pond | 4400+00 to 4700+00 | - | Crossing |
| Farm Pond | 4150+00 to 4950+00 | - | Both sides |
| Farm Pond | 2300+00 to 2550+00 | - | RHS |
| Stream | 1300+00 to 1400+00 | North-South | Crossing |
| Stream | 800+00 to 900+00 | North-South | Crossing |
| **E14** | | | |
| Farm Pond | Near to Buthapudi | - | RHS |
| Farm Pond | Near to Navuluru | - | Crossing &LHS |
| **N16** | | | |
| Farm Pond | 1000+00 to 1600+00 | - | LHS near |
| **N14** | | | |
| Farm Pond | 1000+00 to 1600+00 | - | LHS- |
| Farm Pond | 3400+00 to 4000+00 | - | RHS |
| River Krishna | 8000+00 to 8200+00 | West-South | North |
| **N9** | | | |
| Stream | 4100+00 | North-South | Crossing |
| Lake | 3800+00 to 4300+00 | North-South | Both sides |
| Farm Pond | 9800+00 to 10300+00 | - | RHS |
| Farm Pond | 10400+00 to 10900+00 | - | RHS |
| Stream | 12800+00 to 12900+00 | East-West | Both |
| Farm Pond | 0.000+00 | - | South |
| Stream | 3000+00 to 3100+00 | East-West | Crossing |
| Farm Pond | 2800+00 to 3300+00 | - | Both |
| **N4** | | | |
| Stream | 2200+00 | West-South | Crossing |
| Canal | 1900+00 to 4000+00 | West-South | RHS |
| Stream | 4600+00 | NW-South | Crossing |

| Name of the Water Body/Package abutting 10 Priority roads | Chainage | Side | Remarks |
|---|---|---|---|
| River Krishna | 7000+00 to 7200+00 | West-South | RHS |
| **E6** | | | |
| Farm pond | 900 | Center | Within |
| Farm pond | 900 | LHS | 200 buffer |
| Farm pond | 500-700 | RHS | 200 buffer |
| Farm pond | 1800 | RHS | Within |
| Farm pond | 1900-200 | Crossing | Within+20 buffer |
| Farm pond | 2500-2600 | RHS | Within+20 buffer |
| Farm pond | 3300-3400 | Both | Within+20+200 buffer |
| Farm pond | 4100-4200 | LHS | Within+20 buffer |
| Farm pond | 4300 | Crossing | Within |
| Farm pond | 5000 | LHS | Within+20 buffer |
| Farm pond | 6100-6200 | RHS | Within boarder+20 buffer |
| **N11** | | | |
| Farm pond | 2600 | RHS | 200 buffer |
| Farm pond | 2900-300 | RHS | Within+20 buffer |
| Farm pond | 3100-3200 | LHS | 200 buffer |
| Farm pond | 3100-3200 | RHS | 200 buffer |
| Farm pond | 3200-3300 | RHS | 200 buffer |
| Farm pond | 3700-3800 | RHS | Within |
| Farm pond | 3800-3900 | LHS | 200 buffer |
| Farm pond | 4000-4100 | LHS | 200 buffer |
| Farm pond | 4100-4200 | RHS | 200 buffer |
| Farm pond | 4200-4300 | LHS | 200 buffer |
| Farm pond | 4300-4400 | RHS | 20+200 buffer |
| Farm pond /Stream | 4500-4600 | LHS | 20+200 buffer |
| Farm pond | 4700-4800 | RHS | 200 buffer |
| Farm pond | 4700-4900 | LHS | 200 buffer |
| Farm pond | 4900-5000 | LHS | 200 buffer |
| Farm pond | 4900-5000 | LHS | 200 buffer |
| Farm pond | 4900-5000 | LHS | 20+200 buffer |
| Farm pond | 5000-5100 | LHS | 200 buffer |
| Farm pond | 5300-5400 | RHS | Within+20 buffer |

| Name of the Water Body/Package abutting 10 Priority roads | Chainage | Side | Remarks |
|---|---|---|---|
| Farm pond | 5600-5700 | LHS | Within |
| Farm pond | 5400-5500 | RHS | 200 buffer |
| Farm pond | 5400-5500 | RHS | 200 buffer |
| Farm pond | 5700-5800 | RHS | 200 buffer |
| Farm pond | 5700-5800 | Middle | Within |
| Stream | 6200-6400 | LHS | 200 buffer |
| Farm pond | 6600-6700 | RHS | 20 buffer |
| Farm pond | 2600 | RHS | 200 buffer |
| **E12** | | | |
| Stream | 1100-1200 | Crossing | Within+20 buffer |
| Stream | 2400 | Crossing | Within+20 buffer |
| Farm pond | 5700 | LHS | Within+20 buffer |
| Stream | 6700 | Crossing | Within+20+200 buffer |

Water bodies (River/ Stream/ Canal/ Lake/ Farm pond) mentioned in the above table exist within 500m either side of Right of Way (RoW). River Krishna is a perennial river, seasonal streams such as Kondaveeti vagu & Palu vagu are having low-flow regime during March – July whereas farm ponds and lakes are dry between March – July.

The farm ponds/ lakes falling in the corridor of impact and sub-project influence area were mostly developed for meeting the agricultural needs of the villagers. These farm ponds/ lakes, canals & streams and River Krishna are having very common aquatic flora & fauna. Avia fauna are also found to be common species as identified in the Chapter -6. There are no migratory, rare, endangered and threatened species identified in the the farm ponds falling under the proposed alignments of the project. However, due importance will be given to the ecological habitat during improvement or rehabilitation of Kondaveeti vagu, Pala vagu and other streams. Population of local fauna is very minimal & trans-location is not feasible.

### 7.3.6.1 Green Initiatives/ Environment Enhancement Measures for water bodies

There is a loss of about 17.65 acres of water spread area due to the proposed alignment of 10 roads. This area corresponds to about 0.1% of the water spread area of the capital city. Enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc. As such the water spread area in the capital city is proposed to be increased by 197%. The cost of the same will be included under ADC/ APCRDA and does not fall under the BoQs of the 10 Priority Roads. Package wise details of farm ponds within the alignment, volumes of water spread area lost and budget provision made in EMP is given in Table - 7.7 below.

**Table 7-7 : Details of Environment Enhancement Measures for water bodies in the proposed roads**

| Packages | No. of farm ponds within Alignment | Volume of water spread area lost (in m3) | Budget for enhancement of equivalent water spread area (in Rs. Lakh) |
|---|---|---|---|
| Package 1 (E8) | 13 | 3755.855 | 13.18 |
| Package 2 (N9) | 4 | 3206.03 | 11.25 |
| Package 3 (N4 & N14) | 1+14 | 55102.875 | 193.41 |
| Package 4 (E10, E14 & N16) | 4+1+2 | 995.235 | 3.49 |
| Package V (E6) | 8 | 5851.87 | - |
| Package VI (N11,E12) | 23 | 2532.775 | - |
| **Total** | **39** | **142889.28** | **221.33** |

Source: Assessed by M/s. Aarvee Associates, Hyderabad, assumed depth of 2m

### 7.3.7 Impact on Air Quality

Road construction will involve earth excavation, back filling and concreting. Impacts on air during the construction phase could be due to earth excavation, back filling and transportation of construction materials, D.G sets which may lead to rise in air pollution. However, the impact on ambient air quality will not be significant, since the dust and gases generated is confined to the proposed area and as it will be taken care of by adopting suitable control measures as described in EMP. However, this impact is localized.

Impacts on air during the construction phase could be due to transportation of construction equipment, construction material and road construction activities. Operation

of hot mix plants and Asphalt Plants will result in the emission of fumes and obnoxious gases to the environment. Loading/ unloading of construction materials and their transportation, particularly through the unpaved or un-metaled sections of the road may lead to a rise in the ambient SPM and RPM levels. Material handling, spillage may occur during the transportation of construction materials.

Fugitive dust emission during construction phase due to movement of trucks on haulage roads, excavation activities and loading & unloading activities is estimated based on US EPA reference documents. Notable inputs for the model include 54 precipitation days for Amaravati Capital City area (Gannavaram IMD station) – with precipitation > 2.54 mm, 12% silt and 2% moisture content. 95% EMP efficiency is assumed. It is estimated that a total reduction of 18731078.52 Tonnes/year of $PM_{10}$ and 41624618.93 Tonnes/year of $PM_{100}$ in fugitive dust emissions from haulage roads, excavation and loading & unloading activities during construction phase of 10 Priority Roads with an effective implementation of EMP throughout the construction phase.

The details of Total Fugitive Dust Emissions due to haulage roads, excavation and loading & unloading activities along with the cumulative reduction in tonnes per year when EMP is implemented with 95% efficiency are given in Table -7.8.

The details of respective Fugitive Dust Emissions due to haulage roads, excavation and loading & unloading activities along with the reduction in tonnes per year when EMP is implemented with 95% efficiency are given in Table -7.9

**Table 7-8: Total FDE from Haulage Roads, Excavation and Loading & Unloading activities**

| Total FDE from Haulage Roads, Excavation and Loading & Unloading activities of 10 Priority Roads in Amaravati Capital City area (Construction Phase) | | | | | | |
|---|---|---|---|---|---|---|
| PM Category | FDE without EMP | | FDE with EMP (95% efficiency) | | FDE reduction due to EMP | |
| | Tonnes per year | Tonnes per day | Tonnes per year | Tonnes per day | Tonnes per year | Tonnes per day |
| $PM_{10}$ | 19716924.76 | 54018.97 | 985846.24 | 2700.95 | **18731078.52** | **51318.02** |
| $PM_{100}$ | 43815388.34 | 120042.16 | 2190769.42 | 6002.11 | **41624618.93** | **114040.05** |

Source: Assessed by M/s. Aarvee Associates, Hyderabad

**Table 7-9: Respective Fugitive Dust Emissions due to haulage roads, excavation and loading & unloading activities**

| PM Category | FDE without EMP | | FDE with EMP (95% efficiency) | | FDE reduction due to EMP | |
|---|---|---|---|---|---|---|
| | Tonnes per year | Tonnes per day | Tonnes per year | Tonnes per day | Tonnes per year | Tonnes per day |
| **FDE from Haulage Roads of 10 Priority Roads in Amaravati Capital City Area (Construction Phase)** | | | | | | |
| $PM_{10}$ | 19713879.29 | 54010.63 | 985693.96 | 2700.53 | **18728185.33** | **51310.1** |
| $PM_{100}$ | 43808620.66 | 120023.62 | 2190431.03 | 6001.18 | **41618189.62** | **114022.44** |
| **FDE from Excavation of 10 Priority Roads in Amaravati Capital City Area (Construction Phase)** | | | | | | |
| $PM_{10}$ | 407.62 | 1.12 | 20.38 | 0.056 | **387.24** | **1.06** |
| $PM_{100}$ | 905.81 | 2.48 | 45.29 | 0.124 | **860.52** | **2.36** |
| **FDE from loading and unloading activities of 10 Priority Roads in Amaravati Capital City Area (Construction Phase)** | | | | | | |
| $PM_{10}$ | 2637.84 | 7.23 | 131.89 | 0.361 | **2505.95** | **6.87** |
| $PM_{100}$ | 5861.88 | 16.06 | 293.09 | 0.803 | **5568.78** | **15.26** |

Source: Assessed by M/s. Aarvee Associates, Hyderabad

***Mitigation Measures:***

- Hot mix plants shall be located away from the inhabited areas, residential settlements and water bodies.
- Trucks and tippers carrying earth for filling, sand, gravel or stone will be duly covered with Tarpaulin sheets to avoid spilling.
- Dust level at the construction sites shall be controlled by sprinkling water on haulage roads thrice in a day.
- Construction material, machinery and equipment will be maintained in a good working condition and shall be handled with due precaution and only by trained professionals.

### 7.3.8 Impact on Noise

The impact of noise levels from the project on the neighboring communities would be anticipated with the increase in vehicles and vary with vehicles speed. The increased noise level is attenuated by vegetative noise barriers (two rows of plants) in all the sensitive receptor areas as identified in Table 6.71. The major sources for noise pollution during construction will be movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. The construction equipment with high noise levels, loading and transportation of material near the borrow areas will affect the construction personnel and other humans in the area.

***Mitigation Measures:***

- The required mitigation measures include location of construction equipment at least 250m away from inhabited areas. In addition, construction workers should be provided with protection devices like earplugs.
- Other ancillary measures include maintenance of equipment in good condition, proper design of engine enclosures. Project activities shall be coinciding with periods when people would be least affected. Construction activities shall be strictly prohibited between 10 pm and 6 am in residential areas.

### 7.3.9 Impact on Biological Environment

There is no forest area in the project impact area. Some plants/ saplings needs to be cut due to the proposed project.

**i) Flora**

A detail of the plants to be cut for various roads is given in Table -7.10 below. The predominant species going to be felled include Ravi, Nalla tumma, Neem, Veduru, Nagajemudu, Mango, Teku, Maredu etc. These are all ubiquitous species. The cost of felling and transportation of felled trees which are 2-7 years old with a girth size varying from 15-35 cm is Rs. 4000/- per tree in Amaravati Capital City. The cost of felling of trees is incorporated in EMP and BoQs. The short-term impact due to felling of trees will be compensated in long term through the proposed avenue plantation programme. There are 13,228 nos. of trees proposed to be replanted in the Package -I by avenue plantation for a total length of 13.25 Kms, excluding the Major bridges; 12,834 nos. of proposed to be replanted in the Package -II by avenue plantation for a total length of 12.86 Kms, excluding the major bridges; 14,960 nos. of trees proposed for a length of 14.99 Kms in Package -III, excluding the major bridges and 23,583 nos. of trees proposed for a length of 23.63 Kms in Package -IV, excluding the major bridges. Guidelines on Landscape and Tree Plantation.There are 9513 nos. of trees proposed to be replanted in the Package -V by avenue plantation for a total length of 9.84Km, including the Major bridges; 14855 nos. of trees proposed to be replanted in the Package -VI by avenue plantation for a total length of 15.44 km, including the major bridges; as per the IRC: SP:21-2009: Guidelines on Landscape and Tree Plantation.

It is estimated that the length of the project stretch for Package -I is about 13.65 Kms, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads. Hence, the estimated median plantation for Package -I is around 9,091 nos. The length of the project stretch for Package -II is about 13.16 Kms, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads. Hence, the estimated median plantation for Package -II is around 8,765 nos. The length of the project stretch for Package -III is about 15.50 Kms, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads (in future). Hence, the estimated median plantation for Package -III is around 10,323 nos. The length of the project stretch for Package -IV is about 23.91 Kms, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads (in future). Hence, the estimated median plantation for Package -IV is around 15,924 nos.It is estimated that the length of the project stretch for Package -V is about 9.84Km, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads. Hence, the estimated median

plantation for Package -V is around 6553 nos. The length of the project stretch for Package -VI is about 15.44 Km, median plantation is proposed with a provision of 333 nos. of plants per kilometer for 2 medians in 4 lane + 2 lane BRT roads. Hence, the estimated median plantation for Package -VI is 10283 nos. Details of avenue plantation and median plantation for various packages of 10 roads are given in Table -7.11.

**Table 7-10 : Details of trees to be cut in Proposed 10 Roads**

| Package | Road ID | Affected Trees | Trees to be planted as per Forest Conservation Act, 1980 and subsequent amendments thereof |
|---|---|---|---|
| I | E8 | 266 | 798 |
| II | N9 | 96 | 288 |
| III | N4 | 195 | 981 |
| | N14 | 132 | |
| IV | E10 | 62 | 1467 |
| | E14 | 322 | |
| | N16 | 105 | |
| V | E6 | 85 | 255 |
| | N11 | 94 | 282 |
| VI | E12 | 31 | 93 |
| **Total** | | **849** | **2547** |

**Table 7-11 : Details of proposed avenue plantation and median plantation in Proposed 10 priority roads.**

| Package I | Avenue Plantation | Median Plantation |
|---|---|---|
| E8 | 13,228 | 9,091 |
| **Package II** | **Avenue Plantation** | **Median Plantation** |
| N9 | 12,834 | 8,765 |
| **Package III** | **Avenue Plantation** | **Median Plantation** |
| N4 | 6,916 | 4815 |
| N14 | 8,044 | 5508 |
| **Package IV** | **Avenue Plantation** | **Median Plantation** |
| E10 | 7,610 | 5201 |
| E14 | 7,315 | 4882 |
| N16 | 8,658 | 5841 |
| **Package V** | **Avenue Plantation** | **Median Plantation** |
| E6 | 9,513 | 6554 |
| **Package VI** | **Avenue Plantation** | **Median Plantation** |
| N11 | 8,522 | 5761 |

| | | |
|---|---|---|
| E12 | 6,333 | 4522 |
| **Total** | **88,973** | **60,940** |

***Mitigation Measures:***

- An avenue plantation programme shall be promptly adopted to restore and further enrich the loss of vegetation. Plantation with an appropriate mix of indigenous and especially suited species shall be carried out along the corridor. The number of avenue plants proposed to be planted is nos. 88,973 throughout the proposed 10 roads.
- Along the extreme edge of road boundary, fall growing and desert trees such as *Ravi, Nalla tumma, Neem, Veduru, Nagajemudu, Ganneru, Mango, Teku, Maredu etc* shall be planted *a*t 3 m from the outer ROW of the project stretch.
- In the median, the Flowering plants & shrubs with a height of about 2m shall be proposed to be planted. The plantation in the median will serve, as a barrier against glaring headlights of the vehicular traffic plying in the opposite direction. Further, this will improve the aesthetics of the road. The suggested plantation in the median is *Bougainvillea, Thevita peruviana (Be still tree), Nerium Oleander (Ganneru dwarf)* etc.

**ii) Fauna**

***Terrestrial Fauna:***

During the construction, no impact on the wildlife is anticipated.

***Aquatic Fauna:***

There are 75 nos. farm ponds identified in the project stretch of 200m radius, most of them remain dry during non-monsoon months.

Increasing sediment load to the recipient water bodies i.e. farm ponds and rivers will restrict the penetration of solar energy in the water body and increase the turbidity in the water bodies. This will affect photosynthesis of the aquatic flora, which in turn will have adverse impacts on the aquatic fauna. Since most of the water bodies remain dry during the non-monsoon months, this impact will be negligible. But, the implementation of the following measures will help to avoid soil erosion and further minimize the impacts of the aquatic fauna.

***Mitigation Measures:***

- Works shall be commenced at least 500m away from water bodies,
- Construction of bridges and culverts shall be accomplished during the non-monsoon periods.
- Filling up of farm ponds will be resorted only after exhausting all other options.
- The direct discharge of oil and chemical spills to the water bodies shall be prohibited.

### 7.3.10 Impacts on Human Use Values

**i) Land Use**

Construction of 4 lane/ 4 lane + 2 lane BRT road with Urban Roads norms may lead to a change in the land use pattern of areas adjacent to the road. The existing land adjacent to the road at present is mostly of barren and agricultural use.

The project corridor lies mostly in plain and thus, no disfiguration of land is envisaged due to construction activities except for the opening of borrow pits. The borrow pit locations have already been identified and will be restricted to those areas only.

***Mitigation Measures:***

1. Construction activities shall be limited to the corridor only.
2. Care shall be taken to ensure that the construction workers camp does not disturb the surrounding land use.
3. Existing access/ entrances to the urban roads shall be duly maintained.
4. The bypass/ flyovers alternatives that are best from Engineering, Environmental and Social aspects are selected for this project.

**ii) Flood Characteristics**

The proposed roads (10 roads) project proposes one hundred and sixty two (162) cross drainage structures proposed in the form of Box/ Pipe culverts. There are seventeen (17) bridges proposed in 10 roads. The project stretches are designed for above HFL hence, the flooding in the area can be avoided.

***Mitigation Measures:***

All the structures shall have adequate waterway. The design discharge shall be evaluated for flood of 100 years in case 4 laning is considered in the design of the project.

- Raising of the embankment height above the submergence depth, with provision of balancing culverts.
- Providing drain on both sides of the widened road and extending the drains to a proper outfall.
- Proper supervision during construction to avoid blocking of micro-drainage across the road.
- Maintaining existing drainage outlets.
- Replace inadequate or distressed drainage structures.
- Adequate number of cross drainage structures will be provided along the bypasses.

### 7.3.11 Impacts on Quality of Life

#### i. Socio-economics, Land Acquisitions and Re-settlements

Impacts and mitigation measures associated with social environment in the sub-project influence area (SPIA), land acquisition and resettlement of project-affected persons (PAP) have been dealt in report.

#### ii. Archeological Sites and Chance find of Artefacts.

As per "The Ancient Monuments and Archaeological Sites and Remains Act, 1958, as amended in 2010", the construction activities should be 200m away from the ASI site. Since the proposed roads are away from 200m of the site, no impact on Rock Cut Cave Temple is envisaged.

During the baseline study, no artefacts have been identified in the corridor of impact as per the discussions with the local people. In the case of chance find of artefacts the following mitigation measures shall be followed.

***Mitigation Measures :***

- In the case of chance find of artefacts, the contractor will not disturb the found artefacts further until an assessment by competent professionals is made and actions consistent with the requirements of ASI are taken.
- The Contractor, on behalf of the APCRDA/ADC, will coordinate with the Archeology Department to designate an on-site representative during the entire duration of the project.
- All workers will undergo a briefing with the Archeology Department to ensure safeguarding of artefacts/heritage resource and cultural/religious practices.

**iii. Traffic Management Plan**

The proposed 10 Roads project is completely passing through greenfield area and there are no major state highways or national highways within core area of 500m. However, there are panchayat, village and major district roads are existing and crossing the proposed roads. Site-specific traffic management plan shall be done by the contractor during construction phase of the sub-project as stated in General Conditions of Contract – GCC 62 (c), duly adopting the following key components of traffic management plan.

**Purpose of Overall Traffic Management Plan**

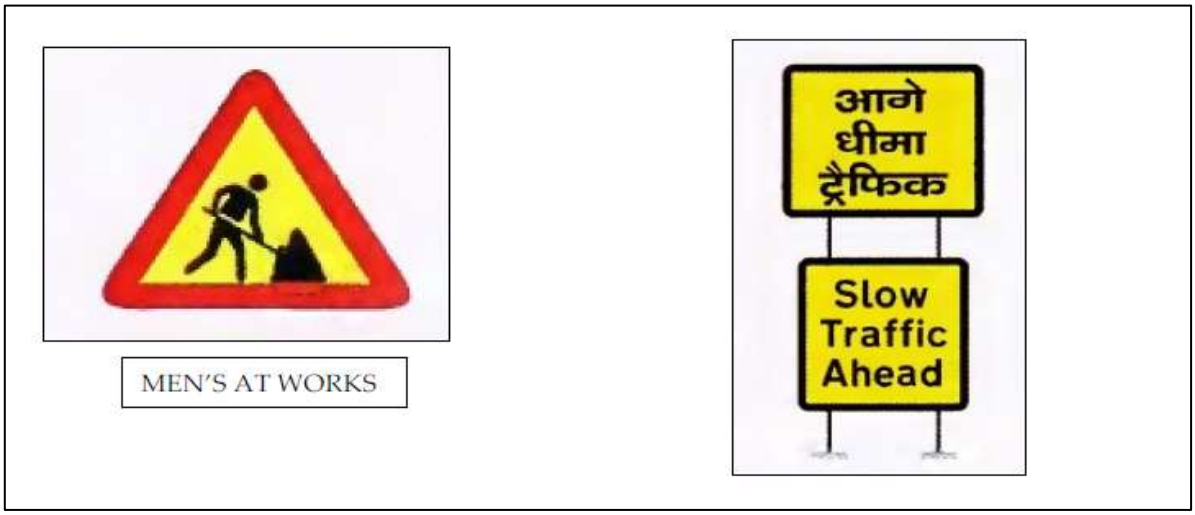
The overall traffic management plan is designed and intended to specify adequate safety measures in advance against identified hazards and stipulated implementation of the said safety measures to ensure safe movement of traffic during the construction operations of the proposed 10 priority Roads. The objective of safety standards is to provide safe travel to the drivers of vehicles plying along the Urban Roads always in the day, throughout the year and provide protection to the project workers when they are on the work. This overall traffic management plan delineates the safety standards in terms of Construction zones, Signs and Safety measures in work zones and during normal operations.

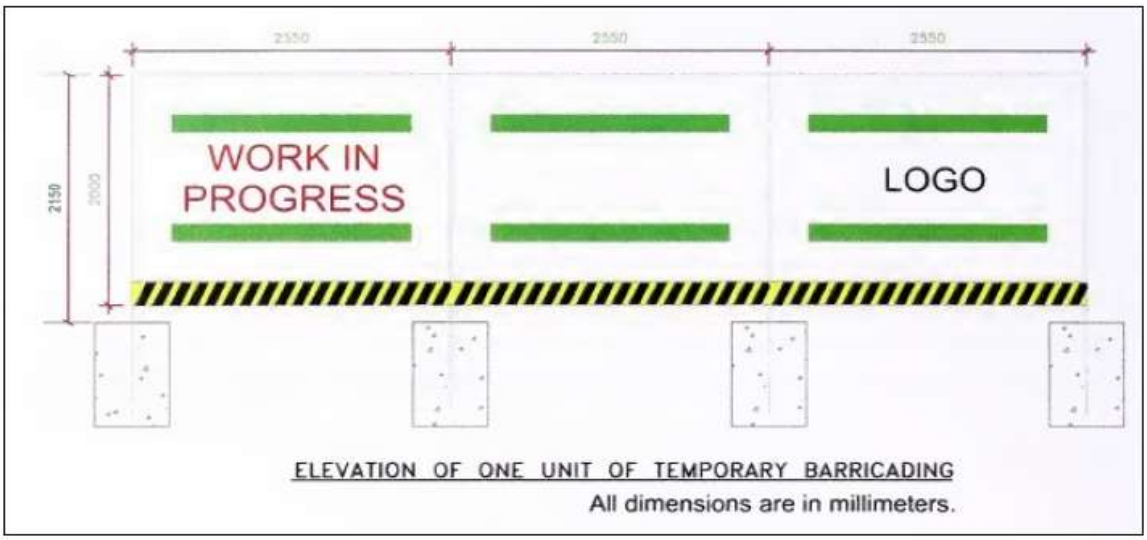
**Construction Zone:**

Construction Zones are an integral part of any road construction system. The safety practices in construction will, therefore, be oriented towards reducing conditions, which lead to such hazards and consequent stress whereby risk of accident increases. Safety measures will be aimed at avoiding hazardous conditions especially in work sub zones where major construction activities are going on. For all purposes, the entire stretch will be treated as work sub zone.

