Draft Initial Environmental Examination

Project Number: 53376-001
September 2020

IND: DBL Highway Project

Prepared by AECOM India Private Limited

FINAL ESIA

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Environment and Social Impact Assessment (ESIA) of Road Asset

Anandapuram-Pendurthi-Anakapalli Section of NH-16

Dilip Buildcon Limited

September 19, 2020

Quality information

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Revision History

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List of Abbreviations

Sl. No	Abbreviation	Extension
1.	AADT	Annual Average Daily Traffic
2.	AAQ	Ambient air quality
3.	AAQM	Ambient air quality monitoring
4.	ADB	Asian Development Bank
5.	AH	Asian Highway
6.	ASI	Archaeological Survey of India
7.	BDL	Below detectable limit
8.	BGL	Below ground level
9.	BOD	Biochemical oxygen demand
10.	BOQ	Bill of quantity
11.	CALA	Competent Authority Land Acquisition
12.	CAP	Corrective Action Plan
13.	CCE	Chief Controller of Explosives
14.	CC&A	Combined Consent and Authorization
15.	CGWA	Central Ground Water Authority
16.	CITES	Convention on International Trade in Endangered Species
17.	CO	Carbon monoxide
18.	COD	Commercial Operation Date
19.	COD	Chemical oxygen demand
20.	CPCB	Central Pollution Control Board
21.	CRZ	Costal Regulatory Zone
22.	CSC	Construction Supervision Consultant
23.	CTE	Consent to Establish
24.	DBFO	Design, Build, Finance, Operate
25.	DFO	Divisional Forest Officer
26.	DG	Diesel generating set
27.	DO	Dissolved oxygen
28.	DPR	Detailed project report
29.	EHS	Environmental Health and Safety
30.	EA	Executing agency
31.	EAC	Expert Appraisal Committee
32.	EPC	Engineering, Procurement and Construction
33.	E&S	Environment and social
34.	EFP	Environmental Focal Person
35.	EHS	Environment Health and Safety
36.	EIA	Environmental impact assessment
37.	EMOP	Environmental monitoring plan
38.	EMP	Environmental management plan
39.	ESCAP	Environmental and Social Corrective Action Plan
40.	ESMS	Environmental and Social Management System
41.	GHG	Greenhouse gas
42.	GIS	Geographical information system

Sl. No	Abbreviation	Extension
43.	GOI	Government of India
44.	GRC	Grievance redress committee
45.	GRM	Grievance redress mechanism
46.	HAM	Hybrid Annuity Model
47.	HFL	Highest flood level
48.	HR	Human Resource
49.	IA	Implementing Agency
50.	IFC	International Finance Corporation
51.	IMD	Indian Meteorological Department
52.	IRC	Indian Road Congress
53.	IUCN	International Union for Conservation of Nature
54.	IVI	Important value index
55.	LA	Land Acquisition
56.	LHS	Left hand side
57.	LPG	Liquefied petroleum gas
58.	MOEF&CC	Ministry of Environment, Forest and Climate Change
59.	NHAI	National Highway Authority of India
60.	NGO	Non-governmental organization
61.	NH	National Highway
62.	NOC	No Objection Certificate
63.	NOx	Oxides of nitrogen
64.	PD	Project Director
65.	PS	Performance Standards
66.	RHS	Right Hand Side
67.	RoW	Right of Way
68.	RSPM	Respiratory suspended particulate matter
69.	SEIAA	State Environmental Impact Assessment Authority
70.	SPV	Special Purpose Vehicle
71.	SH	State highway
72.	SO2	Sulphur Dioxide
73.	SOI	Survey of India
74.	SPCB	State Pollution Control Board
75.	SPL	Sound Pressure Level
76.	SPM	Suspended Particulate Matter
77.	SPS	ADB Safeguard Policy Statement, 2009
78.	TDS	Total dissolved solids
79.	TSS	Total Suspended Solids