**Signs:**

The construction and maintenance of signs fall into the three major categories viz. regulatory signs, warning signs and guide signs as other traffic signs do. Ref: IRC: 67-2001 (Code of Practice for Road Signs). These signs will be placed on the left-hand side of the road. Some other signboards will also be used to regulate the Traffic, which have not been standardized. **Ref: - IRC:SP:55-2014 (Guidelines on Traffic Management in Work Zones)** However they confirm with the general requirement of shape and color, and their message is brief, legible and clearly understandable, i.e., CAUTION- Men and Machinery at work Go Slow, CAUTION- Work in Progress Go Slow etc.



The location, frequency and type of signboards will be governed by the kind of traffic situations arising during the construction. Signboards of the type 'men at work' and 'speed limit' will be provided at locations wherever required on a case-to-case basis.

**Traffic Management Practices:**

The traffic management strategies include the following fundamental principles:

1. Making the traffic safety an integral and high priority element of the project.
2. Avoid inhibiting traffic as much as possible.
3. Guide Drivers in a clear and positive way.
4. Routine inspection of traffic control element and traffic operations
5. Protection to Project workers on work site

**Traffic Control Devices:**

**i. Warning Signs:**

- The advance warning for the construction operation ahead will be provided by the warning sign 'Men at Work' about 100m earlier to the work zone.
- It will be followed by 'Over Taking Prohibited' signboard. These signs will be placed on the left hand side of the road.

**'Men at Work' and 'Overtaking Prohibited' signboards will be as per IRC67: 2001.**

**ii. Barricading:**

Barricade using the CGI sheets would be on vertical steel post. The horizontal members of barricades would be of metal. These should be 200 mm-300 mm wide and should be painted in alternate yellow and black stripes of 150 mm width. The stripes should slope away at an angle of 45° in the direction traffic is to pass. Where the barricades extend entirely across the carriageway, the stripes should slope downward towards the direction the traffic must turn in detour.

The main intention of the barricading is to restrict the entering of the traffic in work area and protecting main carriageway traffic from falling in excavated or lower level area. These barricading will be provided at regular interval of 03 m. Height of Barricade would be 1.5 m.

**iii. Flagman:**

To avoid collision between construction vehicle and traffic; Flagmen with flags will be effectively used at the exit/entry points of working stretch. The flags for signaling will be

0.60 m x 0.60 m size, made of a good red cloth and securely fastened to a staff of approximately 1m in length.

**Safety of project workmen at site:**

- Safety of the Project Workers at site during duty hours will be ensured. Safety measures appropriate (as per Project Safety Plan) for the job will be adopted.
- The job specific PPEs i.e. Helmets and Safety jackets will be provided to workmen at site and it will be compulsory for them to wear the same.
- Site engineers will ensure the use of Personal Protection Equipments (PPEs) by workmen.
    - Use of Safety Jacket will be compulsory for the workmen engaged for roadwork.
    - Use of Safety helmet will be compulsory for all workmen including the staff.
- Labour Laws in force will be followed.

**Maintenance of traffic control devices:**

For maintenance of installed traffic control devices, a separate team shall be engaged. They will be provided with two vehicles for transportation of materials and labor. This team will periodically check for disturbed devices and maintain them accordingly.

**Permanent Barricade:**

Permanent barricades provided along the construction work of road will channelize the vehicles along the existing road. Main intention of this barricade is to make traffic aware about the construction work in progress. This is a psychological barrier preventing vehicles from going astray in to construction area.

Permanent barricade will be made of GI sheets fixed with properly anchored with steel. GI wire will be used to fasten the sheets for better stability. These sheets will be painted with alternate yellow and black inclined strips or red and white vertical strips. For night visibility, red reflective sheets will be fixed on barricades

**Pavement barricade:**

The finished kerb on the median side of carriageway will be pavement barricade preventing the vehicles from entering into the area under construction. The portion of kerb above the finished asphalt top will prevent vehicles from crossing the median under construction, and its further entry into construction area. In eccentric and concentric

widening situations kerb will be the pavement barricade wherever its casting has been completed.

**Delineators:**

Delineators will be of cylindrical shape and will be made of concrete. They will be painted with black and white circumferential strips. Red colored reflectors or retro reflective sheet will be fixed to the delineator so as to make it visible to the traffic from either direction during night. These delineators will be placed at a suitable spacing to guide the drivers along a safe path and control the flow of traffic.

**Construction Entry/ Exit points:**

Construction entry/ exit points will be clearly identified and marked. Construction traffic will be allowed to enter/ exit the construction area through these openings only. These will be marked with signboards or red colored flag.

#### 7.3.11.1 Traffic Management - Potential Risks, Impacts and Mitigation Measures

The potential risk, impacts and mitigation measures associated during construction and operation phase of the 10 priority roads are given in Table 7.12.

**Table 7-12 Traffic Management-Potential Risks, Impacts and Mitigation Measures**

| Potential Risks | Potential Impacts | Proposed Mitigation Measure |
|---|---|---|
| Construction methods may cause disruption to traffic. | Traffic delays causing frustration to drivers. | Consider methods of construction at an early stage during the design to reflect community needs and reduce delay times therefore minimising the impact on traffic. |
| Traffic management - inadequate anticipation and communication of issues. | Potential community issues causing dissatisfaction and frustration. | ▪ Determine traffic routes leading to LPS schemes that are getting connected are: Nekkallu, Sakhamuru, Ainavolu, Penumaka, Navalluru, Buthalpudi, Krishnaiahpalem, Venkataiahpalem, Neerukonda, Velagapudi, Mandadam, Thulluru, Abbarajupalem, Anantavaram, Dondapadu etc., and engage with community to refine details.<br>▪ Confirm pre-existing conditions.<br>▪ Consider the need for night assessment.<br>▪ Identify any short-term corrective actions. |
| Severe delays to traffic perceived by the community as a direct result of the construction activities. | Community dissatisfaction, claims for loss of trade, time delays. | ▪ Establish good public relations from the outset.<br>▪ Erect Early Warning information signs through Variable Message Signs (VMS).<br>▪ Early engagement of affected property/business owners to explain process and ascertain needs and potential effects of changed access. |
| Access for emergency services restricted. | Emergency vehicles and personnel unable to attend to an emergency situation. | Liaise with Emergency Services at an early stage to establish requirements and measures to be adopted in the Vehicle Movement Plan (VMP) |
| Major Traffic Incident. | Local traffic disrupted upsetting locals. | ▪ Regular checking of Implementation of Traffic Management Plan.<br>▪ Have procedures in place for rapid recovery, Keep locals informed. |

| Potential Risks | Potential Impacts | Proposed Mitigation Measure |
|---|---|---|
| Access to site for deliveries. | Traffic disruption or interference. | ▪ Development of this Plan in conjunction with Community Communication Strategy - access points will be high risk locations and will need detailed consideration.<br>▪ Simplification of traffic staging will simplify access arrangements or minimise impacts.<br>▪ Signage and pre-delivery notifications for delivery routes to be clear and simple as per the VMP. |
| Traffic Speed. | Works in multiple areas across the Project may result in intermittent speed changes that may frustrate road users. | Traffic to generally be reduced to 30kmph speeds within construction zone.<br>Construction zone to be full length of the Project. CTMP to consider simplifying traffic staging to avoid construction zone impacting on traffic. |
| Pedestrian access. | Potential disruption to progress causing pedestrians to not comply with pedestrian provisions. | Liaise closely with the 29 villages of Capital city area relevant bodies i.e., village panchayat, R&B, minor/major irrigation, forests etc., from an early stage to ensure pedestrian access provisions are adequately addressed, well established and maintained. |
| Inadequate provisions for break-downs during | Traffic delay. | Design temporary break down bays. Consider temporary verges where possible during design of traffic |
| Public or livestock entering on Arterial / Sub-arterial roads Unauthorised access to site. | Traffic Incident. | Provide clear delineation and fencing. Educate community (neighbours of WorkCover requirements etc.). "Neighbours induction". Channel interests through formally organised tours. |
| Dangerous entry and exits to sites and properties. | Traffic Incident. | Ensure that entries and exits are designed to cater for expected traffic volumes and with respect to sight distances, acceleration and deceleration provision and clear advanced warning signage. |
| Reduced allowable movements | Traffic delay, confusion to commuters that | Implement effective community engagement strategies that will consider businesses, property owner's |

| Potential Risks | Potential Impacts | Proposed Mitigation Measure |
|---|---|---|
| Damage to local roads due to heavy vehicle movements. | Road damage and potential incidents of accidents. Poor community and Panchayat relationship. | ▪ Allow for heavy vehicle movements in traffic staging and planning to ensure existing, temporary alignment and pavements are suitable during the construction period.<br>▪ Carry out Road Dilapidation Surveys and immediate repairs to the roads to be carredout by the same through R&B Department. |
| Impact of construction traffic on haulage roads | Increased traffic on the haulage roads and excessive damages to the local roads. | ▪ Monitor the road safety on haulage roads during construction.<br>▪ Implement measures where reasonable and feasible, in consultation with 29 Panchayats of the Capital City Area, should additional road safety issues to be identified and appropriate road safety measures to be adopted. |

**iii. Accident, Health and Safety**

Construction activities will cause hindrance to the existing traffic flow. Thus, short-term impact in terms of accident is anticipated during construction phase of the project. Adequate safety measures to be considered during construction phase of the project.

***Mitigation Measures:***

- Reduce speed through construction zones.
- Construction of bridges/ culverts shall be carried out prior to construction of new corridor at the first stage.
- Proper cautionary signs shall be displayed at construction sites.
- Diversion roads will be provided wherever needed.

**iv. Aesthetics and Landscape**

The proposed construction of 4 lane/ 4 lane + 2 lane BRT road will require very partial removal of roadside plantation, which will deteriorate the corridors aesthetic values temporarily. But the proposed plantation all along in long run will improve the aesthetics

and landscaping of the corridor. Dis-figuration of the landscape is also anticipated due to opening of borrow pits.

***Mitigation Measures***

- Mixed plantation shall be carried out at roadside and flowering shrubs shall be planted in the median
- Borrow pits shall be resurfaced with conserved topsoil (borrow pit opening shall be as per IRC 10-1961).
- Plan for controlled development shall be evolved by land planning agencies.
- There shall be proper vigilance to avoid squatter development all along the corridor.

### 7.3.12 Impacts from Construction Workers Camp

Local labourers shall be employed for the construction activities to the maximum possible number to minimize the production of domestic waste generation. As for this project is concerned, the number of persons to be employed during the peak and average construction period would be around 1400 nos. and 700 nos. respectively. The period of construction is tentatively worked out for 12 months for roads in the project. For the welfare of the labourers, standards will be followed as per the Building & other Construction Workers' Welfare Cess Act 1996.

**Sanitation and Waste Disposal:** Sewage and domestic solid waste generated at the construction workers camp will be properly disposed of to prevent health and hygiene related problems. Adequate sanitary facilities such as construction of 4 Bio-toilets in each package 4 units*12 members will be established based on the soil conditions in construction camp. Periodical health checkup of construction workers will be undertaken. Sanitation waste from workers camp will not be diverted to water bodies.

***Mitigation Measures:***

- Contractor to prepare, CRDA/ADC's approved detailed public health utilities plan for the workers camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc. Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.

- Labourers residing in the camps shall be provided with safe drinking water, adequate sanitation facilities, gas and all other amenities as per the prevailing Labour laws. Domestic waste generated will be treated as per norms. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well.

**Impacts due to Influx of Labor:** The development of new roads at Amaravati Capital City is likely to lead to considerable influx of workers to the project site which can have adverse social impacts on the local communities, especially since the communities are rural and unskilled in specialized jobs. Therefore, special attention is paid by the contractor. The likely mitigation measures

***Mitigation Measures:***

- Labour Welfare and HIV/AIDS Plan : The Contractor should ensure compliance with appropriate labour laws and implement labor welfare measures including ensuring equal wages for equal work and timely payment to site workers, insurance of site workers, prohibit child labor, create healthy and conducive working environment at construction site, ensure safety of the workers and prevent accidents of construction workers and creating awareness through programs on HIV/AIDS among the workers to reduce the risk of transfer of the HIV virus between and among construction workers, their families and the local community. This will be monitored by the Project Management Consultant(s) engaged under ASCCDP.
- To the extent feasible, engage as many locally available unskilled, semiskilled and skilled human resource as practically possible
- The project will also put in place robust measures to address the risk of gender-based violence, including, training and awareness raising among the workforce, informing workers about national laws that make sexual harassment and gender-based violence a punishable offence;
- The contractor shall prepare a Worker Code of Conduct as part of the employment contract, and including sanctions for noncompliance.

### 7.3.13 Rain Water Harvesting (RWH) Pits

There are 53, 51, 60, 95, 38 & 59 nos. of RWH Pits are proposed either side of the road at an interval of 500m for Package -I, Package -II, Package -III , Package –IV, Package V and Package VI of the proposed roads respectively. All put together, 356 nos. RWH

Pits are proposed for the project. The Rain water harvesting pits are having diameter of 1.5 m with a depth of 3.8 m are proposed in the project. The project stretches were considered about 91.5 Km excluding settlements, bridge portions etc in the proposed roads (10 roads). The budget provision is made in the EMP for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 38.85 Lakhs out of which Rs. 7.95 Lakh, Rs. 7.65 Lakh, Rs. 9.00 Lakh, Rs. 14.25 Lakh, Rs 5.7 Lakhs and 8.85 Lakhs for Package -I, Package -II, Package –III, Package –IV, Package V and Package VI of the proposed roads respectively.

## 7.4 Impacts during Operation Phase

### 7.4.1 Impact on Land use

Road development may lead to establishment of petty shops and other commercial pursuits by the local people. Local statutory bodies will strictly enforce land use. In addition, the project proponent should prevent development of squatter settlements and encroachments on the vacant portions of the RoW of the road.

### 7.4.2 Impact on Air Quality

The prediction of air quality model under diverse traffic conditions in newly formed Andhra Pradesh State capital of Amaravati is really a critical task as there is no traffic exists on the road. Air quality analysis across 10 priority roads was assessed using CALRoads View (US EPA Preferred / recommended model). CALRoads View is an air quality model used to predict pollutant concentration near roads. Model requires source strength, meteorology and site geometry, the model can predict pollutant concentrations for receptors located within 500m of the roadway. The model runs based on crosswind Finite Line Source Gaussian formulation and the thermal turbulence created by hot vehicle exhaust & mechanical turbulence created by moving vehicles.

CALRoads View air quality model developed to assess air quality impacts of Carbon Monoxide (CO), Nitrogen Dioxide (NO2), and suspended particles near roadways. The model was developed by the Lakes Environmental. The CALRoads View model can:

- Predict pollutant concentrations for receptors at different locations.
- Be used to model multiple sources and receptors, curved alignments, or roadway segments with varying emission factors.
- Model air quality near intersections, street canyons, and parking facilities.
- Summarize the contributions from each link to each receptor.

Inputs for the model include meteorology data (Amaravati), roughness coefficient, ambient concentration, mixing zone width, emission coefficient, traffic volumes, emission factors etc. The assessment of air quality was performed for all the 10 priority roads considering worst case scenario for number of vehicles expected on 2050. CO, $NO_2$ and particulate matter were considered to find the air quality of the project area using the model. Weighted average of emission factor was taken by considering the percentage of types of vehicles on the total traffic. Emission factors were calculated for different pollutants as 2.77, 2.71 and 0.15 g/miles for CO, $NO_2$ and particulate matter respectively. The iso-pleths obtained for CO, NO2 $PM_{2.5}$ and $PM_{10}$ is given in Figures -7.2, 7.3, 7.4 &7.5 respectively.

**Carbon Monoxide (CO):**

As can be seen from the Figure – 7.2, the predicted values of CO varied from place to place. The maximum concentrations of CO predicted is 1.83 ppm (2.10 mg/$m^3$) near Venkatapalem and Krishnayya palem. The moderate value predicted is in between 1.2-1.4 ppm (1.38 – 1.60 mg/$m^3$) near Sakhamuru, Ainavolu, Krishnayya palem and Venkatapalem. Minimal value predicted is about 0.6-1.0 ppm (0.69-1.15 mg/$m^3$) in the remaining areas of the Amaravati Capital city. When compared with the National Ambient Air Quality Standard (NAAQS) limit of 4mg/$m^{3,}$ the predicted values for the year 2050 is much lower, showing no adverse effect of traffic on environment.

**Nitrogen Dioxide ($NO_{2)}$:**

As can be seen from the Figure – 7.3, the predicted maximum concentrations of NO2 ranges from 0.02 ppm (37.63 micro gram/$m^3$) near Navaluru, Krishnayya Palem and Venkata Palem. The moderate value predicted is in the range 0.005-0.013 (9.4-24.5 micro-gram/$m^3$) near Krishnayyapalem, Penumaka, Nelapadu, Ainavolu, Sakhamuru and Venkatapalem villages. Minimal values observed are less than 0.002 ppm (3.8 micro gram/$m^3$) in the remaining areas of the Amaravati Capital city . When compared with the National Ambient Air Quality Standard (NAAQS) of 80μg/$m^3$, the predicted values are well within the prescribed standards.

**Particulate Matter ($PM_{2.5}$):**

As can be seen from the Figure –7.4, the predicted maximum concentration of $PM_{2.5}$ is 55.37 micro gram/$m^3$ near Krishnayapalem, village. The moderate values predicted are in the range of 30-38 micro-gram/$m^3$ near Krishnayya Palem, Ainavolu, Mandadam and

Venkata Palem villages. Minimal values observed are in the range 24-28 micro-gram/$m^3$ in the remaining areas of the Amaravati Capital city. When compared with the National Ambient Air Quality Standard (NAAQS) of 60micro gram/$m^3$, the predicted values for the year 2050 are well within the prescribed standards.

**Particulate Matter ($PM_{10}$):**

As can be seen from the Figure –7.5, the predicted maximum concentration of $PM_{10}$ is 86.89 micro gram/$m^3$ near Krishnayapalem, village. The moderate values predicted are in the range of 60-70 micro-gram/$m^3$ near Nelapadu, Sakhamuru,Krishnayya Palem, Ainavolu, Mandadam, Malkapuram, Mandadam, Velgappudi and Venkata Palem villages. Minimal values observed are in the range 55-57.5 micro-gram/$m^3$ in the remaining areas of the Amaravati Capital city. When compared with the National Ambient Air Quality Standard (NAAQS) of 100micro gram/$m^3$, the predicted values for the year 2050 are well within the prescribed standards.

Overall the predicted concentrations of $PM_{10}$, $PM_{2.5}$ CO and $NO_2$ found to be well within the stipulated CPCB Standards for the year 2050. It is already suggested to go for 2 rows of Avenue plantation on either side of the proposed 10 priority roads which will further reduce(than the predicted values at 2050) the air pollution in the Amaravati Capital city area.

Also it is expected that the pollution load from the vehicles in the coming years will be substantially reduced and majority of the vehicles will be running on electric power. The projected concentrations may reduce further on this account.

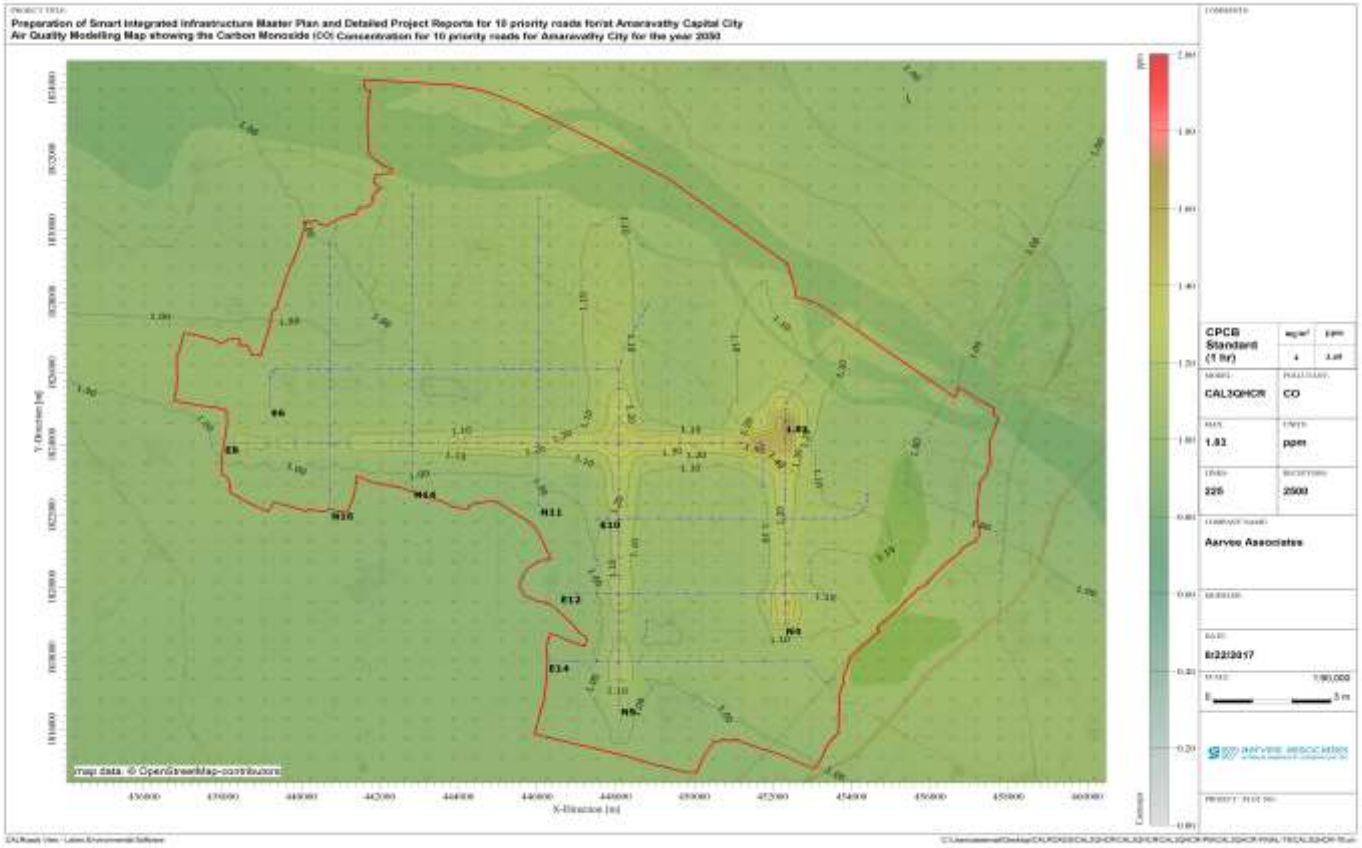



**Figure 7-2 Predicted Carbon monoxide (CO) Concentration along 10 priority roads for the Year 2050**

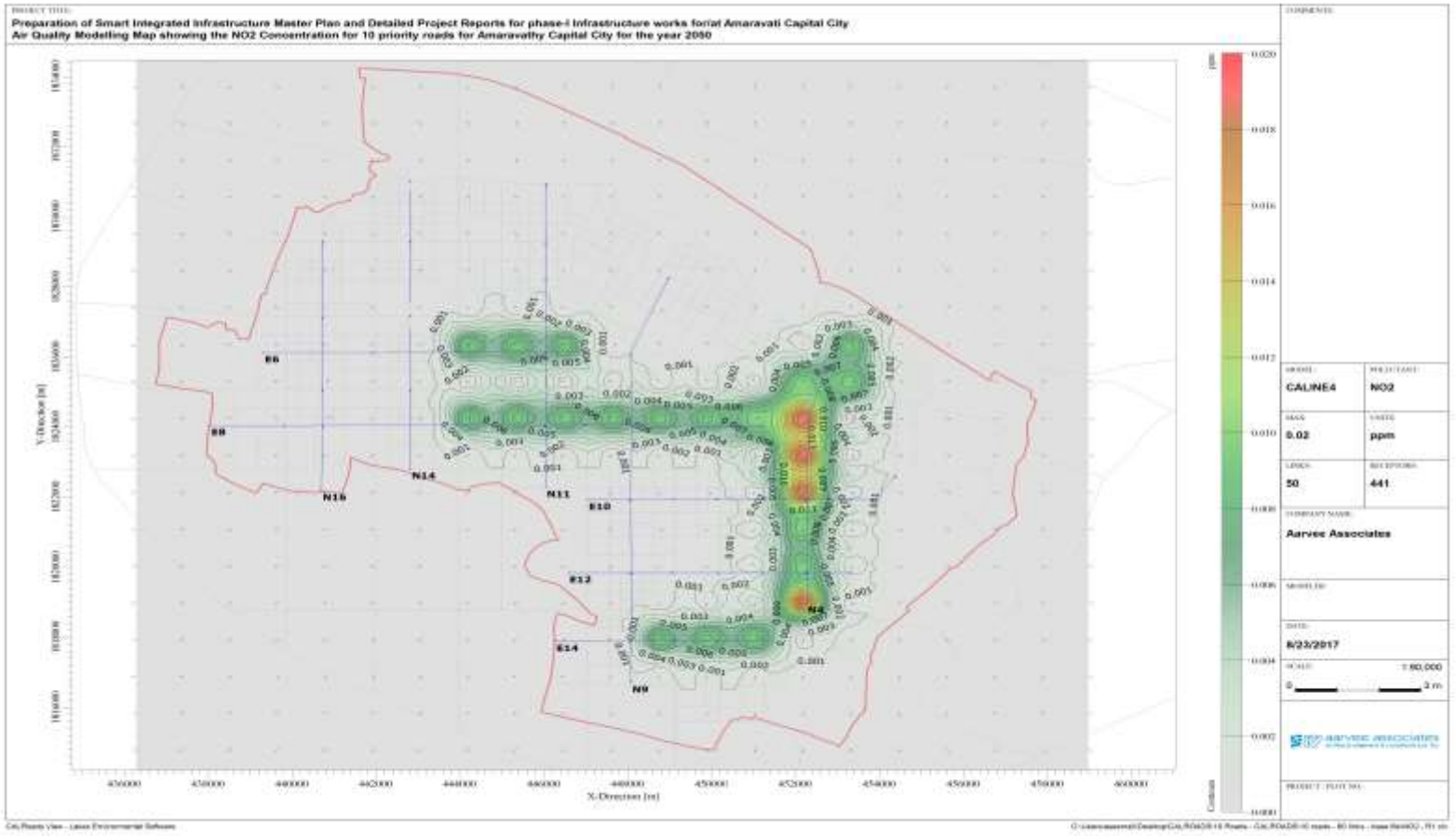



**Figure 7-3: Predicted Nitrogen Dioxide ($NO_2$) Concentration along 10 priority roads for the Year 2050**

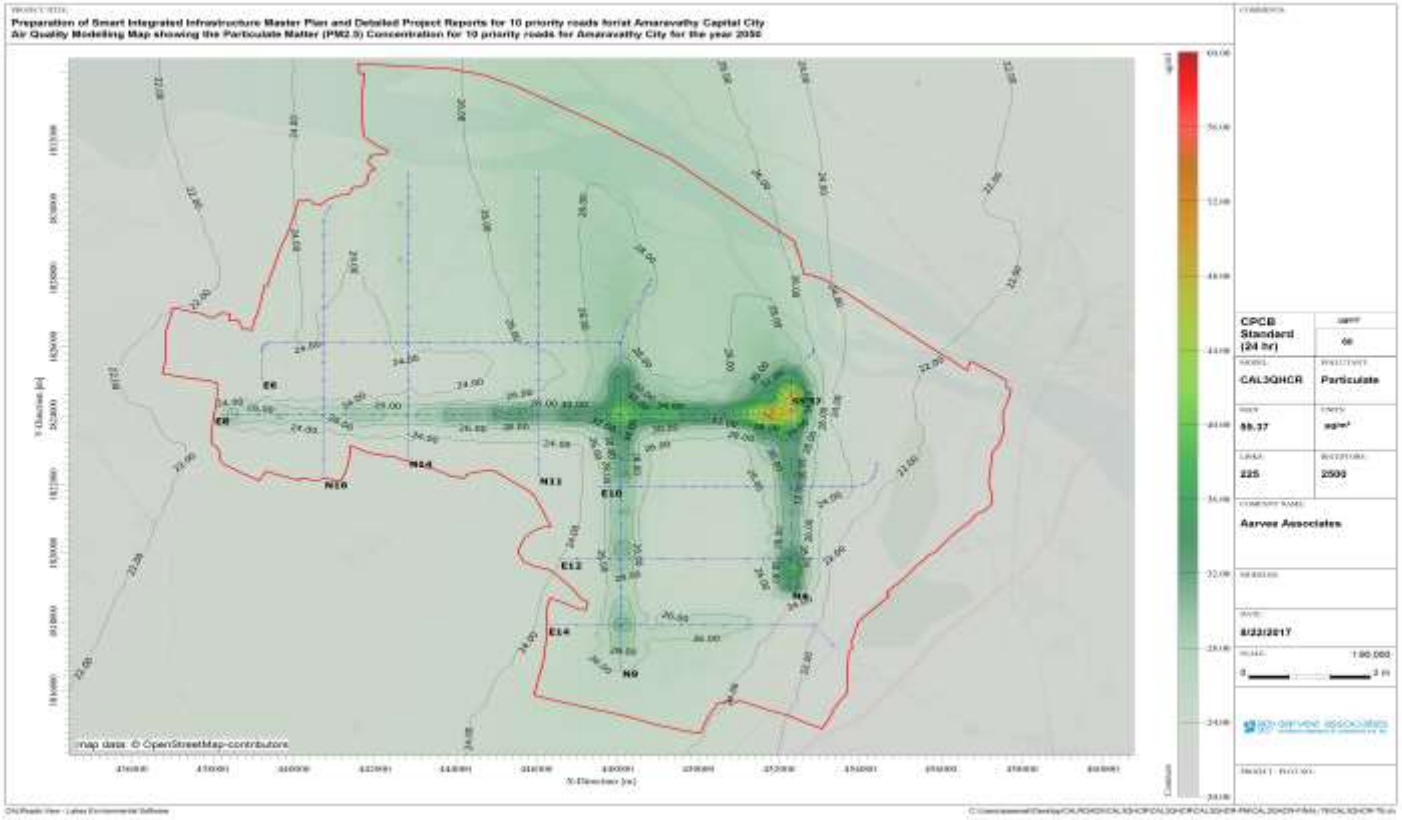



**Figure 7-4 Predicted $PM_{2.5}$ along 10 priority roads for the year 2050**

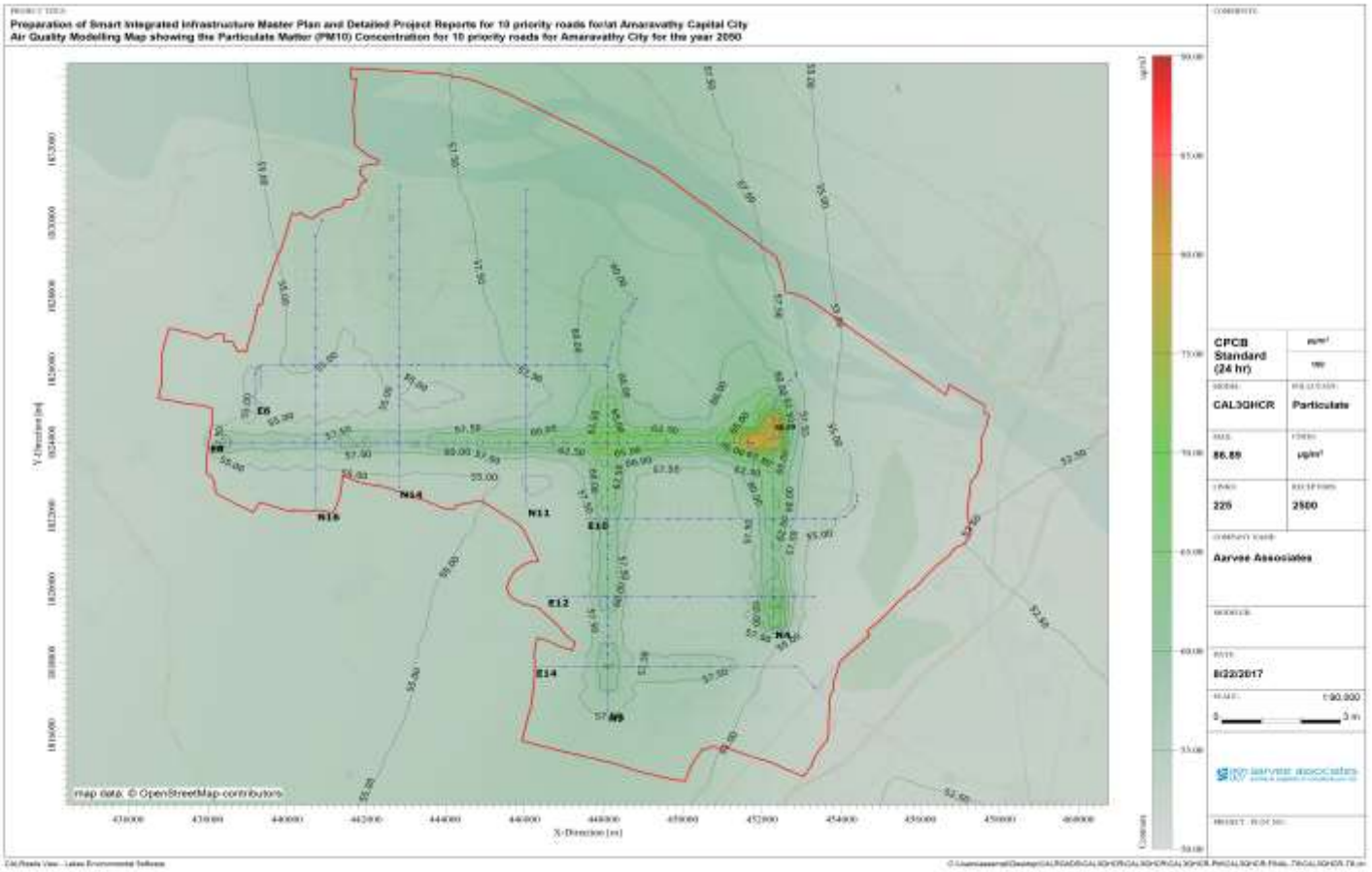



**Figure 7-5 Predicted Concentration of $PM_{10}$ along 10 priority roads**

### 7.4.3 Impact on Noise Quality

Traffic noise has become an urban problem and it is a common reality in major cities throughout India. It significantly affects human health, especially for people living in the vicinity to major roads/ highways. The prediction of noise levels under diverse traffic conditions at different junctions of newly formed capital city Amaravati of Andhra Pradesh state is a challenging task as there is very less traffic exists presently on the road. The proposed 10 priority roads namely E8, N9, N4, N14, E10, E14, N16, E6, E12 & N11 are getting connected the majority of Land Pooling Schemes in the Capital City area are: Nekkallu, Sakhamuru, Ainavolu, Penumaka, Navalluru, Buthalpudi, Krishnaiahpalem, Venkataiahpalem, Neerukonda, Velagapudi, Mandadam, Thulluru, Abbarajupalem, Anantavaram, Dondapadu etc. In addition to that these roads are also connecting the proposed major residential, commercial complexes, statup areas, industrial areas in the Capital City area.

The model used in the present study was developed by 'Environmental Systems Design Modeling Division, CSIR -National Environmental Engineering Research Institute', Nagpur, Maharashtra, India. The noise model performs reasonably well under different traffic conditions and could be implemented for traffic noise prediction at other regions of India as well. As it is one of the few noise prediction methods that consider honking along with other parameters, predicted values are more reliable than other models. The model was developed to calculate equivalent traffic noise based on four input variables i.e. equivalent traffic flow (Qe ), equivalent vehicle speed (Se), distance from the source to the receiver (d) and honking per minute (h). The traffic data is predicted for the year 2050 and is used for the prediction of noise levels at that time in dB(A). According to the model following cases were considered for noise analysis:

- **Case -I** represents congested traffic where equivalent vehicle speed (Se) is less than 30 km/h duly considering honking. The formula used is:

  Leq = 2.772xLogQe - 0.2205xSe – 0.2045xd+0.335xh+76.74

  Where, d: distance from the centre line of the RoW to habitation, h: honking count / min

- **Case -II** represents free-flowing traffic where equivalent vehicle speed(Se) is greater than 30 km/h duly considering honking.

  Leq = 4.461xLogQe + 0.1983xSe – 0.3771xd+0.582xh+59.44

- **Case -III** represents calm traffic where no honking is recorded.

Leq = 5.116xLogQe - 0.7554xSe – 0.5435xd+33.39

Considering all the major Junctions in the 10 Priority Roads are selected and traffic volume is taken for the worst-case scenario duly taken into account of higher traffic volume predicted at a junction. Apart from the above, the user is also considered the following assumptions on speed of the vehicle, distance & honking keeping in view of the project site and duly studying the similar cities in India are:

**Assumptions:**

1. Noise levels for highest traffic volume expected on each junction was calculated keeping worst case scenario in concern.

2. Vehicles were classified in 4 different classes:

i. Heavy vehicles (HV): Heavy goods vehicles + buses

ii. Autos: Light goods vehicles/pickups + mini/midi buses

Iii. Medium vehicles: Car/Taxi/Van

iv. Light vehicles: 2-wheeler motor vehicles

3. Key Assumption are made for three different possible cases

**Table 7-13 Key Assumptions Made for Different Possible Cases**

| S.No. | Model Input Parameter (s) | Unit | Case -I: Se<30 & h>0 | Case -II: Se>30 & h>0 | Case -III: Se>0 & h=0 |
|---|---|---|---|---|---|
| 1 | Heavy Vehicle ($S_{HV}$) Speed | Kmph | 15 | 30 | 30 |
| 2 | Autos ($S_{AUTO}$) Speed | Kmph | 20 | 40 | 40 |
| 3 | Medium Vehicles ($S_{MV}$) Speed | Kmph | 25 | 45 | 45 |
| 4 | Light Vehicles ($S_{LV}$) Speed | Kmph | 35 | 45 | 45 |
| 5 | Distance (d) from the centreline of the Road | m | 40 | 40 | 40 |
| 6 | honking (h) Counts | Counts/min | 20 | 5 | 0 |

Note: Se: Eqvivalent Vehicle Speed, h:honking

3. Research papers states that introduction of electric & hybrid motor vehicles may reduces the traffic noise of 5 dB(A) and and each row of plantation either side of RoW will reduce 3 dB(A) of noise. As per the discussions had with the APCRDA/ADC, the Amaravati city is promoting the use of Electric & hybrid cars as the city progress towards development. Overall, it is assumed that electric & hybrid motor vehicles and with two rows of plantation can reduce noise levels of about 11 dB(A) and bring the values well within limits.

**Prediction of Noise Level:**

In all the 10 priority roads, the predicted equvalent traffic flows are assessed and varying from 13672 – 112109 nos. for the year 2050. The model is predicted for all the intersections of the major junctions and considering the worost case traffic scenarios. The predicted noise levels for the three scenaios of traffic such as Congested flow, free flow and Calm flow traffic in the project are assessed and given in the Table – 7-14.

**Table 7-14 Junction wise predicted equivalent Noise levels for year 2050**

| Road Intersection | Noise Levels as per the original model dB(A) | | | Noise Levels (dB(A)) considering Electric and hybrid vehicles with two rows of plantation | | |
|---|---|---|---|---|---|---|
| | Case -I: Se<30 & h>0 | Case -II: Se>30 & h>0 | Case - III: Se>0 & h=0 | Case -I: Se<30 & h>0 | Case -II: Se>30 & h>0 | Case -III: Se>0 & h=0 |
| E6- N9 | 82.2 | 74.5 | 63.9 | 71.2 | 63.5 | 52.9 |
| E6-N11 | 83.3 | 76.2 | 65.8 | 72.3 | 65.2 | 54.8 |
| E6-N14 | 82.7 | 75.3 | 64.7 | 71.7 | 64.3 | 53.7 |
| E6- N16 | 83.3 | 76.3 | 65.9 | 72.3 | 65.3 | 54.9 |
| E8-N11 | 84.6 | 77.5 | 66.4 | 73.6 | 66.5 | 55.4 |
| E8-N14 | 83.8 | 76.2 | 65.0 | 72.8 | 65.2 | 54 |
| E8-N16 | 83.5 | 75.7 | 64.4 | 72.5 | 64.7 | 53.4 |

| Road Intersection | Noise Levels as per the original model dB(A) | | | Noise Levels (dB(A)) considering Electric and hybrid vehicles with two rows of plantation | | |
|---|---|---|---|---|---|---|
| | Case -I: Se<30 & h>0 | Case -II: Se>30 & h>0 | Case - III: Se>0 & h=0 | Case -I: Se<30 & h>0 | Case -II: Se>30 & h>0 | Case -III: Se>0 & h=0 |
| E8-N9 | 84.9 | 77.5 | 65.7 | 73.9 | 66.5 | 54.7 |
| E10-N4 | 84.3 | 77.0 | 65.9 | 73.3 | 66 | 54.9 |
| E10-N9 | 84.1 | 75.7 | 63.3 | 73.1 | 64.7 | 52.3 |
| E12-N4 | 85.2 | 78.5 | 67.6 | 74.2 | 67.5 | 56.6 |
| E12-N9 | 84.7 | 76.9 | 64.8 | 73.7 | 65.9 | 53.8 |
| E14-N9 | 85.3 | 77.3 | 64.7 | 74.3 | 66.3 | 53.7 |

Source: Assessed by M/s. Aarvee Associates, Hyderabad

As can be seen from above Table:

- The predicted noise levels for the Case I scenario is ranging from 82.2 dB(A) to 85.3 dB(A). The values seem to be moderate to high and the similar scenario is aniticipated in the peak hour traffic conditions between 08.00 to 10.00 am in the morining and 06.00 to 09.00 pm in the evening. Considering electric and hybrid vehicles with two rows of plantation shows the reductionof noise levels from 71.2 to 74.3dB(A.)

- The predicted noise levels for the Case II scenario is ranging from 74.5 dB(A) to 78.5 dB(A). The values seem to be moderate and the similar scenario is aniticipated during day time excluding non-peak hours. Considering electric and hybrid vehicles with two rows of plantation shows the reductionof noise levels from 63.5 to 67.5dB(A.)

- The predicted noise levels for the Case III scenario is ranging from 63.9 dB(A) to 67.6 dB(A). The values seem to be moderate and the similar scenario is aniticipated during night time excluding non-peak hours. Considering electric and

hybrid vehicles with two rows of plantation shows the reductionof noise levels from 52.9 to 56.6dB(A.)

Case -II & III Scenarios are more likely reliable prediction for the newly formed Capital City of AP. And Case I is mostly not envisaged in the project. However, case II and III are mostly meeting the CPCB commercial standards of 65&55 decibels for day and night respectively.

### 7.5 Accident Hazards and Safety

There is a possibility of accidents in the project stretch as more number of vehicles are expected in this road. In the event of spillage of hazardous chemicals, a spillage containment mechanism will be developed along with the participation of police and the fire department. In addition to this an emergency response mechanism should be evolved to tackle accidents and spillage of substances.

### 7.6 Aesthetics

There are various measures taken in the proposed project stretch to improve the traffic movement and public convenience along the project corridor. Junctions development with landscape, median plantation in 4 lane road and avenue plantation along the project will improve the aesthetics of the project. The public amenities, Energy efficient LED lights, Cycle tracks, Side Walks, BRT & BRT Shelters and parking place for long distance travelers have been provided for in the project design.

### 7.7 Evaluation of Impacts

The environmental impact of a project depends both on the project activities and on the background environmental setting. The environmental impact assessment process involves four basic steps:

- Identification
- Evaluation
- Interpretation
- Communication

For the present project, the matrix method is used for assessment of impacts. In the present case the impact, a scale of –4 to +4 is taken. This method is selected because it

identifies the impact of each project activity on each of the environmental attributes. Evaluation and interpretation of impacts is mostly subjective and convey a holistic view of the environmental impact of the project.

**Matrix Method**

The matrix used for EIA consists of project activities on the x-axis and the environmental attributes likely to be affected by these activities on the y-axis. Each cell of the matrix represents a subjective evaluation of the impacts of a activity on a particular attribute in terms of magnitude and importance. A blank cell indicates no impact of the activity on the component. The magnitude (M) is represented by a number from 1 to 4,

Where,

1 = minimal, 2 = appreciable, 3 = significant & 4 = severe

Positive sign (or no sign) indicates beneficial impact and negative sign indicates adverse impact. The importance (I) of the impact is given on a scale of 1 to 4 in each cell. This number indicates relative importance of the impact of the activity on the concerned attribute for this project. The magnitude and importance are multiplied to get a score of each cell. The score of individual cells in each row are added to determine the total impact of the project activities on each attribute. Similarly, the score in individual cells in each column are added to determine the total impact of each activity on all the environmental attributes likely to be affected. The grand total of all cells indicates the total project impact.

Since both 'M' and 'I' vary from 1 to 4, the total score in each cell can theoretically vary between –16 to +16. Therefore the total project impact can vary between (-16 x total number of cells in the matrix) and (16 x total number of cells in the matrix). To compare score from matrices containing different number of cells, the total project scores can be normalized to a scale of 100 as follows

Total project impact scale of 100 = ((Total project impact computed by matrix)/ (16 x total number of cells in the matrix)) X100

On this scale, the overall impact can be classified as follows:

| Total project impact (Scale of 100) | Magnitude of impact |
|---|---|
| -100 to –75 | Severely adverse |
| -75 to –50 | Significantly adverse |
| -50 to –25 | Appreciably adverse |
| -25 to 0 | Minimally adverse |
| 0 to 25 | Minimally beneficial |
| 25 to 50 | Appreciably beneficial |
| 50 to 75 | Significantly beneficial |
| 75 to 100 | Extremely beneficial |

### 7.7.1 Evaluation for Alternative Scenarios

**EIA without EMP**

This scenario was based upon the assumption that the proposed development would go ahead without any environmental management options being implemented. The total project impact for the scenario, as can be seen in Table -7.15, was found to be –74 on a scale of (+/-) 1344. The score on a scale of (+/-) 100 for this scenario was found to be -5.5, which is on the **minimally adverse side**. This shows that if the project goes ahead without an EMP, the adverse impact on the existing environment would be several times that of the impact without the project. Thus, the EMP described in Chapter –8 will have to be implemented to minimize the potential negative impact due to the proposed activity.

**EIA with EMP**

If the environmental management strategies discussed in Chapter -8 is fully implemented, the adverse impact of the project would be reduced, and there will be an overall improvement in physical, chemical, biological and socio-economic environment of the capital city area. This is reflected in the total project impact score of +107 on scale of (+/-) 1536, as shown in the Table -7.16 below, for this scenario. The score on a scale of (+/-) 100 for this scenario was found to be +7.0, which is on the beneficial side. Therefore, the proposed activity will be beneficial for the environment of the area, provided the EMP is in place.

It is clear from the above, that the proposed road development project would have negative effect without implementing certain environmental management strategies. If

EMP, as discussed in the Chapter -8, is strictly adopted and implemented, the adverse impacts will be reduced and the overall environmental quality of the area would improve.