Executive Summary

Introduction

AECOM India Private Limited (hereinafter referred as 'AECOM') has been appointed by M/s Dilip Buildcon Limited (hereinafter referred to as 'DBL' or the 'Client') as an independent consultant to undertake an Environment and Social Impact Assessment (ESIA) including Noise Impact Assessment (NIA) of its six laning of National Highway (NH) 16 (NH 16) (old NH 5) from Anandapuram-Pendurthi- Anakapalli section from kilometer (km) 681.000 (existing km 681.000) to km 731.780 (existing km 742.400) in the State of Andhra Pradesh (hereinafter referred to as 'Project'). The Project has been conceived by National Highways Authority of India (NHAI) under the Bharatmala Pariyojana and is executed as per the Hybrid Annuity Mode (HAM) model of NHAI. The Project is being developed by DBL though it's Special Purpose Vehicle (SPV), M/s Anandapuram Anakapalli Highway Private Limited (AAHPL) a wholly owned subsidiary of DBL.

AECOM understands that the Asian Development Bank (ADB) is in the process of evaluating a potential debt investment in the Project as part of its investment process. Therefore, to assess the environment and social impacts an independent Environment and Social Impact Assessment of the Project (hereinafter referred to as this "assignment" or "ESIA study") is required to be undertaken to ascertain the international and national regulatory compliance, risks of Project against the Applicable Reference Framework.

Project Background

The total length of the existing road under consideration is about 50.8 km, which starts from Anandapuram (km 681.000) to Anakapalli (km 731.780) section of NH-16 in the State of Andhra Pradesh. The Project road falls in Vishakhapatnam district of Andhra Pradesh. The NH 16 connects Kolkata and Chennai and runs along east coast of India. Presently, the Project is under construction with approximately fifty percent (50%) work is completed till date.

For the purpose of ESIA, the study area has been delineated as **area of *direct influence*** *and* ***indirect area of Influence***. The area of ***direct influence*** will be confined in a linear fashion along the corridor where the construction activities takes place, construction campsites and areas which are directly impacted by the Project construction. The road is proposed to be retrofitted into six- lane for which the Right of Way (RoW) is made available by NHAI and only at some places (bypasses and realigned sections) land acquisition is required (mostly completed and at some places it is undergoing).

However, for various other environmental components, which are likely to have a broader area of influence, i.e., 5 km on either side (10 km in total) from the centre of road has been used to define the ***indirect area of Influence***. Thus, the term Project Influence Area (PIA) referred in this report, therefore, covers both direct and indirect area of influence.

Study Methodology

The ESIA Report is based on field surveys and investigations made during site visit. This also include information depicting the existing environment characteristics as well as an assessment of potential impact on the physical and natural environment of the study area. AECOM team conducted a site survey from the 28th February to 7th March 2020 to undertake environmental monitoring and collection of baseline data, biodiversity assessment and collection of biodiversity baseline data, consultation with key stakeholders. Secondary information through literature surveys were also collected for the study area. The impact identification and prediction are undertaken on the basis of environmental and social baseline data collection. The major processes involved are

- Identification – to define the impacts associated with different phases of the project and the activities undertaken;
- Prediction – to forecast the nature, magnitude, type, duration, extent, scale, frequency likelihood and sensitivity of the major impacts; and
- Evaluation – to determine the significance of residual impacts i.e. taking into account how mitigation will reduce a predicted impact Professional judgement, experience and knowledge of similar projects were used for impact analysis. The extent and potential consequences of the impacts have been compared against applicable reference framework. Mitigation measures have been suggested for each of the identified adverse impacts.

Finally, an Environmental and Social Management Plan (ESMP) has been prepared delineates the roles, responsibility and timeline for implementing mitigation measures to prevent the significant impacts arising from activities during different phases of the Project.

Environmental Setting

This entire Project alignment falls within Visakhapatnam district in the State of Andhra Pradesh. The alignment traverses through agricultural fields, barren land and settlements on both sides of the existing carriage way. The Project road does not pass through any wildlife sanctuaries (WLS), costal regulation zone (CRZ) area. The Kambalakonda WLS eco-sensitive area notified under Section -3 of the Environmental Protection Act, 1986 is located close to the Project road A total of 2,399 trees have been either cut or in the process of being cut as per the tree felling permission received by NHAI from the Government of Andhra Pradesh, Forest Department vide letter No.811120171S4, dated 04/01/2018.

In order to establish the baseline environmental monitoring, the Project had carried out ambient air quality monitoring at eight (08) locations, noise monitoring at 16 locations, 8 water quality (4 surface water and 4 ground water) five (05) soil samples from nearby agricultural fields and base camp locations.