**Table 7-15 : Impact Assessment for the Proposed Project (EIA WITHOUT EMP)**

| Environmental components likely to be affected | | Project activities likely to affect environmental components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Site preparation / Resettlement and Rehabilitation | Construction /other activities | Transportation construction materials | Solid waste generation and its handling. | Traffic escalation | Waste water generation | Post construction and operational phase | Total impact component |
| Air quality | M | -1 | -2 | -2 | -1 | -2 | | -2 | **-19** |
| | I | 1 | 2 | 2 | 2 | 2 | | 2 | |
| Noise | M | -2 | -3 | -1 | -2 | -2 | | -3 | **-22** |
| | I | 1 | 2 | 2 | 1 | 2 | | 2 | |
| Surface water quality | M | -2 | -2 | -1 | -2 | | -1 | -2 | **-15** |
| | I | 1 | 2 | 2 | 1 | | 1 | 2 | |
| Ground water quality | M | | -1 | | -1 | | -1 | -1 | **-5** |
| | I | | 2 | | 1 | | 1 | 1 | |
| Soil quality / erosion | M | -1 | -2 | -1 | -1 | -1 | -1 | -1 | **-10** |
| | I | 1 | 2 | 1 | 1 | 1 | 1 | 1 | |
| Land use pattern | M | -2 | -2 | -1 | -1 | | | -2 | **-14** |
| | I | 2 | 2 | 1 | 1 | | | 2 | |
| Flora and Fauna | M | -3 | -3 | -2 | -2 | | | -1 | **-18** |
| | I | 2 | 2 | 1 | 1 | | | 2 | |
| Aesthetics | M | -1 | -2 | -1 | -1 | | | -1 | **-11** |
| | I | 1 | 2 | 2 | 2 | | | 2 | |
| Safety | M | | -2 | -2 | -1 | -2 | | -2 | **-17** |
| | I | | 2 | 2 | 1 | 2 | | 2 | |
| Human health | M | -2 | -2 | -2 | -1 | -1 | -1 | -1 | **-14** |
| | I | 1 | 2 | 2 | 1 | 1 | 1 | 1 | |
| Socio-economic status | M | 4 | 3 | 1 | 1 | 1 | | 3 | **35** |
| | I | 3 | 3 | 2 | 1 | 2 | | 3 | |
| Economy, trade and commerce | M | 2 | 2 | 2 | 1 | 2 | | 4 | **36** |
| | I | 2 | 3 | 2 | 2 | 2 | | 4 | |
| **Total Action Impact** | | **-3** | **-27** | **-16** | **-12** | **-8** | **-4** | **-4** | **-74** |

**Table 7-16 : Impact Assessment for the Proposed Project (EIA WITH EMP)**

| Environmental components likely to be affected | | Project activities likely to affect environmental components | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Site preparation/ Resettlement and Rehabilitation | Construction /other activities | Transpor - tation construction materials | Solid waste generation and its handling | Traffic escalation | Waste water generation | Greenbelt development | Post construction /Operational phase | Total impact component |
| Air quality | M | -1 | -1 | -1 | -1 | -1 | | 2 | -1 | **-2** |
| | I | 1 | 1 | 1 | 1 | 1 | | 2 | 1 | |
| Noise | M | -1 | -1 | -1 | -1 | -1 | | 2 | -1 | **-2** |
| | I | 1 | 1 | 1 | 1 | 1 | | 2 | 1 | |
| Surface water quality | M | -1 | -2 | -1 | -1 | -1 | -1 | | -1 | **-8** |
| | I | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | |
| Ground water quality | M | | -1 | | -1 | | -1 | | -1 | **-4** |
| | I | | 1 | | 1 | | 1 | | 1 | |
| Soil quality / erosion | M | -1 | -1 | -1 | -1 | -1 | -1 | 2 | | **-2** |
| | I | 1 | 1 | 1 | 1 | 1 | 1 | 2 | | |
| Land use pattern | M | -2 | -1 | -1 | -1 | | | 2 | 1 | **-4** |
| | I | 2 | 2 | 1 | 2 | | | 2 | 1 | |
| Flora and Fauna | M | -2 | | -1 | -1 | -1 | | 2 | 1 | **-2** |
| | I | 2 | | 1 | 1 | 1 | | 2 | 1 | |
| Aesthetics | M | -1 | -1 | -1 | -1 | | | 2 | 1 | **-1** |
| | I | 2 | 2 | 2 | 1 | | | 2 | 2 | |
| Safety | M | | -1 | -1 | | -1 | | | -1 | **-7** |
| | I | | 2 | 2 | | 2 | | | 1 | |
| Human health | M | -1 | -1 | -1 | -1 | -1 | -1 | 3 | | **3** |
| | I | 1 | 1 | 1 | 1 | 1 | 1 | 3 | | |
| Socio-economic status | M | 3 | 3 | 3 | 3 | 3 | | 3 | 4 | **66** |
| | I | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | |
| Economy, trade and commerce | M | 3 | 3 | 3 | 3 | 3 | | 3 | 4 | **70** |
| | I | 3 | 3 | 3 | 3 | 3 | | 3 | 4 | |
| **Total Action Impact** | | **3** | **5** | **7** | **8** | **10** | **-4** | **51** | **27** | **107** |

I = Importance, M = Magnitude; Impact scale: 1 = Minimal, 2 = Appreciable, 3 = Significant, 4 = Severe. Positive sign (or no sign) indicates beneficial impact, Negative sign indicates adverse impact, Blank indicates no impact

# Chapter 8
# ENVIRONMENT MANAGEMENT PLAN

## 8.0 ENVIRONMENT MANAGEMENT PLAN

The Environmental Management Plan (EMP) state the procedure in which the project proponent would carry out the implementation of the mitigation measures and ensure compliance with environmental regulations that are binding on the project. This plan also specifies the organizational requirements and institutional strengthening necessary for sound environmental management of the project. The major components of the EMP are:

1. EMP Implementing Agency
2. Monitoring of the EMP implementation
3. Training on Environmental management
4. Budget for EMP implementation.

## 8.1 EMP Implementing Agency

ADC/APCRDA will establish an Environmental Management Cell (EMC) to supervise and implement the mitigation measures as documented in the EMP. This EMC must also be adequately empowered to discharge the responsibilities as outlined in the EMP. To ensure smooth implementation of EMP the project proponent must collaborate with various government agencies like Public Works Department, Revenue Department, State Pollution Control Board, State Forest Department, Police Department and other allied departments.

The EMC constituted by the APCRDA/ADC shall be the prime agency for monitoring all the activities during both the phases. Director, Landscape & Environment of APCRDA/ADC shall supervise all activities and accordingly advise the Contracting Company to improve on areas where any short comings are observed. In addition to implementing and monitoring different environmental attributes, APCRDA/ADC shall also be actively involved in imparting training and raising environmental awareness level of Contractors and the construction staff to enable them to take the environmental aspects into consideration as and when required.

The details of Packages are given below:

| Package | Road | Description |
|---|---|---|
| **Package-I** | E8 | Construction of E8 Road near Krishnayapalem to Nekkellu (Western Boundary) in Amaravati Capital City, Guntur. |
| **Package-II** | N9 | Construction of N9 Road near Uddandarayunipalem to Nidamarru (Southern Boundary) in Amaravati Capital City, Guntur. |
| **Package-III** | N4 | Construction of N4 Road near Venkatapalem to Navuluru (Southern Boundary) and |
| | N14 | N14 Road near Borupalem to Sakhamuru (Southern Boundary) in Amaravati Capital City, Guntur. |
| **Package-IV** | E10 | Construction of E10 Road near Penumaka to Inavolu (Western Boundary), |
| | E14 | E14 Road near Mangalagiri to Neerukonda (Western Boundary) and |
| | N16 | N16 Road Abbarajupalem to Nekkellu (Southern Boundary) in Amaravati Capital City, Guntur. |
| **Package-V** | E6 | Passing in the NW side of Capital City area near to Ananthavaram Village |
| **Package-VI** | E12 | Passing through the South side of capital city area boundary. Nearby village is Kuragallu. |
| | N11 | Passing through middle (NS direction) of Capital City. Nearby villages are Ainavolu, Nelapadu |

The details of EMP implementation and implementation responsibilities for 6 Packages of the proposed roads (10 Roads) are given in Tables -8.1, 8.2, 8.3, 8.4, 8.5 & 8.6. These tables comprehensively list out the tasks to be performed and completed by the Contracting Company, costs to perform these tasks and lists out the agencies that are involved and responsible for ensuring the timely completion of the tasks outlined under EMP. The contractor's responsibilities in matters related to protection of environment shall be the part of the tender document. The contractor shall ensure daily, weekly and monthly environmental monitoring, mitigation & management measures for preparing monthly report, the PMC personnel would consist of a dedicated Environment Specialist to monitor the compliance throughout the construction phase of the project and report the same to the Director, Landscape & Environment of APCRDA/ADC. The Project specific environmental formats are given in **Annexure -VI**. Tables -8.1 to 8.6 give the provisions that are built in the bid document to protect and safeguard the environment by the Contractor/ Concessionaire or Amaravati Development Corporation (ADC).

**Table 8-1 EMP: Implementation Schedule with Supervising Organization/ Authority for Package -I**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| **Design Phase** | | | | | | | |
| 1. | Alignment | • The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for the Package 1 of Priority roads (7 roads) in the project is 13.65 Kms with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference on People | • Passageways are designed /widened for road development work to meet the needs of the local residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | • In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br>• Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | • No cultural relics present in the corridor of Impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. | Flood | • Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 3 major bridge and 17 culverts (slab / box / pipe culverts) are proposed for Package 1 of Priority roads (7 roads) in the project to allow the free flow of the natural flood water in the area. | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |
| 6. | Preparation of feasible land acquisition plan | • Under APCRDA Land Polling Scheme the majority of the land was already acquired and no major issue of land acquisition is envisaged.<br>• Prepare and administer land use control measures. | Quarterly | AP CRDA, Revenue Department in consultation with the affected people | AP CRDA, Revenue Department in consultation with the affected people | - | - |
| **Construction Phase** | | | | | | | |
| 1 | Tree plantation | 1. Prepare an action plan for about 266 nos. of trees to be felled along the Package 1 of Priority roads (7 roads) in the project stretch. An amount of Rs. 10.64 Lakhs provision is made in EMP for felling of trees in Package 1. There are 798 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br>2. Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br>3. *Avenue Plantation:* There are two rows of avenue plants proposed along the Package 1 of Priority roads | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br>10.64 (Felling of trees)<br>164.10 (Avenue and Median Plantation) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | (7 roads) of Project corridor as per IRC-SP-21: 2009. There are 266 nos. of trees are affected due to the proposed Package 1 of Prioirty roads (7 roads) of the project. Hence, 13,228 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>4. *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>5. Median plantation is proposed along the four lane stretches of total length 13.65 Kms. Median plantation is proposed with a provisions of 333 nos. of plants per kilometer for two medians of 13.65 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 9,091 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>6. Budget allocation for avenue and median plantation is Rs.164.10 Lakhs or 1.64 crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 1. 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC/ Mining & Geology | GCC 15.2.2 | Sr. No. 9 & 4.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Geology, GoAP<br>2. Assuming sand quarries of 4 nos. one for each package in the project.<br>3. Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & elevated lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br>4. Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in the project.<br>5. Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc., An amount of Rs. 1.00 Lakh provision is made in the EMP for each borrow area. | | | Department, GoAP/ CE, APCRDA/ CE, ADC | | |
| 3 | Site for storage and construction camp. | 1. The location of the Campsite shall be selected by the Contractor duly confirming the labour laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste | 2. Proper sanitation facilities (bio-toilets) at the construction workers | Monthly | Contractor / Concessionaire | Labour department / Health department /Director, Landscape | GCC 15.2.2 | Sr. No. 9 & |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | disposal. | camp shall be provided<br>3. Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & Handling) Rules, 2000.<br>4. It is envisaged that approximate 300 – 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | | | & Environment of APCRDA/ADC | | 10.00 |
| 5 | Traffic management | 1. Secure assistance from local police for traffic control during the construction.<br>2. Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 62 (c) | - |
| 6 | Air Quality | 1. There are five residential categories locations monitored in the study area and the air quality concentrations are found to be well within the CPCP Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. During construction, a good number | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.30 (for Air quality monitoring) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project will have to keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission generated during construction will be temporary and localized in nature.<br>3. Vehicles carrying construction material shall be covered to avoid spilling.<br>4. Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for air quality monitoring during construction period of 1 year, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br>6. Mixing equipment shall be seated and equipped with dust removal device.<br>7. Water will be sprinkled in morning and evening hours at the | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | 1. There are three commercial and five residential categories monitored in the study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. Stationary equipment shall be placed as far as possible from residential areas to minimise noise impacts on the near inhabitants.<br>3. Noise quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during construction period of 1 year, once in a season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>4. Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br>5. Provision of ear plugs to workers exposed to high noise levels in the | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.09 (for noise quality monitoring) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | project who work in batch mix plants, hot mix plants, quarries etc. | | | | | |
| 8 | Water Quality | 1. There are two nos. of surface water quality samples and two nos. of ground water quality samples monitored in the package. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards.<br>2. The ground water quality is found to be satisfactory. During construction the water quality shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br>3. Slightly high BOD is reported at Tank near Nekkallu (24) in Package -I and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br>4. It is envisaged the only source of contribution of BOD is workers camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br>5. Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.96 (for water quality monitoring) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | water, solid waste and water supply) with in villages premises, hence further deterioration of surface water is not envisaged<br>6. Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposal | | | | | |
| 8 | Water Quality | 1. Water quality monitoring shall be carried out at 4 locations + 4 WQM locations of the package in 3 seasons and compared with the baseline levels and amount of 0.60 Lakhs shall be allotted for water quality monitoring during construction period of 1 year, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>2. Soil laden run off will not be diverted to water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br>3. Vehicle maintenance and refueling will be confined to areas under construction yard to trap discarded lubricant and fuel spills. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.96 (for water quality monitoring) |
| 9 | Soil quality | 1. Periodic monitoring of soil quality at suggested sensitive locations (2 locations) of Package 1<br>2. An amount of 0.24 Lakh shall be allotted for soil quality monitoring | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.24 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | | | | | |
| 10 | Water logging and stagnation of water in the Borrow pits | 1. The majority of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br>2. Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 11 | Occupation Health and Safety | 1. Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br>2. Periodic health checkup of construction workers. | | Contractor or Concessionaire | Labour department /Director, Landscape & Environment of APCRDA/ADC | GCC 2.3(i) | - |
| 12 | Basic amenities and sanitation facilities for labourers | 1. Adequate sanitary facilities shall be provided to the workers to avoid health related problems. Sanitation waste from workers camp will not be diverted to water bodies.<br>2. Periodic health checkup of labourers shall be done.<br>3. Contractor to prepare, CRDA's approved detailed public health | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>4.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | utilities plan for the workers camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br>4. Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.<br>5. Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | | | | | |
| 13 | Fuel for labourers | 1. Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking ad other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and scouring | Stabilizing the embankment with appropriate technique immediately after placing.<br>1. The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br>2. Treating high embankment slopes with rip rap, stone pitching or other technologies to prevent erosion.<br>3. Construction of toe drain all along the road on both sides. | Monthly | Contractor or Concessionaire | Concerned local department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4. Avoiding obstruction of existing drainage during filling. | | | | | |
| 15 | Drainage system | 1. Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 3 major bridge and 17 culverts (slab / box / pipe culverts) are proposed in the project to allow the free flow of the natural drainage water in the area.<br>2. Construction of toe drain along the road on both the sides.<br>3. Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Irrigation /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 16 | Conservation of Eco-resources | 1. To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br>2. Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture.<br>3. Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 17 | Green Initiatives/ Environmental Enhancement Measures | 1. Loss of water spread volume due to the project 7511.71 Cum from 13 farm ponds within alignment and enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc. | Monthly | ADC | Minor Irrigation/ Archaeological/ Endowments/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | 13.18 (for enhancement of water spread area)<br><br>260 (for beautification of lakes/ farm ponds) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2. Beautification of lakes/ farm ponds of 52 nos. present within 200m from the Right of Way (RoW). | | | | | |
| 18 | Communications and Transportation | 1. Local materials should be used as much as possible so as to avoid long distance transportation that of earth and stone.<br>2. If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br>3. Temporary access should be built at the interchange of the urban road and other roads.<br>4. Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br>5. Materials may be delivery in advance in relatively leisurely season of traffic.<br>6. A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | Monthly | Contractor or Concessionaire | Transport Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 19 | Rain Water Harvesting | 1. The package stretch was considered about 13.255 Km excluding settlements, bridge portions etc.<br>2. There are 53 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m.<br>3. The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. | Monthly | Contractor or Concessionaire | GW Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>7.95 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 7.95 Lakhs. | | | | | |
| 20 | Utilization of Fly Ash | 1. In the proposed project, There are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project has to be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling has to be replaced with fly ash at high embankments and approaches to major bridges.<br>2. As per the designs, the proposed pavement crust for all the seven roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the seven roads. It is not feasible to use fly ash in the 10 Priority roads with out embankments | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |
| 21 | Surplus earth/ Muck disposal and C&D waste | 1. The quantity of muck /surplus earth generated in the project is 655470.54 Cum. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>552.9<br>0.05 (for C&D waste |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2. The C&D waste generated in this package is 58.80 Cum. It will be disposed in the dump site identified for C&D waste disposal near Tadepalli and this is designated dump site as identified in master plan as discussed in Section 7.3.4 | | | | | disposal) |
| 22 | Energy efficient initiatives | • Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed wherever its possible.<br><br>Measures to conserve energy include but not limited to the following:<br><br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task,<br>• Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.<br><br>1,196 Double arm Solar/ Energy efficient | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1727.98 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | LED streetlights are proposed for Package - 1. | | | | | |
| 23 | Oil & Grease | Oils and greases and waste are likely to be generated from cleaning of vehicles near workers camp, oil & grease removal tank having size of 1.5×1.5×1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles at camp sites | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| **Operation Phase** | | | | | | | |
| 1 | Air Quality | 1. Monitor periodically the AAQ at suggested locations.<br>2. Developing road side vegetation for pollutant sinking.<br>3. Enforcing different control measures to minimise pollution.<br>4. Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Public will be educated about the regulations on air pollution and noise of vehicles. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.30 (for air quality monitoring) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | Road safety and traffic management | 1. Prepare and administer a monitoring system on road accidents.<br>2. Adequate number of road signs with clear visibility shall be installed.<br>3. In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br>4. Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC/Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | 1. Provision of vegetative noise barriers (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br>2. Periodic monitoring of ambient noise levels at suggested locations<br>3. Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, temples and hospitals.<br>4. Noise monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.09 (for noise monitoring) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | In-charge.<br>5. There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 13,228 nos. either side of the road to control noise levels. | | | | | |
| 4 | Soil characteristics | 1. Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 2 locations along the Project corridor.<br>2. An amount of 0.24 Lakh shall be allotted for soil quality monitoring (2 stations) during operational phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.24 |
| 5 | Water Quality | 1. As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high BOD levels are not envisaged once the STPs are functional.<br>2. Periodic monitoring of water quality at suggested sensitive locations (4 locations + 4 WQM locations) in Package 1 | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>&<br>0.96 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 3. An amount of Rs. 0.96 Lakh shall be allotted for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | | | | | |
| 6 | Maintenance of road side plantations | 1. *Avenue Plantation:* There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 13,228 nos. either side of the road. The plants proposed are i.e., *Ravi, Nalla tumma, Neem, Veduru, Nagajemudu, Mango, Teku, Maredu etc.*<br>2. *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>3. Median plantation is proposed along the four lane stretches of total length 13.65 Kms. Median plantation is proposed with a provisions of 333 nos. of plants per kilometer for two medians of 13.65 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 9,091 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc. | Quarterly | Contractor or Concessionaire | Forests Department/Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>164.10 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 4. Employment of local people for the maintenance of plantation along the corridor. | | | | | |
| 7 | Maintenance of Drainage System | 1. The drainage system will be periodically cleared so as to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

**Table 8-2 EMP: Implementation Schedule with Supervising Organization/ Authority for Package 2**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| **DESIGN PHASE** | | | | | | | |
| 1. | Alignment | The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for the Package 2 of the Priority roads (7 roads) in the project is 13.16 Kms with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference<br><br>on People | Passageways are designed/widened for road development work to meet the needs of the local residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br><br>Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | No cultural relics present in the corridor of impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 5. | Flood | Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 2 major bridge and 17 culverts (slab / box / pipe culverts) are proposed for Package 2 of Priority roads (7 roads) in the project to allow the free flow of the natural flood water in the area. | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |
| 6. | Preparation of feasible land acquisition plan | • Under APCRDA Land Polling Scheme the majority of the land was already acquired and no major issues of land acquisition is envisaged.<br>• Prepare and administer land use control measures. | Quarterly | AP CRDA, Revenue Department in consultation with the affected people | AP CRDA, Revenue Department in consultation with the affected people | - | - |
| **CONSTRUCTION PHASE** | | | | | | | |
| 1 | Tree plantation | • Prepare an action plan for about 96 nos. of trees to be felled for Package 2 of the Priority roads (7 roads). An amount of Rs. 3.84 Lakhs provision is made in EMP for felling of trees in Package 2. There are 288 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br>• Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br>• *Avenue Plantation:* There are two rows of avenue plants proposed along Package 2 of the Priority roads (7 roads) as per IRC-SP-21: 2009. There are 96 nos. of trees are affected due to the proposed Package | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br>3.84 (Felling of trees)<br>159.01 (Avenue and Median Plantation) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | 2 of Prioirty roads (7 roads) of the project. Hence, 12,834 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>• *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>• Median plantation is proposed along the four lane stretches of total length 12.86 Kms. Median plantation is proposed with a provisions of 333 nos. of plants in two medians per kilometer for 12.86 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 8,765 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>• Budget allocation for avenue and median plantation is Rs. 1.59 Crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 1. 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & Geology, GoAP<br>2. Assuming sand quarries of 4 nos. one for each package in the project.<br>3. Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & elevated | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with Mining & Geology Department, GoAP/ CE, APCRDA/ CE, ADC | GCC 15.2.2 | Sr. No. 9 &<br>4.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br>4. Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in the package.<br>5. Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc.,. An amount of Rs. 1.00 Lakh provision is made in the EMP for each borrow area. | | | | | |
| 3 | Site for storage and construction camp. | The location of the Campsite shall be selected by the Contractor duly confirming the labour laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste disposal. | 1. Proper sanitation facilities (bio-toilets) at the construction workers camp shall be provided<br>2. Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & Handling) Rules, 2000.<br>3. It is envisaged that approximate 300 – | Monthly | Contractor / Concessionaire | Labour department / Health department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>10.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | | | | | |
| 5 | Traffic management | 1. Secure assistance from local police for traffic control during the construction.<br>2. Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC GCC 62 (c) | - |
| 6 | Air Quality | 1. There are five residential categories locations monitored in the study area and the air quality concentrations are found to be well within the CPCP Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. During construction, a good number of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project will have to keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission generated during construction will be temporary and localized in nature.<br>3. Vehicles carrying construction material shall be covered to avoid spilling. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.30 (for Air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | 4. Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for air quality monitoring during construction period of 1 year, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br>6. Mixing equipment shall be seated and equipped with dust removal device.<br>7. Water will be sprinkled in morning and evening hours at the construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | 1. There are three commercial and five residential categories monitored in the study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. Stationary equipment shall be placed as | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.09 (for noise quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | far as possible from residential areas to minimise noise impacts on the near inhabitants.<br>3. Noise quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during construction period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>4. Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br>5. Provision of ear plugs to workers exposed to high noise levels in the project who work in batch mix plants, hot mix plants, quarries etc. | | | | | |
| 8 | Water Quality | 1. There are three nos. of surface water quality samples and two nos. of ground water quality samples monitored in the package. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards.<br>2. The ground water quality is found to be satisfactory. During construction the water quality shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br>3. Slightly high BOD is reported at Stream | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.48 (for water quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | near Velagapudi (30) in Package -II and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br>4. It is envisaged the only source of contribution of BOD is workers camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br>5. Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) with in villages premises, hence further deterioration of surface water is not envisaged<br>6. Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposal | | | | | |
| 8 | Water Quality | 1. Water quality monitoring shall be carried out at 4 locations of the package in 3 seasons and compared with the baseline levels and amount of Rs. 0.48 Lakhs shall be allotted for water quality monitoring during construction period of 1 year, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>2. Soil laden run off will not be diverted to | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.48 (for water quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br>3. Vehicle maintenance and refueling will be confined to areas under construction yard to trap discarded lubricant and fuel spills. | | | | | |
| 9 | Soil quality | 1. Periodic monitoring of soil quality at suggested sensitive locations (2 locations) of the package<br>2. An amount of 0.24 Lakh shall be allotted for soil quality monitoring during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.24 |
| 10 | Water logging and stagnation of water in the Borrow pits | 1. The majority of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br>2. Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 11 | Occupation Health and Safety | 1. Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br>2. Periodic health checkup of construction | | Contractor or Concessionaire | Labour department /Director, Landscape & Environment of APCRDA/ADC | GCC 2.3 (i) | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | workers. | | | | | |
| 12 | Basic amenities and sanitation facilities for labourers | • Adequate sanitary facilities shall be provided to the workers to avoid health related problems. Sanitation waste from workers camp will not be diverted to water bodies.<br>• Periodic health checkup of labourers shall be done.<br>• Contractor to prepare, CRDA's approved detailed public health utilities plan for the workers camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br>• Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.<br>• Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>4.00 |
| 13 | Fuel for labourers | • Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking ad other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and | • Stabilizing the embankment with appropriate technique immediately after | Monthly | Contractor or Concessionaire | Concerned local department /Director, Landscape | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | scouring | placing.<br>• The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br>• Treating high embankment slopes with rip rap, stone pitching or other technologies to prevent erosion.<br>• Construction of toe drain all along the road on both sides.<br>• Avoiding obstruction of existing drainage during filling. | | | & Environment of APCRDA/ADC | | |
| 15 | Drainage system | 1. Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 2 major bridge and 17 culverts (slab / box / pipe culverts) are proposed in the project to allow the free flow of the natural drainage water in the area.<br>2. Construction of toe drain along the road on both the sides.<br>3. Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Irrigation /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 16 | Conservation of Eco-resources | 1. To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br>2. Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | agriculture.<br>3. Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | | | | | |
| 17 | Green Initiatives/ Environmental Enhancement Measures | 1. Loss of water spread volume due to the project 6412.06 Cum from 4 farm ponds within alignment and enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.<br>2. Beautification of lakes/ farm ponds of 25 nos. present within 200m from the Right of Way (RoW). | Monthly | ADC | Minor Irrigation/ Archaeological/ Endowments/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>11.25 (for enhancement of water spread area)<br>125 (for beautification of lakes/ farm ponds) |
| 18 | Communications and Transportation | 1. Local materials should be used as much as possible so as to avoid long distance transportation that of earth and stone.<br>2. If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br>3. Temporary access should be built at the interchange of the urban roads and other roads.<br>4. Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br>5. Materials may be delivery in advance in | Monthly | Contractor or Concessionaire | Transport Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | relatively leisurely season of traffic.<br>6. A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | | | | | |
| 19 | Rain Water Harvesting | 1. The project stretch was considered about 12.86 Km excluding settlements, bridge portions etc.<br>2. There are 51 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m.<br>3. The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 7.71 Lakhs. | Monthly | Contractor or Concessionaire | GW Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 7.71 |
| 20 | Utilization of Fly Ash | 1. In the proposed project, There are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project has to be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling has to be replaced with fly ash at high embankments and approaches to major bridges.<br>2. As per the designs, the proposed pavement crust for all the seven roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the seven roads. It is not feasible to use fly ash in the 10 Priority roads with out embankments | | | | | |
| 21 | Surplus earth/ Muck disposal and C&D waste | 1. The quantity of muck /surplus earth generated in the project is 511576.3 Cum. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations.<br>2. The C& waste generated in this package is 121.29 Cum. It will be disposed in the dump site identified for C&D waste disposal near Tadepalli and this is designated dump site as identified in master plan as discussed in Section 7.3.4 | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>429.83<br>0.10 (for C&D waste disposal) |
| 22 | Energy efficient initiatives | • Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed whereever its possible.<br>Measures to conserve energy include but not limited to the following:<br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task, | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 1522.50 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | • Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.<br><br>1,054 Double arm Solar/ Energy efficient LED streetlights are proposed for Package 2. | | | | | |
| 23 | Oil & Grease | • oils and greases and waste are likely to be generated from cleaning of vehicles near workers camp, oil & grease removal tank having size of 1.5×1.5×1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles at camp sites | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| **OPERATION PHASE** | | | | | | | |
| 1 | Air Quality | 1. Monitor periodically the AAQ at suggested locations.<br>2. Developing road side vegetation for pollutant sinking.<br>3. Enforcing different control measures to minimise pollution.<br>4. Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 0.30 (for air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Public will be educated about the regulations on air pollution and noise of vehicles. | | | | | |
| 2 | Road safety and traffic management | 1. Prepare and administer a monitoring system on road accidents.<br>2. Adequate number of road signs with clear visibility shall be installed.<br>3. In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br>4. Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC/Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | 1. Provision of vegetative noise barriers (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br>2. Periodic monitoring of ambient noise levels at suggested locations<br>3. Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 0.09 (for noise monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | temples and hospitals.<br>4. Noise monitoring shall be carried out at 2 locations of the project in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 12,834 nos. either side of the road to control noise levels. | | | | | |
| 4 | Soil characteristics | 1. Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 4 locations along the Project corridor.<br>2. An amount of 0.24 Lakh shall be allotted for soil quality monitoring (2 stations) during operational phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 0.24 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 5 | Water Quality | 1. As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high BOD levels are not envisaged once the STPs are functional.<br>2. Periodic monitoring of water quality at suggested sensitive locations (4 locations) in the package 2<br>3. An amount of 0.48 Lakh shall be allotted for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>&<br>0.48 |
| 6 | Maintenance of road side plantations | 1. *Avenue Plantation:* There are two rows of avenue plants proposed along Package 2 of the Priority roads (7 roads) as per IRC-SP-21: 2009. There are 96 nos. of trees are affected due to the proposed Package 2 of Priority roads (7 roads) of the project. Hence, 12,834 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>2. *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>3. Median plantation is proposed along the four lane stretches of total length 12.86 Kms. Median plantation is proposed with a | Quarterly | Contractor or Concessionaire | Forests Department/Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & 159.01 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | provisions of 333 nos. of plants in two medians per kilometer for 12.86 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 8,765 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>4. Employment of local people for the maintenance of plantation along the corridor | | | | | |
| 7 | Maintenance of Drainage System | 1. The drainage system will be periodically cleared so as to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

**Table 8-3 EMP: Implementation Schedule with Supervising Organization/ Authority for Package 3**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| **DESIGN PHASE** | | | | | | | |
| 1. | Alignment | The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for Package 3 of the Priority roads (7 roads) in the project is 15.50 Kms (N4-7.23 Kms & N14-8.27 Kms) with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference on People | Passageways are designed/widened for road development work to meet the needs of the local residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br><br>Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | No cultural relics present in the corridor of impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |
| 5. | Flood | Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. 2 major bridge and 12 culverts (slab / box / pipe culverts) in N4 and 2 major bridge and 7 culverts (slab / box / pipe culverts) in N14 are proposed for Package 3 to allow the free flow of the natural flood water in the area. | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 6. | Preparation of feasible land acquisition plan | • Under APCRDA Land Polling Scheme the majority of the land was already acquired and no major issues of land acquisition is envisaged.<br>• Prepare and administer land use control measures. | Quarterly | AP CRDA, Revenue Department in consultation with the affected people | AP CRDA, Revenue Department in consultation with the affected people | - | - |
| **CONSTRUCTION PHASE** | | | | | | | |
| 1 | Tree plantation | • Prepare an action plan for about 195 (N4) and 132 (N14) nos. of trees to be felled along the Package 3 of Priority roads (7 roads). An amount of Rs. 13.08 Lakhs provision is made in EMP for felling of trees in Package 3. There are 981 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br>• Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br>• *Avenue Plantation:* There are two rows of avenue plants proposed along the Package 3 of Priority roads (7 roads) as per IRC-SP-21: 2009. There are 195 (N4) and 132 (N14) nos. of trees are affected due to the proposed Package 3 of Prioirty roads (7 roads). Hence, 14,960 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>• *Median Plantation:* Since the project is construction of four laning road, project | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br>13.08 (Felling of trees)<br>185.73 (Avenue and Median plantation) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | median will be utilized.<br>• Median plantation is proposed along the four lane stretches of total length 14.99 Kms. Median plantation is proposed with a provisions of 666 nos. of plants (only two rows are proposed since BRT is planned in the remaining space in future) per kilometer for 14.99 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 10,323 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>• Budget allocation for avenue and median plantation is Rs. 1.85 Crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 1. 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & Geology, GoAP<br>2. Assuming sand quarries of nos. one for each package in the project.<br>3. Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & elevated lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br>4. Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC/ Mining & Geology Department, GoAP/ CE, APCRDA/ CE, ADC | GCC 15.2.2 | Sr. No. 9 &<br>4.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | the project.<br>5. Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc.,.An amount of Rs. 4.00 Lakh provision is made in the EMP for each borrow area | | | | | |
| 3 | Site for storage and construction camp. | The location of the Campsite shall be selected by the Contractor duly confirming the labour laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste disposal. | 1. Proper sanitation facilities (bio-toilets) at the construction workers camp shall be provided<br>2. Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & Handling) Rules, 2000.<br>3. It is envisaged that approximate 300 – 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | Monthly | Contractor / Concessionaire | Labour department / Health department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>10.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 5 | Traffic management | 1. Secure assistance from local police for traffic control during the construction.<br>2. Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 2.3 (i) | - |
| 6 | Air Quality | 1. There are five residential categories locations monitored in the study area and the air quality concentrations are found to be well within the CPCP Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. During construction, a good number of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project will have to keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission generated during construction will be temporary and localized in nature.<br>3. Vehicles carrying construction material shall be covered to avoid spilling.<br>4. Air quality monitoring shall be carried out at 4 locations of the package in3 seasons and compared with the baseline levels and amount of 0.60 Lakhs shall be allotted for air quality monitoring during construction | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.60 (for Air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | period of 1 years, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br>6. Mixing equipment shall be seated and equipped with dust removal device.<br>7. Water will be sprinkled in morning and evening hours at the construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | 1. There are three commercial and five residential categories monitored in the study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase of the package. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. Stationary equipment shall be placed as far as possible from residential areas to minimise noise impacts on the near inhabitants.<br>3. Noise quality monitoring shall be carried out at 4 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.18 Lakhs shall be allotted for Noise monitoring during | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.18 (for noise quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | construction period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>4. Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br>5. Provision of ear plugs to workers exposed to high noise levels in the project who work in batch mix plants, hot mix plants, quarries etc. | | | | | |
| 8 | Water Quality | 1. There are seven nos. of surface water quality samples and four nos. of ground water quality samples monitored in the package. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards.<br>2. The ground water quality is found to be satisfactory. During construction the water quality shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br>3. Slightly high BOD is reported at Chakali cheruvu near Thullur (24) in Package -III and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br>4. It is envisaged the only source of | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1.68 (for water quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | contribution of BOD is workers camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br>5. Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) with in villages premises, hence further deterioration of surface water is not envisaged<br>6. Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposal. | | | | | |
| 8 | Water Quality | 7. Water quality monitoring shall be carried out at 7 locations+ 7 WQM locations of the package in 3 seasons and compared with the baseline levels and amount of 1.68 Lakhs shall be allotted for water quality monitoring during construction period of 1 years, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>8. Soil laden run off will not be diverted to water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br>9. Vehicle maintenance and refueling will be confined to areas under construction yard to trap discarded lubricant and fuel spills. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1.68 (for water quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 9 | Soil quality | 1. Periodic monitoring of soil quality at suggested sensitive locations (4 locations) in the package 3<br>2. An amount of 0.48 Lakh shall be allotted for soil quality monitoring during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.48 |
| 10 | Water logging and stagnation of water in the Borrow pits | 1. The majority of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br>2. Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 11 | Occupation Health and Safety | 1. Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br>2. Periodic health checkup of construction workers. | | Contractor or Concessionaire | Labour department /Director, Landscape & Environment of APCRDA/ADC | GCC 2.3(i) | - |
| 12 | Basic amenities and sanitation facilities for labourers | • Adequate sanitary facilities shall be provided to the workers to avoid health related problems. Sanitation waste from workers camp will not be diverted to water bodies. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>4.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | • Periodic health checkup of labourers shall be done.<br>• Contractor to prepare, CRDA's approved detailed public health utilities plan for the workers camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br>• Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.<br>• Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | | | | | |
| 13 | Fuel for labourers | • Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking and other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and scouring | Stabilizing the embankment with appropriate technique immediately after placing.<br>• The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br>• Treating high embankment slopes with rip rap, stone pitching or other technologies | Monthly | Contractor or Concessionaire | Concerned local department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | to prevent erosion.<br>• Construction of toe drain all along the road on both sides.<br>• Avoiding obstruction of existing drainage during filling. | | | | | |
| 15 | Drainage system | 1. Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 2 major bridge and 12 culverts (slab / box / pipe culverts) in N4 and 2 major bridge and 7 culverts (slab / box / pipe culverts) in N14 are proposed for Package 3 to allow the free flow of the natural drainage water in the area.<br>2. Construction of toe drain along the road on both the sides.<br>3. Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Irrigation /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 16 | Conservation of Eco-resources | 1. To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br>2. Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture.<br>3. Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 17 | Green Initiatives/ | 1. Loss of water spread volume due to the | Monthly | ADC | Minor Irrigation/ Archaeological/ | GCC 15.2.2 | Sr. No. 9 & |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | Environmental Enhancement Measures | project 110205.73 Cum from 15 small & medium farm ponds within alignment and enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.<br>2. Beautification of lakes/ farm ponds of 22 nos. present within 200m from the Right of Way (RoW). | | | Endowments/ Director, Landscape & Environment of APCRDA/ADC | | 193.41 (for enhancement of water spread area)<br>110 (for beautification of lakes/ farm ponds) |
| 18 | Communications and Transportation | 1. Local materials should be used as much as possible so as to avoid long distance transportation that of earth and stone.<br>2. If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br>3. Temporary access should be built at the interchange of the urban roads and other roads.<br>4. Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br>5. Materials may be delivery in advance in relatively leisurely season of traffic.<br>6. A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | Monthly | Contractor or Concessionaire | Transport Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 19 | Rain Water | 1. The package stretch was considered about | Monthly | Contractor or | GW Department | GCC 15.2.2 | Sr. No. 9 & |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | Harvesting | 14.99 Km excluding settlements, bridge portions etc.<br>2. There are 60 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m.<br>3. The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 8.99 Lakhs. | | Concessionaire | /Director, Landscape & Environment of APCRDA/ADC | | 8.99 |
| 20 | Utilization of Fly Ash | 1. In the proposed project, There are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project has to be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling has to be replaced with fly ash at high embankments and approaches to major bridges.<br>2. As per the designs, the proposed pavement crust for all the seven roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the seven roads. It is not feasible to use fly ash in the 10 Priority roads with out embankments | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 21 | Surplus earth/ Muck disposal and C&D waste | 1. The quantity of muck /surplus earth generated in the project is 264308.03 Cum in N4 and 365590.71 cum in N14. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations.<br>2. The C&D waste generated in this package is 1831 Cum. It will be disposed in the dump site identified for C&D waste disposal near Tadepalli and this is designated dump site as identified in master plan as discussed in Section 7.3.4 | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>550.86 |
| 22 | Energy efficient initiatives | • Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed whereever its possible.<br>• Measures to conserve energy include but not limited to the following:<br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task,<br>• Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1079.19 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | 574 (N4) & 662 (N14) single arm Solar/ Energy efficient LED streetlights are proposed | | | | | |
| 23 | Oil & Grease | • oils and greases and waste are likely to be generated from cleaning of vehicles near workers camp, oil & grease removal tank having size of 1.5x1.5x1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles at camp sites | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| **OPERATION PHASE** | | | | | | | |
| 1 | Air Quality | 1. Monitor periodically the AAQ at suggested locations.<br>2. Developing road side vegetation for pollutant sinking.<br>3. Enforcing different control measures to minimise pollution.<br>4. Air quality monitoring shall be carried out at 4 locations of the project in 3 seasons and compared with the baseline levels and amount of 0.60 Lakhs shall be allotted for monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Public will be educated about the | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.60 (for air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | regulations on air pollution and noise of vehicles. | | | | | |
| 2 | Road safety and traffic management | 1. Prepare and administer a monitoring system on road accidents.<br>2. Adequate number of road signs with clear visibility shall be installed.<br>3. In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br>4. Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC/Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | 1. Provision of vegetative noise barriers (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br>2. Periodic monitoring of ambient noise levels at suggested locations<br>3. Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, temples and hospitals.<br>4. Noise monitoring shall be carried out at 4 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.18 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.18 (for noise monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. There are two rows of avenue plants proposed along the package as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 14,960 nos. either side of the road to control noise levels. | | | | | |
| 4 | Soil characteristics | 1. Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 4 locations along the Project corridor.<br>2. An amount of 0.48 Lakh shall be allotted for soil quality monitoring (4 stations) during operational phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.48 |
| 5 | Water Quality | 1. As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high BOD levels are not envisaged once the STPs are functional.<br>2. Periodic monitoring of water quality at suggested sensitive locations (7 locations + 7 WQM locations) of the package.<br>3. An amount of 1.68 Lakh shall be allotted | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>&<br>1.68 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | | | | | |
| 6 | Maintenance of road side plantations | 1. *Avenue Plantation:* There are two rows of avenue plants proposed along the Package 3 of Priority roads (7 roads) as per IRC-SP-21: 2009. There are 195 (N4) and 132 (N14) nos. of trees are affected due to the proposed Package 3 of Prioirty roads (7 roads). Hence, 14,960 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>2. *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>3. Median plantation is proposed along the four lane stretches of total length 14.99 Kms. Median plantation is proposed with a provisions of 666 nos. of plants (only two rows are proposed since BRT is planned in the remaining space in future) per kilometer for 14.99 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 10,323 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>4. Employment of local people for the | Quarterly | Contractor or Concessionaire | Forests Department/Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>&<br>185.73 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | maintenance of plantation along the corridor | | | | | |
| 7 | Maintenance of Drainage System | 1. The drainage system will be periodically cleared so as to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

**Table 8-4 EMP: Implementation Schedule with Supervising Organization/ Authority for Package 4 (E10+E14+N16)**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| **DESIGN PHASE** | | | | | | | |
| 1. | Alignment | The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for the Package 4 of Priority roads (7 roads) is 7.81 Kms (E10), 7.33 Kms (E14) and 8.77 Kms (N16) with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference on People | Passageways are designed/widened for road development work to meet the needs of the local residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br><br>Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | No cultural relics present in the corridor of impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |
| 5. | Flood | Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. 1 major bridge and 14 culverts (slab / box / pipe culverts) in E10, 0 major bridge and 17 culverts (slab / box / pipe culverts) in E14 and 1 major bridge and 12culverts (slab / box / pipe culverts) in E10 are proposed for Package 4 of Priority roads (7 roads) to allow the free flow of the natural flood water in the area. | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |
| 6. | Preparation of feasible land | • Under APCRDA Land Polling Scheme the majority of the land was already acquired | Quarterly | AP CRDA, Revenue | AP CRDA, Revenue Department in | - | - |

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| | acquisition plan | and no major issues of land acquisition is envisaged.<br>• Prepare and administer land use control measures. | | Department in consultation with the affected people | consultation with the affected people | | |
| **CONSTRUCTION PHASE** | | | | | | | |
| 1 | Tree plantation | • Prepare an action plan for about 62 (E10), 322 (E14) and 105 (N16) nos. of trees to be felled along the Package 4 of the Priority roads (7 roads) in the project stretch. An amount of Rs. 19.56 Lakhs provision is made in EMP for felling of trees in Package 4. There are 1467 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br>• Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br>• *Avenue Plantation:* There are two rows of avenue plants proposed along the Package 4 of Priority roads (7 roads) as per IRC-SP-21: 2009. There are 62 (E10), 322 (E14) and 105 (N16) nos. of trees that are affected due to the proposed Package 4 of Prioirty roads (7 roads). Hence, 23,583 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>• *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>• Median plantation is proposed along the four lane stretches of total length 23.63 Kms. Median plantation is proposed with a provisions of 666 nos. of plants (two rows | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br>19.56 (Felling of trees)<br>291.56 (Avenue and Median plantation) |

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| | | are proposed since BRT is planned in the remaining space in future) per kilometer for 23.63 Kms. Hence, the estimated median plantation is around 15,924 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>• Budget allocation for avenue and median plantation is Rs. 2.91 crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 1. 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & Geology, GoAP<br>2. Assuming sand quarries of 6 nos. one for each package in the project.<br>3. Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & elevated lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br>4. Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in the project.<br>5. Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc., | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC/ Mining & Geology Department, GoAP/ CE, APCRDA/ CE, ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>4.00 |

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| | | An amount of Rs. 4.00 Lakh provision is made in the EMP for each borrow area | | | | | |
| 3 | Site for storage and construction camp. | The location of the Campsite shall be selected by the Contractor duly confirming the labour laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste disposal. | 1. Proper sanitation facilities (bio-toilets) at the construction workers camp shall be provided<br>2. Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & Handling) Rules, 2000.<br>3. It is envisaged that approximate 300 – 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | Monthly | Contractor / Concessionaire | Labour department / Health department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>10.00 |
| 5 | Traffic management | 1. Secure assistance from local police for traffic control during the construction.<br>2. Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 2.3 (i) | - |
| 6 | Air Quality | 1. There are five residential categories locations monitored in the study area and the air quality concentrations are found to be well within the CPCP Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.90 (for Air quality monitoring) |

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| | | 2. During construction, a good number of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project will have to keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission generated during construction will be temporary and localized in nature.<br>3. Vehicles carrying construction material shall be covered to avoid spilling.<br>4. Air quality monitoring shall be carried out at 6 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.90 Lakhs shall be allotted for air quality monitoring during construction period of 1 years, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br>6. Mixing equipment shall be seated and equipped with dust removal device.<br>7. Water will be sprinkled in morning and evening hours at the construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | 1. There are three commercial and five residential categories monitored in the | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution | GCC 15.2.2 | Sr. No. 9 & |

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| | | study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br>2. Stationary equipment shall be placed as far as possible from residential areas to minimise noise impacts on the near inhabitants.<br>3. Noise quality monitoring shall be carried out at 6 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.27 Lakhs shall be allotted for Noise monitoring during construction period of 1 years, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>4. Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br>5. Provision of ear plugs to workers exposed to high noise levels in the project who work in batch mix plants, hot mix plants, quarries etc. | | | Control Board /Director, Landscape & Environment of APCRDA/ADC | | 0.27 (for noise quality monitoring) |
| 8 | Water Quality | 1. There are eight nos. of surface water quality samples and six nos. of ground water quality samples monitored in the package. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards.<br>2. The ground water quality is found to be | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>1.68 (for water quality monitoring) |

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| | | satisfactory. During construction the water quality shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br>3. Slightly high BOD is reported at Tank near Penumaka (20) in Package -IV and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br>4. It is envisaged the only source of contribution of BOD is workers camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br>5. Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) with in villages premises, hence further deterioration of surface water is not envisaged<br>6. Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposal. | | | | | |
| 8 | Water Quality | 7. Water quality monitoring shall be carried out at 12 locations + 2 WQM locations of the package and compared with the baseline levels and amount of 1.68 Lakhs shall be allotted for water quality monitoring during construction period of 1 years, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1.68 (for water quality monitoring) |

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| | | 8. Soil laden run off will not be diverted to water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br>9. Vehicle maintenance and refueling will be confined to areas under construction yard to trap discarded lubricant and fuel spills. | | | | | |
| 9 | Soil quality | 1. Periodic monitoring of soil quality at suggested sensitive locations (6 locations) in the package 4.<br>2. An amount of 0.72 Lakh shall be allotted for soil quality monitoring during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.72 |
| 10 | Water logging and stagnation of water in the Borrow pits | 1. The majority of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br>2. Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 11 | Occupation Health and Safety | 1. Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br>2. Periodic health checkup of construction workers. | | Contractor or Concessionaire | Labour department /Director, Landscape & Environment of APCRDA/ADC | GCC 2.3(i) | - |
| 12 | Basic amenities and sanitation | • Adequate sanitary facilities shall be provided to the workers to avoid health | Monthly | Contractor or Concessionaire | Labour department / Health Department | GCC 15.2.2 | Sr. No. 9 & |

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| | facilities for labourers | related problems. Sanitation waste from workers camp will not be diverted to water bodies.<br>• Periodic health checkup of labourers shall be done.<br>• Contractor to prepare, CRDA's approved detailed public health utilities plan for the workers camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br>• Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected. Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | | | /Director, Landscape & Environment of APCRDA/ADC | | 4.00 |
| 13 | Fuel for labourers | • Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking ad other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and scouring | Stabilizing the embankment with appropriate technique immediately after placing.<br>• The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br>• Treating high embankment slopes with rip rap, stone pitching or other technologies to prevent erosion.<br>• Construction of toe drain all along the road | Monthly | Contractor or Concessionaire | Concerned local department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| | | on both sides.<br>• Avoiding obstruction of existing drainage during filling. | | | | | |
| 15 | Drainage system | 1. Adequate care has been taken for the purpose of free flow of flood discharge in the design stage itself. There are 1 major bridge and 14 culverts (slab / box / pipe culverts) in E10, 0 major bridge and 17 culverts (slab / box / pipe culverts) in E14 and 1 major bridge and 12culverts (slab / box / pipe culverts) in E10 that are proposed in the project to allow the free flow of the natural drainage water in the area.<br>2. Construction of toe drain along the road on both the sides.<br>3. Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Irrigation /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 16 | Conservation of Eco-resources | 1. To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br>2. Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture.<br>3. Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| 17 | Green Initiatives/ Environmental Enhancement Measures | 1. Loss of water spread volume due to the project 1990.47 Cum from 7 farm ponds within alignment and enhancement of equivalent water spread area is proposed in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.<br>2. Beautification of lakes/ farm ponds of 38 nos. present within 200m from the Right of Way (RoW). | Monthly | ADC | Minor Irrigation/ Archaeological/ Endowments/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>3.49 (for enhancement of water spread area)<br>190 (for beautification of lakes/ farm ponds) |
| 18 | Communications and Transportation | 1. Local materials should be used as much as possible so as to avoid long distance transportation that of earth and stone.<br>2. If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br>3. Temporary access should be built at the interchange of the urban roads and other roads.<br>4. Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br>5. Materials may be delivery in advance in relatively leisurely season of traffic.<br>6. A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | Monthly | Contractor or Concessionaire | Transport Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 19 | Rain Water Harvesting | 1. The package stretch was considered about 23.630 Km excluding settlements, bridge portions etc.<br>2. There are 95 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are | Monthly | Contractor or Concessionaire | GW Department /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>14.17 |

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| | | having dia. of 1.5 m with a depth of 3.8 m.<br>3. The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 14.17 Lakhs. | | | | | |
| 20 | Utilization of Fly Ash | 1. In the proposed project, There are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the Package 4 has to be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling has to be replaced with fly ash at high embankments and approaches to major bridges.<br>2. As per the designs, he proposed pavement crust for all the seven roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the seven roads. It is not feasible to use fly ash in the 10 Priority roads with out embankments | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |
| 21 | Surplus earth/ Muck disposal and C&D waste | 1. The quantity of muck /surplus earth generated in the project is 390988.9Cum in E10 and 366528.74in E14 and 438391.33 in N16. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations.<br>2. The C&D waste generated in this package is 474.15 Cum. It will be disposed in the | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1004..81(for muck/surplus earth)<br><br>0.39 (for C&D waste disposal) |

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| | | dump site identified for C&D waste disposal near Tadepalli and this is designated dump site as identified in master plan as discussed in Section 7.3.4 | | | | | |
| 22 | Energy efficient initiatives | • Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed whereever its possible.<br>• Measures to conserve energy include but not limited to the following:<br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task,<br>• Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible.<br><br>626 (E10), 588 (E14) and 703 (N16) nos. of single arm Solar/ Energy efficient LED streetlights are proposed | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1674.36 |
| 23 | Oil & Grease | • oils and greases and waste are likely to be generated from cleaning of vehicles near workers camp, oil & grease removal tank having size of 1.5x1.5x1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| | | at camp sites | | | | | |
| **OPERATION PHASE** | | | | | | | |
| 1 | Air Quality | 1. Monitor periodically the AAQ at suggested locations.<br>2. Developing road side vegetation for pollutant sinking.<br>3. Enforcing different control measures to minimise pollution.<br>4. Air quality monitoring shall be carried out at 6 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.90 Lakhs shall be allotted for air quality monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. Public will be educated about the regulations on air pollution and noise of vehicles. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board /Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.90 (for air quality monitoring) |
| 2 | Road safety and traffic management | 1. Prepare and administer a monitoring system on road accidents.<br>2. Adequate number of road signs with clear visibility shall be installed.<br>3. In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br>4. Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC/Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | 1. Provision of vegetative noise barriers | Quarterly | Contractor or | Andhra Pradesh | GCC 15.2.2 | Sr. No. 9 & |

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| | | (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br>2. Periodic monitoring of ambient noise levels at suggested locations<br>3. Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, temples and hospitals.<br>4. Noise monitoring shall be carried out at 6 locations of the project in 3 seasons and compared with the baseline levels and amount of 0.27 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge.<br>5. There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 23,583 nos. either side of the road to control noise levels. | | Concessionaire | State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | | 0.27 (for noise monitoring) |
| 4 | Soil characteristics | 1. Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 4 locations along the Project corridor.<br>2. An amount of 0.72 Lakh shall be allotted for soil quality monitoring (6 stations) during operational phase (of 1 year), once every season other than monsoon season. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.72 |