The monitoring locations along the Project road were selected based on the sensitivity of the receptors to vehicular traffic and to obtain baseline concentrations of the various representative land uses. The selection of the receptors was based on the following considerations:

- Covering entire Project road
- Representative location of regional background
- Covering land use characteristics and socio-economic conditions
- Major settlements
- Highway intersections
- Influence on urban activities

The air pollution samples were analysed for pollutants using the appropriate method prescribed by Bureau of Indian Standards and Central Pollution Control Board/ MoEF&CC. Amongst the six air quality monitoring stations, the particulate matter (PM) was found to be within permissible concentrations at all places. The maximum values found at Pendurthi village and near Indian Oil petrol pump due to presence of other polluting activities like commercial development and presence of mixed landuse in the vicinity. It is seen, that the present PM level is in a safer range and anticipated that widening of the road will lead to lower SPM levels for the same volume of traffic, due to reduced congestion at these locations. The SO_2 level was found to vary in the range of 6.5- 12.8$\mu g/m^3$. None of the locations recorded higher SO_2 levels with respect to National Ambient Air Quality Standards (NAAQS) for residential, industrial, rural and other areas. The NOx level was found to vary in the range of 11 - 19 $\mu g/m^3$ along the Project road. Anandapuram village recorded the maximum level followed by Gulapetha and Pendurthi. However, none of the monitoring locations show higher concentration of NOx with respect to National Ambient Air Quality Standards for residential, industrial, rural and other areas. Lead particulates level was found in the range of 0.1-0.42 $\mu g/m^3$ in the monitoring locations. Comparison with NAAQS reveals that none of the sampling locations exceed in lead concentration to prove it hazardous. The CO concentration was found to vary in the range 0.65 - 0.98 mg/m^3 in the monitoring locations. It is seen that none of the above locations exceed the NAAQS laid for all pollutants for residential, industrial, rural and other areas.

The predicted NOx concentration for the entire corridor falls within residential standard and the predicted values are not surpassed the ambient standards till 2035. The Particulate Matter values will remain within the standards all along the corridor throughout all years for residential standards. The CO concentrations are observed to be slightly higher than the residential standards in 2035 and 2040 for 8-hourly standards. However, the same will remain within permissible for 1-hourly standards. The modeling shows that there will not be any adverse increase of pollutants all along the corridor till 2035.

The water quality of the ground and surface water samples were collected and analysed for all essential characteristics and for most of the desirable characteristics specified in IS 10500: 1991, and are analysed in accordance with the standard methods specified by IS codes.

The analytical values of water quality reveal that pH of water in the project corridor varies between 7.3 – 8.5 and does not exceed the standard of 6.5 – 8.5. All the samples show permissible turbidity of 5 NTU except for Ramapuram and Balijipatem surface water, which is not used for drinking purpose. The Total Hardness of all the

water samples are found to be within permissible range. Though the Total Dissolved Solid in ground water is found to exceed the acceptable limit at three places (Base Camp 2, Anandapuram and Pendurthi), however the same has been within permissible limits in absence of alternate sources of drinking water. The BOD of the surface water bodies varies between 3-9, which is an acceptable range for bathing purpose or other non-drinking purposes.

Similarly, other parameters such as Nitrates, Chlorides, Fluorides, Sulphates, Iron, Zinc, Manganese and Lead Concentrations of these water samples are found to be in a much lower side compared to Indian Standards for drinking water. It is noticed that all the surface water bodies are contaminated with Total Coliforms, is attribute that it is difficult to stop such contamination because cattle regularly use these water bodies and people are found to dump wastes along banks of these water bodies.

Tube well water sample was collected from both Base Camps, Anandapuram and Pendurthi were analysed for required parameters to judge its potability. The analytical table reveals that most of the parameters are in a safer range as compared with Indian Standards specifications for drinking water.

The daily water requirement in the Project is approximately 400 KLD, which is sourced from both ground water and water supply through secondary market (vendors). It is reported that ground water accounts for approximately 75 KLD and rest 325 KLD is procured by DBL from water vendors from nearby areas.