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| | | All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | | | | | |
| 5 | Water Quality | 1. As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high BOD levels are not envisaged once the STPs are functional.<br>2. Periodic monitoring of water quality at suggested sensitive locations (12 locations + 2 WQM locations)in the package 4<br>3. An amount of 1.68 Lakh shall be allotted for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Environmental Expert/ Engineer In-charge. | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br>&<br>1.68 |
| 6 | Maintenance of road side plantations | 1. *Avenue Plantation:* There are two rows of avenue plants proposed along the Package 4 of Priority roads (7 roads) as per IRC-SP-21: 2009. There are 62 (E10), 322 (E14) and 105 (N16) nos. of trees that are affected due to the proposed Package 4 of Prioirty roads (7 roads). Hence, 23,583 nos. of trees are proposed to be planted. The plants proposed are i.e., Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.<br>2. *Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br>3. Median plantation is proposed along the four lane stretches of total length 23.63 Kms. Median plantation is proposed with a | Quarterly | Contractor or Concessionaire | Forests Department/Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>291.56 |

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| | | provisions of 666 nos. of plants (two rows are proposed since BRT is planned in the remaining space in future) per kilometer for 23.63 Kms. Hence, the estimated median plantation is around 15,924 nos. The median plant proposed in the project are i.e., Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.<br>4. Employment of local people for the maintenance of plantation along the corridor | | | | | |
| 7 | Maintenance of Drainage System | 1. The drainage system will be periodically cleared so as to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

**Table 8-5 EMP: Implementation Schedule with Supervising Organization/ Authority for Package -V (E6)**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
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| **DESIGN PHASE** | | | | | | | |
| 1. | Alignment | The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for the Package V of proposed roads in the project is 9.84 Km with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference on People | Passageways are designed/widened for road development work to meet the needs of the residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br><br>Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | No cultural relics present in the corridor of Impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |
| 5. | Flood | Adequate care has been taken for free flow of flood discharge in the design stage itself. There are 4 bridges and 19 culverts (slab / box / pipe culverts) are proposed for Package V of the proposed 10 roads in the project to allow the free flow of the natural flood water in the area. | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |

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| 6. | Preparation of feasible land acquisition plan | Under APCRDA Land Polling Scheme most the land was already acquired and no major issues of land acquisition is envisaged.<br><br>Prepare and administer land use control measures. | Quarterly | AP CRDA, Revenue Department in consultation with the affected people | AP CRDA, Revenue Department in consultation with the affected people | - | - |
| **CONSTRUCTION PHASE** | | | | | | | |
| 1 | Tree plantation | Prepare an action plan for about 85 nos. of trees to be felled along the Package V of the proposed roads in the project stretch. An amount of Rs. 3.4 Lakhs provision is made in EMP for felling of trees in Package V. There are 255 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br><br>Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br><br>*Avenue Plantation:* There are two rows of avenue plants proposed along the Package V of Proposed roads (E6) of Project corridor as per IRC-SP-21: 2009. There are 85 nos. of trees are affected due to the proposed Package V of proposed roads of the project. Hence, 9513 nos. of trees are proposed to be planted. The plants proposed are i.e., *Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.*<br><br>*Median Plantation:* Since the project is construction of four laning road, project median will be utilized. | Monthly | Contractor/Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br><br>3.4<br>(Felling of trees)<br><br>118.067<br>(Avenue and Median Plantation) |

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| | | Median plantation is proposed along the four lane stretches of total length 9.84 Kms. Median plantation is proposed with a provision of 333 nos. of plants per kilometer for two medians of 9.84 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 6553 nos. The median plant proposed in the project are i.e., *Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.*<br><br>Budget allocation for avenue and median plantation is Rs. 118.067 Lakhs or 1.18 crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & Geology, GoAP<br><br>Assuming sand quarries of 6 nos. one for each package in the project.<br><br>Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & elevated lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br><br>Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in the project.<br><br>Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC / Mining & Geology Department, GoAP/ CE, APCRDA/ CE, ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>4.00 |

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| | | adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc., An amount of Rs. 1.00 Lakh provision is made in the EMP for each borrow area | | | | | |
| 3 | Site for storage and construction camp. | The location of the Campsite shall be selected by the Contractor duly confirming the labor laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste disposal. | Proper sanitation facilities (bio-toilets) at the construction workers camp shall be provided<br><br>Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & Handling) Rules, 2000.<br><br>It is envisaged that approximate 300 – 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | Monthly | Contractor / Concessionaire | Labour department / Health department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>10 |
| 5 | Traffic management | Secure assistance from local police for traffic control during the construction. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 62 (c) | - |

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| | | Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | | | | | |
| 6 | Air Quality | There are 2 locations monitored in the study area and the air quality concentrations are found to be well within the CPCB Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br><br>During construction, a good number of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project should keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission generated during construction will be temporary and localized in nature.<br><br>Vehicles carrying construction material shall be covered to avoid spilling.<br><br>Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for air quality monitoring during construction period of 1 year, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Director, | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.30 (for Air quality monitoring) |

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| | | Landscape & Environment of APCRDA/ADC.<br><br>Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br><br>Mixing equipment shall be seated and equipped with dust removal device.<br><br>Water will be sprinkled in morning and evening hours at the construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | There is one commercial and seven residential categories monitored in the study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br><br>Stationary equipment shall be placed as far as possible from residential areas to minimise noise impacts on the near inhabitants.<br><br>Noise quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during construction period of 1 year, once in a season. All monitoring to be carried out at all baseline locations or follow the | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.09 (for noise quality monitoring) |

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| | | directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br><br>Provision of ear plugs to workers exposed to high noise levels in the project who work in batch mix plants, hot mix plants, quarries etc. | | | | | |
| 8 | Water Quality | There are 1 no. of surface water quality samples and 2 nos. of ground water quality samples monitored in the project. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards. The ground water quality is found to be satisfactory. During construction, the water quality shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br><br>Slightly high BOD is reported at Pond near Nelapadu (14) in Package -V and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br><br>Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) within villages premises, hence further deterioration | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.84 (for water quality monitoring) |

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| | | of surface water is not envisaged<br><br>It is envisaged the only source of contribution of BOD is worker camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br><br>Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposing of any material arising from the execution of the works.<br><br>During construction, it will be ensured that contractor does not dispose debris in water bodies.<br><br>Water quality monitoring shall be carried out at 2 ground water samples + 1 surface water and 4 WQM locations of the package in 3 seasons and compared with the baseline levels and amount of 0.84 Lakhs shall be allotted for water quality monitoring during construction period of 1 year, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the Director, Landscape & Environment of APCRDA/ADC.<br><br>Soil laden run off will not be diverted to water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br><br>Vehicle maintenance and refueling will | | | | | |

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| | | be confined to areas under construction yard to trap discarded lubricant and fuel spills. | | | | | |
| 9 | Soil quality | Periodic monitoring of soil quality at suggested sensitive locations (2 locations) of Package V<br>An amount of 0.24 Lakh shall be allotted for water quality monitoring during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>0.24 |
| 10 | Water logging and stagnation of water in the Borrow pits | Most of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br>Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 11 | Occupation Health and Safety | Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br>Periodic health checkup of construction workers. | | Contractor or Concessionaire | Labour department / Director, Landscape & Environment of APCRDA/ADC | GCC 2.3 (i) | - |
| 12 | Basic amenities and sanitation facilities for labourers | Adequate sanitary facilities shall be provided to the workers to avoid health related problems. Sanitation waste from worker's camp will not be diverted to water bodies. | Monthly | Contractor or Concessionaire | Labour department / Health Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br>1.00 |

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| | | Periodic health checkup of labourers shall be done.<br><br>Contractor to prepare, CRDA's approved detailed public health utilities plan for the worker's camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br><br>Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.<br><br>Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | | | | | |
| 13 | Fuel for labourers | Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking and other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and scouring | Stabilizing the embankment with appropriate technique immediately after placing.<br><br>The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br><br>Treating high embankment slopes with | Monthly | Contractor or Concessionaire | Concerned local department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| | | rip rap, stone pitching or other technologies to prevent erosion.<br><br>Construction of toe drain all along the road on both sides.<br><br>Avoiding obstruction of existing drainage during filling. | | | | | |
| 15 | Drainage system | Adequate care has been taken for free flow of flood discharge in the design stage itself. There are 4 bridges and 19 culverts (slab / box / pipe culverts) proposed in the project to allow the free flow of the natural drainage water in the area.<br><br>Construction of toe drain along the road on both the sides.<br><br>Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Irrigation / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 16 | Conservation of Eco-resources | To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br><br>Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture.<br><br>Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| 17 | Green Initiatives/ Environmental Enhancement Measures | Loss of water spread volume due to the project is 11703.74 m3 from 8 farm ponds within alignment and enhancement of equivalent water spread area in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.<br><br>Beautification of lakes/ tanks/ farm ponds of 8 nos. present within 200m from the Right of Way (RoW). | Monthly | ADC | Minor Irrigation/ Archaeological/ Endowments/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | 20.54 (for enhancement of water spread area)<br><br>40 (for beautification of lakes/ tanks/ farm ponds) |
| 18 | Communications and Transportation | Local materials should be used as much as possible to avoid long distance transportation that of earth and stone.<br><br>If there are traffic jammed during construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br><br>Temporary access should be built at the interchange of the urban road and other roads.<br><br>Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br><br>Materials may be delivery in advance in relatively leisurely season of traffic.<br><br>A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | Monthly | Contractor or Concessionaire | Transport Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

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| 19 | Rain Water Harvesting | The package stretch was considered about 9.84 Km excluding settlements, bridge portions etc.<br><br>There are 38 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m.<br><br>The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 5.72 Lakhs. | Monthly | Contractor or Concessionaire | GW Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>5.72 |
| 20 | Utilization of Fly Ash | 1. In the proposed project, there are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project must be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly Ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling should be replaced with fly ash at high embankments and approaches to major bridges.<br><br>2. As per the designs, the proposed pavement crust for all the proposed 10 roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the pr0posed roads. It is not feasible to | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |

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| | | use fly ash in the proposed roads without embankments. | | | | | |
| 21 | Surplus earth/ Muck disposal and C&D waste | 1. The quantity of muck /surplus earth generated in the project is 1093818.23 Cum. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations.<br><br>2. The C&D waste generated in this package is 686.28 Cum. It will be disposed in the dump site identified for C&D waste disposal near Tadepalli and this is the designated dumpsite as identified in master plan as discussed in Section 7.3.4 | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br><br>919.38 |
| 22 | Energy efficient initiatives | Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed wherever its possible.<br><br>Measures to conserve energy include but not limited to the following:<br><br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task,<br>• Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 |

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| | | maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible. | | | | | |
| 23 | Oil & Grease | Oils and greases are likely to be generated from cleaning of vehicles near workers camp, oil & grease removal tank having size of 1.5x1.5x1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles at camp sites | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| **OPERATION PHASE** | | | | | | | |
| 1 | Air Quality | Monitor periodically the AAQ at suggested locations.<br><br>Developing road side vegetation for pollutant sinking.<br><br>Enforcing different control measures to minimize pollution.<br><br>Air quality monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.30 Lakhs shall be allotted for monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>Public will be educated about the regulations on air pollution and noise of | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.30 (for air quality monitoring) |

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| | | vehicles. | | | | | |
| 2 | Road safety and traffic management | Prepare and administer a monitoring system on road accidents.<br><br>Adequate number of road signs with clear visibility shall be installed.<br><br>In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br><br>Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | Provision of vegetative noise barriers (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br><br>Periodic monitoring of ambient noise levels at suggested locations<br><br>Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, temples and hospitals.<br><br>Noise monitoring shall be carried out at 2 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.09 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.09 (for noise monitoring) |

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| | | Environment of APCRDA/ADC.<br><br>There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 9513 nos. either side of the road to control noise levels. | | | | | |
| 4 | Soil characteristics | Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 8 locations along the Project corridor.<br><br>An amount of 0.24 Lakh shall be allotted for soil quality monitoring (2 stations) during operational phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.24 |
| 5 | Water Quality | Periodic monitoring of water quality at suggested sensitive locations (1 SW locations + 2 GW + 4 WQM locations) in Package V<br><br>As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high BOD levels are not envisaged once the STPs are functional.<br><br>An amount of Rs. 0.84 Lakh shall be allotted for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br><br>&<br><br>0.84 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC. | | | | | |
| 6 | Maintenance of road side plantations | *Avenue Plantation:* There are two rows of avenue plants proposed along the Package V of proposed 10 roads of Project corridor as per IRC-SP-21: 2009. There are 85 nos. of trees are affected due to the proposed Package V of proposed 10 roads of the project. Hence, 9513 nos. of trees are proposed to be planted. The plants proposed are i.e., *Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.*<br><br>*Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br><br>Median plantation is proposed along the four lane stretches of total length 9.84 Kms. Median plantation is proposed with a provision of 333 nos. of plants per kilometer for two medians of 9.84 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 6553 nos. The median plant proposed in the project are i.e., *Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria* etc.<br><br>Employment of local people for the maintenance of plantation along the corridor. | Quarterly | Contractor/Concessionaire | Forests Department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>118.067 |
| 7 | Maintenance of Drainage System | The drainage system will be periodically cleared to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape | GCC 15.2.2 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | & Environment of APCRDA/ADC | | |

**Table 8-6 : EMP: Implementation Schedule with Supervising Organization/ Authority for Package -VI**

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| **DESIGN PHASE** | | | | | | | |
| 1. | Alignment | The new alignment is proposed in the Capital City of Andhra Pradesh. The proposed length for the Package VI of the proposed (N11, E12) in the project is 15.44 Kms with a Right of Way of 50m. The land required for this project is falling under Land Pooling Scheme of APCRDA. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 2. | Interference on People | Passageways are designed/widened for road development work to meet the needs of the residents and vehicles. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 3. | Soil Erosion | In slopes and suitable places along the corridor of impact, bush grass will be planted, and retaining wall, water intercepting ditches, and masonry rubble will be built to prevent soil erosion.<br><br>Temporary and permanent drainage systems are designed to minimize the soil erosion and the impact on irrigation canals. | Monthly | DPR Consultant | AP Capital Region Development Authority (CRDA) | - | - |
| 4. | Cultural Relics | No cultural relics present in the corridor of Impact. | Quarterly | DPR Consultant | AP CRDA / Archaeological dept. | - | - |
| 5. | Flood | Adequate care has been taken for free flow of flood discharge in the design stage itself. There are 2 bridges and 47 culverts (slab / box / pipe culverts) are proposed for Package | Quarterly | DPR Consultant | AP CRDA / I & CAD Department | - | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | VI in the project to allow the free flow of the natural flood water in the area. | | | | | |
| 6. | Preparation of feasible land acquisition plan | Under APCRDA Land Polling Scheme most of the land was already acquired and no major issues of land acquisition is envisaged.<br><br>Prepare and administer land use control measures. | Quarterly | AP CRDA, Revenue Department in consultation with the affected people | AP CRDA, Revenue Department in consultation with the affected people | - | - |
| **CONSTRUCTION PHASE** | | | | | | | |
| 1 | Tree Plantation | Prepare an action plan for about 125 nos. of trees to be felled along the Package VI of the proposed roads (E12, N11) in the project stretch. An amount of Rs. 5 Lakhs provision is made in EMP for felling of trees in Package VI. There are 375 nos. of trees need to be planted as per the Forest Conservation Act, 1980 and subsequent amendments thereof.<br><br>Intimate forest department before cutting trees. Prepare action plan for avenue and median plantation.<br><br>*Avenue Plantation:* There are two rows of avenue plants proposed along the Package VI of the proposed roads (N11, E12) of Project corridor as per IRC-SP-21: 2009. There are 125 nos. of trees affected due to the proposed Package VI) of the project. Hence, 14855 nos. of trees are proposed to be planted. The | Monthly | Contractor/Concessionaire | Director, Landscape & Environment of APCRDA/ADC in consultation with the Forest dept. | GCC 15.2.2 | Sr. No. 9 &<br><br>5<br>(Felling of trees)<br><br>184.52<br>(Avenue and Median Plantation) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | plants proposed are i.e., *Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.*<br><br>*Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br><br>Median plantation is proposed along the four lane stretches of total length 15.44 Kms. Median plantation is proposed with a provision of 333 nos. of plants per kilometer for two medians of 15.44 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 10283 nos. The median plant proposed in the project are i.e., *Bougainvillea, Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.*<br><br>Budget allocation for avenue and median plantation is Rs.184.52 Lakhs or 1.84 crores for Implementation. | | | | | |
| 2 | Borrow pits and Quarry sites (stone / sand). | 10 nos. of operational licensed borrow areas and 2 nos. of operational licensed metal quarries are allotted for APCRDA for the project by Department of Mines & Geology, GoAP<br><br>Assuming 6 sand quarries with, one for each package in the project.<br><br>Borrow areas shall be carried out upto depth of 2.0m in non-cultivable & | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC / Mining & Geology Department, GoAP/ CE, APCRDA/ CE, ADC | GCC 15.2.2 | Sr. No. 9 & 4.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | elevated lands, 0.45 m in productive lands etc. with a slope of not steeper than 1 vertical to 4 horizontal.<br><br>Borrow areas shall be away from the 15m of the 2 nos. of water bodies identified in the project.<br><br>Rehabilitation, Resurfacing and landscaping of the borrow pits utilized in the project shall be done duly adopting Borrow areas shall be rehabilitated/ mitigation measures to be taken duly adopting the Sustainable Sand Mining Management Guidelines 2016 for activities of borrowing/ excavation of 'brick earth' and 'ordinary earth' for purpose of construction of roads, embankments etc., An amount of Rs. 1.00 Lakh provision is made in the EMP for each borrow area | | | | | |
| 3 | Site for storage and construction camp. | The location of the Campsite shall be selected by the Contractor duly confirming the labour laws. | Monthly | Contractor / Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 4 | Sewerage and solid waste disposal. | Proper sanitation facilities (bio-toilets) at the construction workers camp shall be provided<br><br>Domestic refuse shall be collected separately for bio-degradable waste as well as the inert waste and the same shall be sent for the disposal as per the MSW (Management & | Monthly | Contractor / Concessionaire | Labour department / Health department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>10.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | Handling) Rules, 2000.<br><br>It is envisaged that approximate 300 – 500 Kg of domestic solid waste (300 – 500 gm/person) per day will be generated from the workers camps which will be disposed of to the nearest solid waste disposal sites as discussed above. | | | | | |
| 5 | Traffic management | Secure assistance from local police for traffic control during the construction.<br><br>Safety measures shall also be undertaken by installing road signs and markings for safe and smooth movement of traffic. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 62 (c) | - |
| 6 | Air Quality | There are 5 locations monitored in the study area and the air quality concentrations are found to be well within the CPCP Standards. The same shall be monitored during the construction phase of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br><br>During construction, a good number of trucks will carry the construction material for which emission of air pollutants will increase. We should see that all the vehicles deployed for construction of the project should keep "Pollution Under Control" certificates. DG sets will also emit air pollutants in the area during construction period. The emission | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.75 (for Air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | generated during construction will be temporary and localized in nature.<br><br>Vehicles carrying construction material shall be covered to avoid spilling.<br><br>Air quality monitoring shall be carried out at 5 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.75 Lakhs shall be allotted for air quality monitoring during construction period of 1 year, once in a season (other than monsoon season). All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>Hot mixing plant shall be over 500m away from residential neighborhood and 300m away from the road.<br><br>Mixing equipment shall be seated and equipped with dust removal device.<br><br>Water will be sprinkled in morning and evening hours at the construction yards and the unpaved sections of the road. | | | | | |
| 7 | Noise level | There is one commercial, one industrial and five residential categories monitored in the study area and the monitored levels found to be slightly higher side for only three stations when compared with the CPCB Standards. The same shall be monitored during the construction phase | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.225 (for noise quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | of the project. Adequate measures shall be taken as per the mitigation measures suggested in the Chapter -6.<br><br>Stationary equipment shall be placed as far as possible from residential areas to minimize noise impacts on the near inhabitants.<br><br>Noise quality monitoring shall be carried out at 5 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.225 Lakhs shall be allotted for Noise monitoring during construction period of 1 year, once in a season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>Construction activities will be strictly prohibited between 10.00 p.m. to 6.00 a.m. near habitation<br><br>Provision of ear plugs to workers exposed to high noise levels in the project who work in batch mix plants, hot mix plants, quarries etc. | | | | | |
| 8 | Water Quality | There are 6 nos. of surface water quality samples and 5 nos. of ground water quality samples monitored in the project. The surface water quality is found to be satisfactory and matching with the IS:2296 Class C Standards. The ground water quality is found to be satisfactory. During construction, the water quality | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>1.68 (for water quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | shall be monitored and take appropriate mitigation measures as given in Chapter-6.<br><br>High BOD is reported at Kuragallu lake (20) and lake near Yerrabalem (16) in Package -VI and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br><br>Under SIIMP, the proposed project is already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) within villages premises, hence further deterioration of surface water is not envisaged<br><br>It is envisaged the only source of contribution of BOD is worker camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD in Package -VI and this high value can be attributed to a village intervention close to water bodies. This could possibly be due to wastewater, cattle slurry, solid waste, domestic wastewater already joining into streams, tanks and other surface water sources<br><br>Under SIIMP, the proposed project is | | | | | |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | already having provision for improvement of existing infrastructure (sewerage, storm water, solid waste and water supply) within villages premises, hence further deterioration of surface water is not envisaged<br><br>It is envisaged the only source of contribution of BOD is worker camps. Already provision is made in EMP that bio-toilets and oil & grease tanks should be constructed for abatement of further deterioration of BOD<br><br>Prior permission of the concerned engineer and regulatory authorities shall be taken regarding the discharge or disposing of any material arising from the execution of the works.<br><br>During construction, it will be ensured that contractor does not dispose debris in water bodies.<br><br>Water quality monitoring shall be carried out at 5 ground water samples + 6 surface water and 3 WQM locations of the package in 3 seasons and compared with the baseline levels and amount of 1.68 Lakhs shall be allotted for water quality monitoring during construction period of 1 year, once in a season other than monsoon. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of | | | | | |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | APCRDA/ADC<br><br>Soil laden run off will not be diverted to water bodies. Provision of waste disposal site for waste from construction and storage yards shall be made.<br><br>Vehicle maintenance and refueling will be confined to areas under construction yard to trap discarded lubricant and fuel spills. | | | | | |
| 9 | Soil quality | Periodic monitoring of soil quality at suggested sensitive locations (5 locations) of Package VI<br><br>An amount of 0.60 Lakh shall be allotted for water quality monitoring during construction phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.60 |
| 10 | Water logging and stagnation of water in the Borrow pits | Most of the project stretch is plain & horizontal land which will be act as water logging areas during the rainy seasons and may cause the breeding of the vectors in the area.<br><br>Uncontrolled digging of approved Burrow pits in the areas will be avoided to prevent water accumulation which results in breeding of disease causing vectors in the area. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 11 | Occupation Health and Safety | Labourers shall be equipped with proper safety gears like helmets, gloves and gum boots.<br><br>Periodic health checkup of construction workers. | | Contractor or Concessionaire | Labour department / Director, Landscape & Environment of APCRDA/ADC | GCC 2.3 (i) | - |
| 12 | Basic amenities and sanitation facilities for labourers | Adequate sanitary facilities shall be provided to the workers to avoid health related problems. Sanitation waste from worker's camp will not be diverted to water bodies.<br><br>Periodic health checkup of labourers shall be done.<br><br>Contractor to prepare, CRDA's approved detailed public health utilities plan for the worker's camp and other working sites, which make adequate provision for safe disposal of all wastes and prevention of spillages, leakage of polluting materials etc.<br><br>Contractor will be required to pay all costs associated with cleaning up any pollution caused by their activities and to pay full compensation to those affected.<br><br>Construction of 4 Bio-toilets in each package 4 units*12 members. An amount of Rs. 1 Lakh per Bio-toilet provision is made in EMP and this include oil & grease removal tank costs as well. | Monthly | Contractor or Concessionaire | Labour department / Health Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>2.00 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 13 | Fuel for labourers | Adequate supply of fuel (LPG/Kerosene) shall be provided to the labourers to avoid felling of trees for cooking and other domestic chores. | Monthly | Contractor or Concessionaire | Labour department / Health Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 14 | Prevention of erosion and scouring | Stabilizing the embankment with appropriate technique immediately after placing.<br><br>The high embankment slopes near to the major bridges are washed out or weaken and the same shall be strengthened.<br><br>Treating high embankment slopes with rip rap, stone pitching or other technologies to prevent erosion.<br><br>Construction of toe drain all along the road on both sides.<br><br>Avoiding obstruction of existing drainage during filling. | Monthly | Contractor or Concessionaire | Concerned local department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 15 | Drainage system | Adequate care has been taken for free flow of flood discharge in the design stage itself. There are 2 bridges and 47 culverts (slab / box / pipe culverts) are proposed in the project to allow the free flow of the natural drainage water in the area.<br><br>Construction of toe drain along the road on both the sides. | Monthly | Contractor or Concessionaire | Irrigation / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | Avoiding obstruction of existing drainage during filling. | | | | | |
| 16 | Conservation of Eco-resources | To preserve the forests, earth borrowing, piling, and building temporary camps are prohibited in forests lands.<br><br>Arable lands should not be used as earth borrowing whenever possible. If needed, the topsoil (30cm) should be kept and refilled after construction is over to minimize the impact on ecosystem and agriculture.<br><br>Construction vehicles should run at temporary accesses to avoid damaging arable lands and cattle-raising lands. | Monthly | Contractor or Concessionaire | Forests department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| 17 | Green Initiatives/ Environmental Enhancement Measures | Loss of water spread volume due to the project is 5065.55 m3 from 12 farm ponds within alignment and enhancement of equivalent water spread area in the streams, canals, vagus of sub-project influence area viz., Kondaveeti vagu, Pala vagu, other streams etc.<br><br>Beautification of lakes/ tanks/ farm ponds of 23 nos. present within 200m from the Right of Way (RoW). | Monthly | ADC | Minor Irrigation/ Archaeological/ Endowments/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | 8.14 (for enhancement of water spread area)<br><br>115 (for beautification of lakes/ tanks/ farm ponds) |
| 18 | Communications and Transportation | Local materials should be used as much as possible to avoid long distance transportation that of earth and stone.<br><br>If there are traffic jammed during | Monthly | Contractor or Concessionaire | Transport Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | construction, measures should be taken to move the jam with the coordination of transportation and public security department.<br><br>Temporary access should be built at the interchange of the urban road and other roads.<br><br>Passing time on Urban Roads will be limited, similar measures will also be applied to roads with traffic jams.<br><br>Materials may be delivery in advance in relatively leisurely season of traffic.<br><br>A transportation plan of materials will be formulated to avoid delivered of them at peak hours on existing roads. | | | | | |
| 19 | Rain Water Harvesting | The package stretch was considered about 15.4 Km excluding settlements, bridge portions etc.<br><br>There are 72 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m.<br><br>The budget provision for the RWH structures are provided at the rate of Rs. 15000/pit and the total amount is estimated to be Rs. 8.87 Lakhs. | Monthly | Contractor or Concessionaire | GW Department / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>8.87 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 20 | Utilization of Fly Ash | 1. In the proposed project, there are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project should be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly Ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling should be replaced with fly ash at high embankments and approaches to major bridges.<br><br>2. As per the designs, the proposed pavement crust for all the proposed roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /APPCB | GCC 15.2.2 | - |
| 21 | Surplus earth/ Muck disposal | 1. The quantity of muck /surplus earth generated in the project is 400716.97 cum in N11 and 344801 Cum in E12. The muck generated mostly consists of expansive black cotton soil. Hence its reuse for project is not recommended. The excess muck will be disposed off in identified locations.<br><br>2. The C&D waste generated in this package is 104.90 Cum. It will be disposed in the dump site identified for C&D waste disposal near Tadepalli and this is the designated dumpsite as | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br><br>626.32 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | identified in master plan as discussed in Section 7.3.4 | | | | | |
| 22 | Energy efficient initiatives | Integrating solar energy generation right from the project planning and design stage for the project to be sustainable is essential. Solar LED lights to be proposed wherever its possible.<br><br>Measures to conserve energy include but not limited to the following:<br><br>• Use of energy efficient motors and pumps,<br>• Use of energy efficient lighting,<br>• Adequate and uniform illumination level at construction sites suitable for the task,<br>• Proper size and length of cables/ wires to match the rating of equipment,<br>• Use of energy efficient air conditioner.<br><br>The contractor shall design site offices for maximum daylight and minimum heat gain. The rooms shall be well insulated to enhance the efficiency of air conditioners and the use of solar films on windows may be used where feasible. | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 & |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| 23 | Oil & Grease | Oils and greases are likely to be generated from cleaning of vehicles near worker's camp, oil & grease removal tank having size of 1.5x1.5x1.2 m shall be installed at initial stage of effluent treatments and it is suggested to use Green-seal certified bio-degradable cleaning solvents for cleaning of vehicles at camp sites | Monthly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |
| **OPERATION PHASE** | | | | | | | |
| 1 | Air Quality | Monitor periodically the AAQ at suggested locations.<br><br>Developing road side vegetation for pollutant sinking.<br><br>Enforcing different control measures to minimise pollution.<br><br>Air quality monitoring shall be carried out at 5 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.75 Lakhs shall be allotted for monitoring during Operational period of 1 year, once in a season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>Public will be educated about the regulations on air pollution and noise of | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.75 (for air quality monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | vehicles. | | | | | |
| 2 | Road safety and traffic management | Prepare and administer a monitoring system on road accidents.<br><br>Adequate number of road signs with clear visibility shall be installed.<br><br>In case of spill of hazardous materials, report to the relevant departments at once and deal with it in accordance with the emergency plan.<br><br>Drivers and Public will be educated about the Safety regulations. | Quarterly | Contractor or Concessionaire | Director, Landscape & Environment of APCRDA/ADC /Traffic Police dept. | GCC 15.2.2 | - |
| 3 | Noise level | Provision of vegetative noise barriers (two rows of plants) has been proposed at sensitive areas and other noise prone areas.<br><br>Periodic monitoring of ambient noise levels at suggested locations<br><br>Erecting sign boards at sensitive and residential locations, prohibiting the use of air horns. Particularly near schools, temples and hospitals.<br><br>Noise monitoring shall be carried out at 5 locations of the package in 3 seasons and compared with the baseline levels and amount of 0.225 Lakhs shall be allotted for Noise monitoring during Operational period of 1 year, once in a season other | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.225 (for noise monitoring) |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC<br><br>There are two rows of avenue plants proposed along the project corridor as per IRC-SP-21: 2011. The avenue plants proposed to be planted in the project are about 14855 nos. either side of the road to control noise levels. | | | | | |
| 4 | Soil characteristics | Periodic monitoring of soil quality at specified distance from the corridor for assessing soil contamination by vehicular emissions. The analyzed samples shall be compared with the baseline values monitored at 5 locations along the Project corridor.<br><br>An amount of 0.60 Lakh shall be allotted for soil quality monitoring (5 stations) during operational phase (of 1 year), once every season other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>0.60 |
| 5 | Water Quality | Periodic monitoring of water quality at suggested sensitive locations (6 SW locations + 5 GW + 3 WQM locations) in Package VI<br><br>As part of sewerage master plan, 13 STPs are proposed covering 29 villages of Amaravati Capital City area. So, the high | Quarterly | Contractor or Concessionaire | Andhra Pradesh State Pollution Control Board / Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9<br><br>&<br><br>1.68 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | BOD levels are not envisaged once the STPs are functional.<br><br>An amount of Rs. 1.68 Lakh shall be allotted for water quality monitoring during operation phase (of 1 year), once in 3 months other than monsoon season. All monitoring to be carried out at all baseline locations or follow the directions of the Director, Landscape & Environment of APCRDA/ADC | | | | | |
| 6 | Maintenance of road side plantations | *Avenue Plantation:* There are two rows of avenue plants proposed along the Package VI of the proposed roads (N11,E12) of Project corridor as per IRC-SP-21: 2009. There are 125 nos. of trees are affected due to the proposed Package VI of the project. Hence, 14855 nos. of trees are proposed to be planted. The plants proposed are i.e., *Ravi, marri, Gulmohar, rain tree, Ganuga, Neem, Nagajemudu, Mango, Maredu etc.*<br><br>*Median Plantation:* Since the project is construction of four laning road, project median will be utilized.<br><br>Median plantation is proposed along the four lane stretches of total length 15.44 Kms. Median plantation is proposed with a provision of 333 nos. of plants per kilometer for two medians of 15.44 Kms of 4 lane + 2 lane BRT. Hence, the estimated median plantation is around 4522 nos. The median plant proposed in the project are i.e., *Bougainvillea,* | Quarterly | Contractor/Concessionaire | Forests Department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | Sr. No. 9 &<br><br>184.46 |

| S. No | Project related Issues | Action to be taken | Frequency | Implementation Agency | Supervision Agency | Relevant Contract Conditions | Relevant BoQ Items & Cost (Rs. Lakh) |
|---|---|---|---|---|---|---|---|
| | | *Nerium Oleander, Thevitia Nerifolia, Tabernaemontana Coronaria etc.* Employment of local people for the maintenance of plantation along the corridor. | | | | | |
| 7 | Maintenance of Drainage System | The drainage system will be periodically cleared to ensure water flow. | Quarterly | Contractor or Concessionaire | Irrigation department/ Director, Landscape & Environment of APCRDA/ADC | GCC 15.2.2 | - |

## 8.2 Corporate Social Responsibility (CSR)

The World Bank Group, stating, "Corporate social responsibility is the commitment of businesses to contribute to sustainable economic development by working with employees, their families, the local community and society at large, to improve their lives in ways that are good for business and for development."

The core elements of the CSR are:

1. Care for all stakeholders
2. Ethical functioning
3. Respect for workers' rights and welfare
4. Respect for human rights
5. Protection of Environmental
6. Activities for Social and Inclusive

### 8.2.1 CSR in Companies Bill 2012

The Companies Bill, 2012 incorporates a provision of CSR under Clause 135 which states that every company having net worth Rs. 500 crore or more, or a turnover of Rs. 1000 crore or more or a net profit of rupees five (05) crore or more during any financial year, shall constitute a CSR Committee of the Board consisting of three or more Directors, including at least one Independent Director, to recommend activities for discharging corporate social responsibilities in such a manner that the company would spend at least 2 per cent of its average net profits of the previous three years on specified CSR activities.

Per Schedule-VII of Companies Bill, 2012 the following activities can be included by companies in their CSR Policies: -

- Eradicating extreme hunger and poverty;
- Promotion of education;
- Promoting gender equality and empowering women;
- Reducing child mortality and improving maternal health;
- Combating human immunodeficiency virus, acquired immune deficiency syndrome, malaria and other diseases;
- Ensuring environmental sustainability;
- Employment enhancing vocational skills;

- Social business projects;
- Contribution to the Prime Minister's National Relief Fund or any other fund set by the Central Government or the State Governments for socio-economic development and relief and funds for the welfare of the Scheduled Caste, the Scheduled Tribes, other backward classes, minorities and women; and
- Such other matters as may be prescribed.

### 8.2.2 Guidelines on CSR for Public Enterprises

The Department of Public Enterprises had issued Guidelines on Corporate Social Responsibility (CSR) for Central Public Sector Enterprises (CPSEs) in April, 2010 which have been issued formally to the Ministries/Departments for compliance in the CPSEs under their administrative control. Following are the some of the salient features of guidelines on CSR & Sustainability:

(i) Corporate Social Responsibility and Sustainability is a company's commitment to its stakeholders to conduct business in an economically, socially and environmentally sustainable manner that is transparent and ethical.

(ii) In the revised guidelines, CSR and Sustainability agenda is perceived to be equally applicable to external and internal stakeholders, including the employees of a company, and a company's corporate social responsibility is expected to cover even its routine business operations and activities. CPSEs are expected to formulate their policies with a balanced emphasis on all aspects of CSR and Sustainability – equally with regard to their internal operations, activities and processes, as well as in their response to externalities.

(iii) In the revised guidelines, CSR and Sustainable Development have been clubbed together in one set of guidelines for CSR and Sustainability because of close linkage between the two concepts.

(iv) Public Sector enterprises are required to have a CSR and Sustainability policy approved by their respective Boards of Directors. The CSR and Sustainability activities undertaken by them under such a policy should also have the approval/ratification of their Boards. Within the ambit of these guidelines, it is the discretion of the Board of Directors of CPSEs to decide on the CSR and Sustainability activities to be undertaken.

(v) The financial component/budgetary spend on CSR and Sustainability will be based on the profitability of the company and shall be determined by the Profit After Tax (PAT) on the company in the previous year.

| S.No. | PAT of CPSEs in the Previous Years | Range of Budgetary allocation for CSR & Sustainability Activities (as % of PAT in Previous Year) |
|---|---|---|
| 1 | Less than 100 Crores | 3-5% |
| 2 | Rs. 100 Crores to Rs. 500 Crores | 2-3% |
| 3 | Rs. 500 Crores and Above | 1-2% |

Loss making companies are not mandated to earmark specific funding for CSR and Sustainability activities. However, they must pursue CSR and Sustainability policies by integrating them with their business plans, strategies and processes, which do not involve any financial expenditure. They may also collaborate with the profit making CPSEs and assist them in ingenious ways without financial support in CSR and Sustainability activities.

### 8.2.3 CSR Budgetary Allocations for this Project

CRDA has undertaken the development of the proposed project road stretch of 4-lane roads. The estimated cost of 10 Priority roads (10 roads) is Rs. 1936.98 Crores. CSR in Companies Bill, 2012 stating that the budgetary provisions shall be made on PAT, which is not envisaged throughout the concessions period for this project. However, as per the Government of India initiative taken on CSR activities, the lump-sum amount provision of Rs. 4 Crores shall be made in the project initially and the same shall be reviewed and adjusted time to time by the CSR Board of Directors for this project.

## 8.3 Environmental Training

The Environmental Management Cell (EMC), in addition to implementing and monitoring different environmental attributes, shall also be actively involved in imparting training and raising environmental awareness level of Contractors and the construction staff to enable them to take the environmental aspects into consideration as and when required. In the long term, the EMC can impart additional and specialized training in the Environmental Management of the road system.

### 8.3.1 Training Module

As a part of its capacity building initiatives, APCRDA /ADC will provide formal training to its personnel to develop comprehensive understanding of environmental and social issues and the associated risks. Thus, a training program has been devised for employees at different levels. This training program aims to provide APCRDA's/ADC's employees with the necessary expertise and other project participants like workers, civil contractor(s), construction project management team (viz., Project Management, Project Engineers and Project Superintendents/ Supervisors) to recognize Environmental & Social (E&S) issues at project sites, and develop suitable safeguards. These training programs would to be conducted with the help of local and national training institutions and individual technical experts. Project Management Unit is formed for the smooth implementation of Strategic Environmental & Social Assessment – Environmental & Social Management Framework (SESA -ESMF) in the Amaravati Sustainable Capital City Development Project (ASCCDP). The Director, Landscape & Environment of APCRDA/ADC will identify select courses offered by the premier institutions in India and develop an E&S training module. The Director, Landscape & Environment of APCRDA/ADC with the assistance of the Environmental Engineers (EE/DE) will coordinate these training programs. The Director, Landscape & Environment of APCRDA/ADC will customize the course contents to suit the needs of the urban road infrastructure projects. Two types of training will be conducted, namely:

- Awareness training
- Competence training

Awareness training will be imparted to all senior staff of APCRDA (Engineers and above) on a rotational basis and other project participants like workers, civil contractor(s), construction project management team (viz., Project Management, Project Engineers and Project Superintendents/ Supervisors). This training program will mainly cover an appreciation of E&S issues, APCRDA /ADC environmental policy and vision, Environmental Induction Program, Environment & Social (E&S) initiatives and requirements to be implemented. To provide competence training, needs identification will be done by The Director, Landscape & Environment of APCRDA/ADC for their Engineers. The training program will mainly cover the introduction to SESA -ESMF, pollution prevention techniques, environmental management systems, implementation of EMP ec. Executive Engineers (EE)/ Deputy Executive Engineers (DE)/ Others having the following basic skills would be selected to receive the competence training:

- Masters /Engineering degree in civil/ chemical / environment
- Environmental Science Graduate with Masters in geology/ biology/ mathematics etc.
- At least 5 years of experience in handling direct portfolios.
- Good communication skills in English.

Table -8.7 provides an outline of the awareness and competence training modules to be prepared.

**Table 8-7: Awareness and Competence Training Module**

| S.No. | Module | Course Outline | Duration | Frequency | Target Audience | Training Institutions /Individual Expertise |
|---|---|---|---|---|---|---|
| **A. Awareness Training** | | | | | | |
| 1 | APCRDA /ADC EHS policies and Environmental Induction Program | APCRDA's /ADC E&S policy, requirements and initiatives | 30 min. | Once Every year for all staff | All Senior Staff of APCRDA and other staff including workers, civil contractor(s), construction project management team (viz., Project Management, Project Engineers and Project Superintendents/ Supervisors) | APCRDA/ ASCI /ESCI |
| 2 | Environmental & Social (E&S) Regulations | • Introduction to Indian regulatory framework and environmental & social legal requirements for projects /sub-projects of AP CRDA/ADC and implementation bottlenecks.<br>• E&S requirements of major funding institutions like World Bank, WB-EHS etc | 30 min. | Once Every year for all staff | All Senior Staff of APCRDA | ASCI /ESCI |
| 3 | Introduction to causes of pollution and its consequences on environment | • Introduction to air, water, noise and land pollution.<br>• Global environmental issues.<br>• Case studies of infrastructure projects (urban roads) and associated environmental impacts. | 60 min. | Once Every year for all staff | All Senior Staff of APCRDA | ASCI /ESCI /AP PCB/ EPTRI |
| **B. Competence Training** | | | | | | |
| 1 | Introduction to APCRDA's /ADC's Strategic | • SESA -ESMF principles<br>• SESA -ESMF Forms and formats and check sheets. | 4 Hrs | Once in every six months | Senior Management & Executive Engineers (EE)/ Deputy Executive | ASCI /ESCI/ EPTRI |

| S.No. | Module | Course Outline | Duration | Frequency | Target Audience | Training Institutions /Individual Expertise |
|---|---|---|---|---|---|---|
| | Environmental & Social Assessment – Environmental & Social Management Framework (SESA - ESMF) and procedures | • Environmental & social regulation in India (Acts and rules)<br>• SESA -ESMF Risk Classification of AP CRDA /ADC.<br>• Project appraisal methodology.<br>• Risk management and mitigation techniques.<br>• Monitoring requirements. | | | Engineers (DE) | |
| 2 | Pollution Prevention Techniques | • Cleaner production practices.<br>• Cleaner production initiatives for World Bank EA, EB & EC Categories of infrastructure projects.<br>• Air pollution control techniques<br>• Wastewater treatment techniques.<br>• Solid & Hazardous waste substances management<br>• Occupational health and safety Management | 4 Hrs | Once in every six months | Senior Management & Executive Engineers (EE)/ Deputy Executive Engineers (DE) | ASCI /ESCI / EPTRI /Eminent Environment Expert |
| 3 | Environmental management systems and Implementation of Environmental Management Plan (EMP) | • Introduction to environment management systems (EMS) and benefits<br>• EMS implementation techniques.<br>• Monitoring and measurement of EMP performance in line with BoQs | 1 day | Once in every six months | Senior Management & Executive Engineers (EE)/ Deputy Executive Engineers (DE) | ASCI /ESCI / EPTRI /Eminent Environment Expert |

# Chapter 9
# ENVIRONMENTAL MONITORING PLAN

## 9.1 Pre-Construction Phase

The environmental monitoring programme is a vital process of any Environmental Management Plan (EMP) of development project for review of indicators and to take immediate preventive action. This helps in signaling the potential problems resulting from the proposed project activities and will allow for prompt implementation of corrective measures. APCRDA has keen interest in environmental monitoring as it is an integral part towards better environmental management of air, noise, water quality etc both during construction and in operation. Generation of dust and noise are two main issues during any large construction activity. Degradation of water quality is another. During construction, management of dust was carried out by monitoring Suspended Particulate Matter. Now, the same is being done by monitoring Particulate Matter (size less than 10microns). Similarly, for example, noise monitoring is carried out by recording dB(A) values. The parameters are monitored in pre-construction, construction and operation phase and are based on the need to evaluate the deviation of environmental conditions from baseline environmental conditions due to construction and operation of the Roads. If it is observed that environmental conditions are deteriorating, then proper mitigation measures will be taken. The monitoring parameters are thus those that are generally impacted during construction activities. Impact monitoring during construction help to discipline the contractors and assist them in meeting their contractual obligations. Construction phase monitoring data is also intended to evaluate the efficacy of some control mechanisms found in the environmental manual which are then either modified, upgraded or deleted. Monitoring is also extended to the operational phase, to ascertain the impacts over a long-term period. These parameters are also of immediate public concern. Over a period, much environmental monitored data has been generated and is also of academic interest. The data is much sought after by Institutions, NGOs and interested public. The environmental monitoring will be required during both construction and operational phases. The following parameters are proposed to be monitored:

- Water Quality,
- Air Quality,
- Noise

- Soil Quality
- Workers health and safety

Environmental monitoring during pre-construction phase is important to know the baseline data and to predict the adverse impacts during construction and operations phases. Pre-construction phase monitoring has been done for the proposed project for air, noise, water, soil quality and ecology. The results so obtained are documented in **Chapter -6**.

### 9.2 Construction Phase

During construction stage, environmental monitoring will be carried out for air quality, noise levels, water quality, and ecology. Environmental monitoring should be carried out at the locations where baseline monitoring was carried-out. These numbers could be modified based on need when the construction commences. The contractor shall ensure daily, weekly and monthly environmental monitoring, mitigation & management measures for preparing monthly report, the PMC personnel would consist of a dedicated Environmental Specialist to monitor the compliance throughout the construction phase of the project and report the same to the Director, Landscape & Environment of APCRDA/ADC. The project specific environmental formats are given in **Annexure -VI**. The monitoring program shall also be conducted by Project Management Consultant/ third party on a random sample basis covering 20% of sampling requirements in addition to, and independent of the tests that need to be carried out by the contractor as specified in the EMP under the supervision of Director, Landscape & Environment of ADC/APCRDA.

#### 9.2.1 Water Quality

Since water contamination leads to various water related diseases, the project authorities shall establish a procedure for water quality surveillance and ensure safe water for the consumers. The water quality parameters are to be monitored during the entire period of project construction. Monitoring should be carried out by NABL certified private or Government agency. Water quality should be analyzed following the procedures given in the standard methods. Parameters for Surface water quality monitoring will be as per IS: 2296 and for Ground water quality monitoring will be as per IS: 10500. The monitoring points could be ground and surface water.

### 9.2.2 Air Quality

Air quality is regularly monitored by Central/State Pollution Control Boards at number of places in Amaravati Capital City. In addition to these, air quality should be monitored at the locations of baseline monitoring as reported in Chapter 6. The parameter recommended is Particulate Matter (PM10). The contractor will be responsible for carrying out air monitoring during the entire construction phase under the supervision of APCRDA

### 9.2.3 Noise

The noise will be monitored at construction sites for entire phase of construction by the site contractor and under the supervision of APCRDA.

### 9.2.4 Soil Quality

Soil quality should be monitored at the locations of baseline monitoring as reported in **Chapter -6**.

### 9.2.5 Workers health and safety

Monitoring of health risk issues that might arise throughout the project life time will be done. Epidemiological studies at construction sites and workers camp will be performed to monitor the potential spread of diseases. Regular inspection and medical checkups shall be carried out to workers' health and safety monitoring. Any reoccurring incidents such as irritations, rashes, respiratory problems etc. shall be recorded and appropriate mitigation measures shall be taken. Contractor will be the responsible person to take care of health and safety of workers during the entire period of the construction and project proponent shall review/audit the health and safety measures/plans. However, supervision agency for Workers health and safety is the project proponent, APCRDA, which should include site representation, compliance monitoring, training and incident management. The monitoring Schedule for Air, noise, water and soil are presented in Table -9.1 for Roads in the Project.

**Table 9-1: Construction Stage Monitoring Schedule for Roads in the Project**

| Parameter | Frequency | No. of Locations (Package & road wise) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | | IV | | | V | VI | |
| | | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | E12 | N11 |
| Air (PM10) | 24 hours, Once in 3 months other than monsoon season | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Noise | Hourly for 24 hours, Once in 3 months other than monsoon season | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| Water | Once in 3 months other than monsoon season | 8 | 4 | 7 | 7 | 5 | 5 | 4 | 3 | 6 | 4 |
| Soil | Once in 3 months other than monsoon season | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |

### 9.3 Operation Phase

Even though the environmental hazards during the operation phase of the project are minimal, the environmental monitoring will be carried out for air, noise, water, soil and ecology during operation phase of the project. The parameters monitored during operation will be PM10, PM2.5, CO, NO2 & SO2 for air, water quality parameters will be monitored as per BIS 10500. The monitoring schedule is presented in Table -9.2 for Roads in the Project. The monitoring program shall also be conducted by Project Management Consultant/ third party on a random sample basis covering 20% of sampling requirements in addition to, and independent of the tests that need to be carried out by the contractor as specified in the EMP under the supervision of Director, Landscape & Environment of APCRDA/ADC

**Table 9-2 : Operational Stage Monitoring Schedule for Roads in the Project**

| Parameter | Frequency | No. of Locations (Package & Road wise) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | | IV | | | V | VI | |
| | | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | E12 | N11 |
| Air (PM10) | 24 hours, Once in 3 months other than monsoon season | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| Noise | Hourly for 24 hours, Once in 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | months other than monsoon season | | | | | | | | | | |
| Water | Once in 3 months other than monsoon season | 8 | 4 | 7 | 7 | 5 | 5 | 4 | 7 | 10 | 4 |
| Soil | Once in 3 months other than monsoon season | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |

The results of Air quality, water quality, noise quality and soil quality will be submitted to management quarterly during construction phase and semiannually during operation phase. All monitoring to be carried out at all baseline locations, wherever not mentioned follow the directions of the Director, Landscape & Environment of APCRDA/ADC. The monitoring schedule for both construction and operational phases of all the roads is presented in **Table -9.3.**

**9.4 Establishment of an Environment Management Cell**

It is recommended that APCRDA establishes Environment Management Cell at the initial stage of the project itself. The cell should be staffed with an Environmental Engineer/Officer and a Technical Assistant (environment background). The task of the cell would be to supervise and coordinate studies, environmental monitoring and implementation of environmental mitigation measures, and it should report directly to Director, Landscape & Environment of APCRDA/ADC. The Hierarchical structure of Environment Management Cell is shown in the figure -9.1 below.

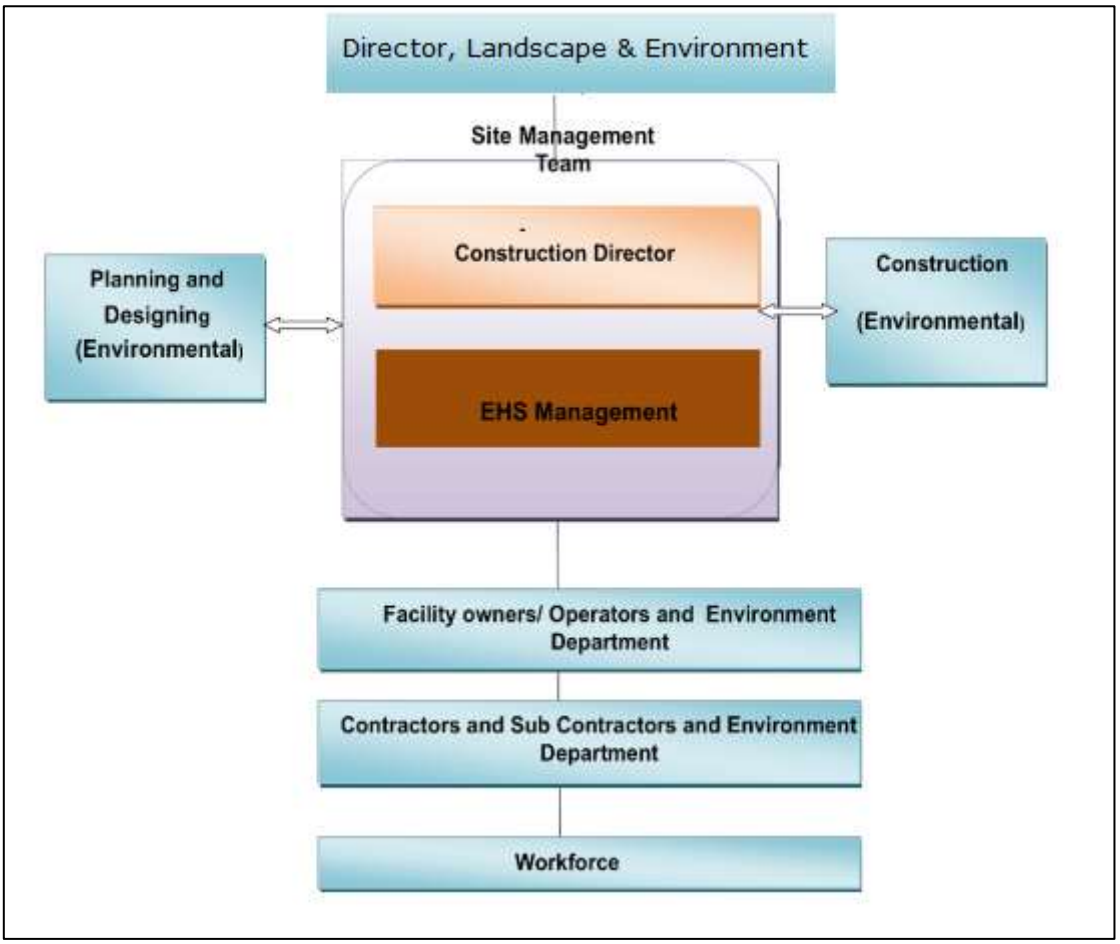


**Figure 9-1 : Hierarchical structure of Environmental Management Cell**

### 9.5 Implementation of EMP by Third party/ Project Management Consultant

As per the requirement of World Bank, a Third-party engineer/ Project Management Consultant shall be deployed at site during construction phase of the project for an effective Implementation of EMP. Organizational setup for Environmental Monitoring during construction and operation phase are shown in **Figure -9.2**.

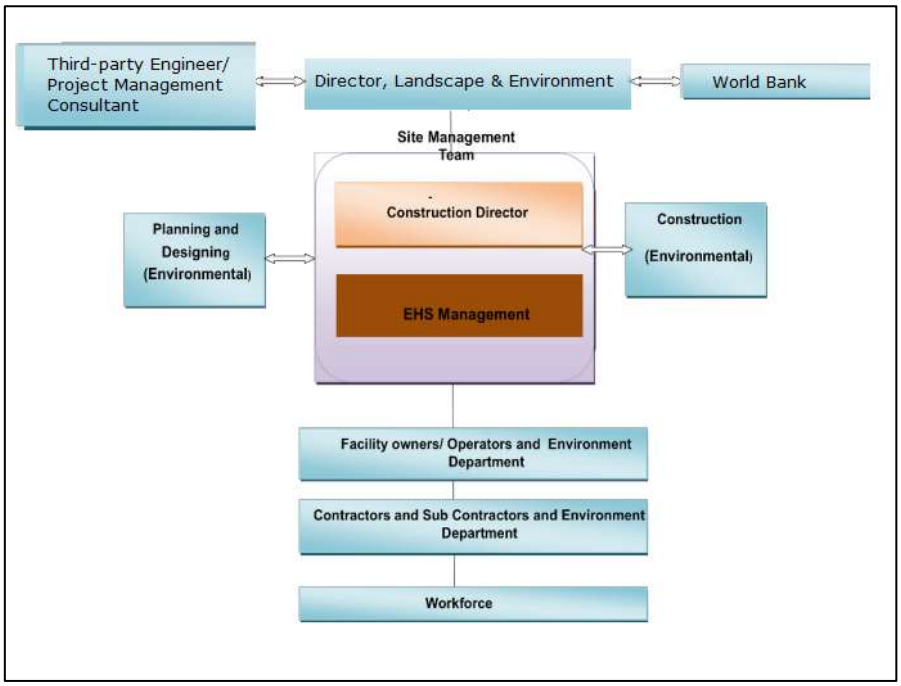


**Figure 9-2 : Organizational Setup During Construction and Operation Phase**

**Table 9-3 : Environmental Monitoring Schedule during Construction & Operation Phases**

## CONSTRUCTION STAGE MONITORING SCHEDULE

| Attributes | No. of Stations | | | | | | | | | | 2017 | | | | | | | | | 2018 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | | IV | | | V | VI | | | | | | | | | | | |
| | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | E12 | N11 | April | May | June | July | August | September | October | November | December | January |
| Air | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |
| Noise | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |
| Water | 8 | 4 | 7 | 7 | 5 | 5 | 4 | 3 | 6 | 4 | | 1 | | | | | 1 | | | 1 |
| Soil | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |

## OPERATION STAGE MONITORING SCHEDULE

| Attributes | No. of Stations | | | | | | | | | | 2018 | | | | | | | | | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | | IV | | | V | VI | | | | | | | | | | | |
| | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | E12 | N11 | April | May | June | July | August | September | October | November | December | January |
| Air | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |
| Noise | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |
| Water | 8 | 4 | 7 | 7 | 5 | 5 | 4 | 7 | 10 | 4 | | 1 | | | | | 1 | | | 1 |
| Soil | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | | 1 | | | | | 1 | | | 1 |

# Chapter 10
# ENVIRONMENTAL COST ESTIMATES

## 10.1 Budget for EMP Implementation

The design and construction of the project involves number of items such as erosion prevention, rehabilitation of borrow areas, safety signage, etc., which are included in the contract cost. Only those items that are not covered under the budget for construction are shown in the EMP implementation budget. The Budget for Environmental Management Plan for Items to be covered in BoQs works out to be **Rs. 66.98 Crores** and the budget for Environmental Management Plan for Items included in Project Cost worked out to be **Rs. 108.55 Crores** as given in Tables-10.1 & 10.2 respectively.

The main components are:

- Tree plantation / Transplantation
- Environmental Enhancement Measures
- Green initiatives
- Environmental monitoring during construction and operation phase
- Training during construction and operation phase
- Initiatives to be undertaken as part of Corporate Social Responsibilities.
- Dust Suppression systems
- Muck/ Debris Disposal and C&D Waste

## Table 10-1 : Budget for Environmental Management Plan for Items to be covered in BoQs

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | N11 | E8 | |
| **I. Logistics cum Administrative costs** | | | | | | | | | | | | | |
| 1 | Vehicle cost | 1 Vehicles/ Package @ Rs 50,000/- per month for 12 vehicle months | 6.00 | 6.00 | 3.00 | 3.00 | 2.00 | 2.00 | 2.00 | 6.00 | 3.00 | 3.00 | 36.00 |
| 2 | Office administration (including man power costs) and logistics etc for Environment Management Cell (EMC) | 1 location for 12 months @ Rs.166666.5 /- per month/ Package | 20.00 | 20.00 | 10.00 | 10.00 | 6.66 | 6.67 | 6.67 | 20.00 | 10.00 | 10.00 | 120.00 |
| **II. Construction costs** | | | | | | | | | | | | | |
| 3 | Sprinkling of water thrice in a day all along the stretch<br>&<br>Erosion control Retaining walls, slope pitching and turfing. (Included in project cost)<br><br>(365 days x 3 times x 1 year x 2 vehicles/road x Rs. 1000/trip) | - | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 21.90 | 219.00 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Muck/Debris and C&D Waste Disposal from site<br><br>**Road / C&D (m3) / Muck (m3)**<br>E8 / 1895 / 655470.54<br>N9 / 121.29 / 511576.3<br>N4 / 62.04 / 264308.03<br>N14 / 1769 / 365590.71<br>E10 / 0 / 390988.9<br>E14 / 474.15 / 366528.74<br>N16 / 0 / 438391.33<br>E6 / 686.28102 / 1093818.23<br>N11 / 70.79973 / 400716.97<br>E8 / 34.10999 / 344801 | Rs. 84/- per $m^3$ # | 552.19 | 429.83 | 222.07 | 308.58 | 328.43 | 308.28 | 368.25 | 919.38 | 336.66 | 289.66 | 4063.33 |
| **III. Tree Plantation** | | | | | | | | | | | | | |
| 5 | Avenue trees including 3 years maintenance – around 13,228 nos. of trees in Package I; 12,834 nos. of trees in Package II; 14,960 nos. of trees in Package III ;23,583 nos. of trees in Package IV; 9513 nos of trees in Package V and 14855 nos of trees in Package VI including tree guards (Rs. 1000/tree) | 1000/Tree | 132.28 | 128.34 | 69.18 | 80.42 | 76.09 | 73.16 | 86.57 | 95.13 | 85.21 | 63.33 | 889.71 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Shrub plantation in median and landscaping in 4/6- lane estimated median plantation for Package I is around 9,091 nos, Package II is around 8,765 nos, Package III is around 10,323 nos, Package IV is around 15,924 nos, Package V is 6554 and Package VI is 10283 @ Rs.350/- including maintenance for one year. | 350/Plant | 31.81 | 30.67 | 16.86 | 19.27 | 18.21 | 17.08 | 20.44 | 22.93 | 20.16 | 15.82 | 213.25 |
| **IV. Monitoring costs: Construction Phase (1 year)** | | | | | | | | | | | | | |
| 7 | Air Quality Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Year)<br>E8 – 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations* 3 seasons*Rs. 5,000 per station | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.30 | 0.30 | 0.45 | 3.15 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Noise level Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Years)<br>E8– 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations* 3 seasons *Rs.1500 per station | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.135 | 0.945 |
| 9 | Water Quality Monitoring (61 Monitoring stations) once in a season other than monsoon season during the construction period – (61 Stations x 3 Seasons x 1 Years)<br>E8– 8 stations<br>N9– 4 stations<br>N4 – 7 stations<br>N14 – 7 stations<br>E10 – 5 stations<br>E14 – 5 stations<br>N16 – 4 stations<br>E6 - 7 station,<br>E12 - 10 station,<br>N11 – 4 stations. | No. of monitoring locations*3 seasons*Rs. 4000 per station | 0.96 | 0.48 | 0.84 | 0.84 | 0.6 | 0.6 | 0.48 | 0.84 | 0.48 | 1.20 | 7.32 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Soil Quality Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Years)<br>E8– 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations*3 seasons *Rs.4000 per station | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.36 | 2.52 |
| 11 | Awareness programmes (Lumpsum) | LS | 5.00 | 5.00 | 2.50 | 2.50 | 1.66 | 1.67 | 1.67 | 5.00 | 2.50 | 2.50 | 30.00 |
| 12 | Rehabilitation, Resurfacing and landscaping of the borrow pits | Rs. 1.00 Lakh per borrow area | 4.00 | 4.00 | 2.00 | 2.00 | 1.33 | 1.33 | 1.34 | 1.00 | 0.50 | 0.50 | 18.00 |
| 13 | 356 Rain Water Harvesting Structures (RWH) Pits of dia. 1.5m with a depth of 3.8 m at an interval of 500m either side of the road.<br>Package 1 (E8) – 53<br>Package 2 (N9)- 51<br>Package 3 (N4) – 28<br>Package 3 (N14) – 32<br>Package 4 (E10) - 31<br>Package 4 (E14) -29<br>Package 4 (N16) - 35<br>Package 5 (E6) – 38<br>Package 6 (E12) – 34 | Rs. 15000 per RWH | 7.95 | 7.71 | 4.16 | 4.84 | 4.58 | 4.40 | 5.21 | 5.72 | 5.12 | 3.75 | 53.44 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Package 6 (N11)- 25 | | | | | | | | | | | | |
| **V. Monitoring costs: Operational Phase (1 year)** | | | | | | | | | | | | | |
| 14 | Air Quality Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Year)<br>E8 – 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations* 3 seasons*Rs. 5,000 per station | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.30 | 0.30 | 0.45 | 3.15 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | Noise level Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Years)<br>E8– 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations* 3 seasons *Rs.1500 per station | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.135 | 0.945 |
| 16 | Water Quality Monitoring (61 Monitoring stations) once in a season other than monsoon season during the construction period – (61 Stations x 3 Seasons x 1 Years)<br>E8– 8 stations<br>N9– 4 stations<br>N4 – 7 stations<br>N14 – 7 stations<br>E10 – 5 stations<br>E14 – 5 stations<br>N16 – 4 stations<br>E6 - 7 station,<br>E12 - 10 station,<br>N11 – 4 stations. | No. of monitoring locations*3 seasons*Rs. 4000 per station | 0.96 | 0.48 | 0.84 | 0.84 | 0.6 | 0.6 | 0.48 | 0.84 | 0.48 | 1.20 | 7.32 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Soil Quality Monitoring (21 Monitoring stations) once every month other than monsoon season during the construction period – (21 Stations x 3 seasons x 1 Years)<br>E8– 2 stations<br>N9 – 2 stations<br>N4 – 2 stations<br>N14 – 2 stations<br>E10 – 2 stations<br>E14 – 2 stations<br>N16 – 2 stations<br>E6 - 2 station,<br>E12 - 3 station,<br>N11 - 2 stations. | No. of monitoring locations*3 seasons*Rs. 4000 per station | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.36 | 2.52 |
| **Sub Total** | | | **784.31** | **655.67** | **354.61** | **455.45** | **463.32** | **438.95** | **516.27** | **1100.00** | **487.27** | **414.75** | **5676.60** |
| **Service tax @18%** | | | **141.18** | **118.02** | **63.83** | **81.98** | **83.40** | **79.01** | **92.93** | **198.00** | **87.71** | **74.66** | **1021.79** |
| **Grand Total** | | | **925.48** | **773.69** | **418.44** | **537.43** | **546.72** | **517.96** | **609.20** | **1298.00** | **574.98** | **489.41** | **6698.39** |
| **Say Rs 66.98 Crores** | | | | | | | | | | | | | |

**Table 10-2 : Budget for Environmental Management Plan for Items included in Project Cost**

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E8 | N9 | N4 | N14 | E10 | E14 | N16 | E6 | N11 | E8 | |
| 1 | Energy efficient streetlights<br>4 lane — 150 watt LED, 10 m high pole every 25m<br>2 lane BRT – 90 watt LED, at 9m high on other arm<br><br>E8 – 1196 Double arm streetlights<br>N9 – 1054 Double arm streetlights<br>N4— 574 Single arm streetlights<br>N14 — 662 Single arm streetlights<br>E10 - 626 Single arm streetlights<br>E 14 - 588 Single arm streetlights<br>N16—703 Single arm streetlights<br>E6 – 454 Double arm streetlights<br>E12- 332 Double arm streetlights<br>N11- 406 Double arm streetlights | Rs. 1,06,084/- per Double arm streetlight<br>Rs. 1,03,924/- per single arm streetlight | 1727.98 | 1522.5 | 500.94 | 578.25 | 546.70 | 513.68 | 613.98 | 481.62 | 430.70 | 352.20 | 7268.55 |
| 2 | Construction of 4 Bio-toilets in each package where each Bio-toilet unit possess 5 one piece toilet | 4 units per package*12 members*1 Lakh per bio-toilet | 4 | 4 | 2 | 2 | 1 | 1 | 2 | 4.00 | 2.00 | 2.00 | 24.00 |
| 3 | Labour camps, health and other services | LS | 10 | 10 | 5 | 5 | 3.33 | 3.33 | 3.34 | 10.00 | 5.00 | 5.00 | 60.00 |
| 4 | Solid waste management | LS | 10 | 10 | 5 | 5 | 3.33 | 3.33 | 3.34 | 10 | 5 | 5 | 60.00 |
| 5 | Felling of trees<br><br>Package I – 266 Nos.<br>Package II – 96 Nos.<br>Package III – 327 Nos.<br>Package IV – 489 Nos.<br>Package V – 85 Nos. | Rs. 4000/- per tree | 10.64 | 3.84 | 7.8 | 5.28 | 2.48 | 12.88 | 4.2 | 3.40 | 3.76 | 1.24 | 55.52 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Package VI – 125 Nos. | | | | | | | | | | | | |
| 6 | Allocation of Budget towards the Corporate Social Responsibility (CSR) activities | LS | 100 | 100 | 50 | 50 | 33.34 | 33.33 | 33.33 | 100.00 | 50.00 | 50.00 | 600.00 |
| 7 | Loss of water spread area due to the project and enhancement of equivalent water spread area along the ponds/lakes present within 200m from the Right of Way (RoW).<br>&<br>Beautification of lakes/ tanks/ ponds within 200m from the Right of Way (RoW).<br>Total water spread area lost is 17.65 acres.Package wise details of volume of water lost are given below,<br>Package I – 7511.71 m3 of excavation and 52 ponds for beautification<br>Package II – 6412.06 m3 of excavation and 25 ponds for beautification<br>Package III – 110205.73 m3 of excavation and 22 ponds for beautification<br>Package IV – 1990.47 m3 of excavation and 38 ponds for beautification<br>Package V – 11703.74 m3 of excavation and 8 ponds for beautification<br>Package VI – 5065.55 m3 of excavation and 23 ponds for beautification | Rs. 175.5/- per m3 of excavation##<br><br>Rs. 5.00 Lakh per beautification of one pond | 273.18 | 136.25 | 16.83 | 286.58 | 60.85 | 30.19 | 102.45 | 60.54 | 110.78 | 13.11 | 1090.76 |

| S. No. | Item | Unit cost/ Lump sum cost (Rs.) | Package I | Package II | Package III | | Package IV | | | Package V | Package VI | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Training Programmes | LS | 5 | 5 | 2.5 | 2.5 | 1.66 | 1.67 | 1.67 | 5 | 2.5 | 2.5 | 30 |
| 9 | Environmental quality monitoring by Third Party/ Project Management Consultant (PMC)<br><br>At least 20% of sample size in both construction phase and operation phase | At least 20% of sample size budget | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 0.87 | 1.11 | 10.86 |
| **Sub Total** | | | 2141.91 | 1792.70 | 591.18 | 935.72 | 653.80 | 600.52 | 765.42 | 678.67 | 613.55 | 435.16 | 9199.69 |
| **Service tax @18%** | | | 385.54 | 322.69 | 106.41 | 168.43 | 117.68 | 108.09 | 137.78 | 122.16 | 110.44 | 78.33 | 1655.94 |
| **Grand Total** | | | 2527.45 | 2115.39 | 697.59 | 1104.15 | 771.48 | 708.61 | 903.20 | 800.83 | 723.99 | 513.49 | 10855.63 |
| Say Rs. 108.55 Crores | | | | | | | | | | | | | |

**Note:**
**# Cost per m3 is Rs. 84/-. (Page no. 39, AP Common SOR 2015-16)**
**## Cost for Removal of wet silt and sludge from sullage drains with aid of baskets and vessels. (Page no. 289 of SOR 2015-2016 GoAP)**

**Budget under the purview of Amaravati Development Corporation (ADC):**

From Table -10.2, the budget components under the purview of ADC are component I – Construction cost which includes item 5 – Felling of Trees, component II - Green Initiatives/ Environmental Enhancement Measures which includes item 9 – Environmental Enhancement Measures and component III- Training programmes which includes item 10 – Training Programme

**Budget under the purview of Contractor/ Concessionaire:**

From Table -10.2, the budget component under the purview of Contractor/ Concessionaire is component I - Construction costs which includes items 1,2,3,4 & 6 – Energy efficient streetlight, Bio-toilets, Labor camps, Solid waste management & Corporate Social Responsibility (CSR).

**Budget under the purview of Third party/ Project Management Consultant.**

From table 10.2, the component under the purview of Third party/ Project Management Consultant is component IV – Third party/ Project Management Consultant Environmental Quality Monitoring which includes item 11 – Environmental quality monitoring by Third Party/ Project Management Consultant (PMC)

# Chapter 11

# CONCLUSIONS AND RECOMMENDATIONS

## 11.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed construction of 4 lane/ 4 lane + 2 lane BRT roads in Capital City of Andhra Pradesh can harmonize with the surrounding environment with the following direct and indirect benefits.

1. The proposed roads will provide inter connectivity within the newly formed state capital of the Andhra Pradesh State and to the major National and State Highways.
2. To improve the economic and social welfare of nearby people.
3. There will be improvements of the economic growth in the surrounding places due to establishment of more industries, institutions, MNCs and other organizations.

Environmental Improvement Measure Adopted in the project are:

1. During the construction phase of the project, air pollution will be increased due to various construction activities, movement of construction vehicles etc. and the same will be mitigated by sprinkling of water thrice in a day. An amount of Rs. 2.91 Crores provision is made in the EMP implementation budget to take care of this issue.
2. *Avenue Plantation:* There are two rows of avenue plants proposed along the roads as per IRC-SP-21: 2009. The avenue plants proposed to be planted in the project are about 88,973 nos. either side of the road. The avenue plants proposed are i.e., *Ravi, Nalla tumma, Neem, Veduru, Nagajemudu, Mango, Teku, Maredu etc.* The budget allocation for the avenue plantation is Rs. 8.89 Crores.
3. *Median Plantation:* Since the project is construction of four lane project median will be utilized. The median plantation is proposed in single/quadruple rows and the numbers of species proposed are 60,940 nos. The median plant proposed in the project are i.e., *Bougainvillea, Nerium Oleander, Thevitia Nerifolia,*

*Tabernaemontana Coronaria* etc. The budget allocation for the median plantation is Rs. 2.13 Crores.

4. There are 356 nos. of RWH Pits are proposed either side of the road at an interval of 500m. The proposed RWHs are having dia. of 1.5 m with a depth of 3.8 m. The budget provision for the RWH structures are already made in the EMP and amount is estimated to be Rs. 0.53 Crores.
5. In the proposed project, there are two Thermal Power Station namely Narla Tatarao Thermal Power Station (NTTPS) and Kothagudem Thermal Power Station identified and which fall within 300 Km from the project corridor. Utilization of Fly Ash in the project has to be made at high embankments and approaches to major bridges as per the IRC SP:58 – 2001 and Fly ash Notification 2007 and the same shall also be put under the BoQs. 25% of earth required for filling has to be replaced with fly ash at high embankments and approaches to major bridges and the same shall also be estimated and put under the BoQs. As per the designs, the proposed pavement crust for all the 10 Priority roads is 1.115 m and the difference from ground level to FRL varies from 0.5 to 1.2 m. To achieve FRL, existing ground need to be cut to lay all the pavement crust in this regards embankment is not arrived in all the 10 Priority roads. It is not feasible to use fly ash in the 10 Priority roads without embankments.
6. The total budget for implementation of EMP during construction & operation phases of the project for items to be covered in BoQs is Rs. 66.98 Crores.

# Chapter 12
# DISCLOSURE OF CONSULTANT ENGAGED

## 12.0 DISCLOSURE OF THE CONSULTANT ENGANGED

**Aarvee Associates is a premier, ISO 9001:2008 certified** multi-disciplinary engineering consulting company, established in 1989 and based at Hyderabad in India. We have a pan-India presence, with branch offices in New Delhi, Ahmedabad and Bhubaneshwar, and project offices in all the major states across the country. We also have a wholly-owned Australian subsidiary, Aarvee Associates Pty Ltd, based at Brisbane, Queensland.

In addition to over 1,000 successful assignments in India, we have carried out projects in Australia, Bangladesh, Ethiopia, Gabon, Mozambique, Nigeria, South Africa, Sri Lanka, and Uganda. We have worked on projects funded by various international agencies including the World Bank, the Asian Development Bank (ADB), the Department for International Development (DFID), and Japan International Cooperation Agency (JICA).

M/s. Aarvee Assocates Architects Engineers and Consultants Pvt., Ltd., Hyderabad is a Civil Engineering Consultancy accredited by QCI-NABET in their Vide letter no. NABET/EIA/SA091/254 Dated: 12$^{th}$ December 2013 for doing EIA and EMP Studies in "Highways, Railways, Transport terminals, and Mass Rapid Transport Systems Sector".

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