The baseline noise monitoring was conducted at sixteen (16) locations over a period of 48 hours, split between weekends (Saturday and Sunday) and weekdays (Monday and Tuesday). The noise modelling results shows that of 16 locations, noise barrier is required at eight (08) places and rest eight (08) places noise barrier is not recommended. The location wise details are presented in Chapter 4.

For the assessment of the baseline soil quality, soil samples were collected at 5 locations from agricultural fields, basecamps along the Project road. The Project area is largely located in a flat land and in general the soil along the road alignment is red loamy soil. All these soil samples collected along the Project road were analysed for the physical and chemical properties.

From biodiversity assessment, the estimated area of influence of the Project has been taken as the Project alignment along with the area extending outward to a distance of 1km from the Project alignment. This area of influence has been estimated considering the farthest known receptors of biodiversity-related impacts of the Project. There is one (01) designated area which is situated partially within the Study Area, but completely outside the Project alignment.

The closest legally protected area with respect to the Project alignment is the nationally designated Kambalakonda Wildlife Sanctuary (WLS). The notified Eco-sensitive Zone (ESZ) of the Kambalakonda WLS is situated approximately 200m east of the nearest point on the Project alignment (at km 686.400 and km 688.900). Parts of the legally protected area (LPA) of the Kambalakonda WLS, which is composed of a main protected area and an eco-sensitive zone, is situated within the Study Area (Figure 4-13). Kambalakonda has been declared as Eco-sensitive Zone (ESZ), vide S.O. 1366(E), dated 28th April 2017 by MoEF&CC. The ESZ is spread over an area of 30.51 square kilometer and includes 14 villages of 2 Mandals, i.e., Anandapuram and Chinagadhili in Visakhapatnam district. Inputs received from Forest Department officials, the Forest Department's wildlife management plan for the Kambalakonda WLS, as well as, a media article (secondary sources), indicate that wildlife injury and/or mortality is considered a significant adverse impact of the existing highway alignment proposed for widening.

Social Setting

The road is being developed keeping in view the six-lane cross section along with additional facilities fitted in such a manner that the improvements are accommodated to the maximum extent within the proposed right-of-way of 60m width. The proposed widening is considered keeping in mind the existing road and its facilities that are used to the greater extent and least inconvenience to the traffic during the construction period. Grade separators have been proposed at major junctions. Facilities such as service roads, under/over passes and grade separators have been considered at the reasonable intervals for local traffic including pedestrians. This section of National Highway will be developed as an access-controlled road with limited numbers of access at interchanges without any median opening. The median width has been proposed as 4 m for the entire project stretch except at km 689.900, where a median width of 12 m is proposed (to save one high transmission tower). AAHPL is also carrying out ancillary operations to support the road development by operating crusher units, batching plants, Wet Mix Macadam (WMM) plants etc which are housed in two (02) main base camps (Base Camp 1 and Base Camp 2) and two (02) Sub-

Base Camps (Sub-base camp 1 and 2), along with quarrying operations at two sub-leased mines, the Marturu quarry located in Marturu village and Vavilapadu quarry is located in Vavilapadu village.

The entire land for the project has been acquired by NHAI through Competent Authority Land Acquisition (CALA) in accordance with the National Highway Act 1956 and the compensation to Project Affected Persons (PAP) have been evaluated on the basis of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. As per the Concession Agreement (CA), NHAI is sole authority responsible for land acquisition and Resettlement and Rehabilitation (R&R).

Analysis of alternatives were carried out to review the 'Project with alternatives' scenario, with its minor adverse impacts is more acceptable than 'No project scenario'. After considering all alternatives, it is recommended that the Project has proposed two bypasses at Pendurthi and Sabbavaram built up areas and a realignment at Anakapalli. There are two/ three alternatives were proposed for each bypass/ realignment and the best option is finalized based on the land requirement, loss of property and density of the habitation.

The total land requirement for the Project is 335.68 hectares (ha), of which about 304.68 ha is required for RoW and rest 31 ha for interchange, toll plaza and other facilities. The land has been acquired and provided by NHAI for construction of road. As of date approximately 22.12 ha of land acquisition is pending. The details of land acquisition is given in Section 4.12.1.

The land acquisition process for the Project was initiated in 2016. The earliest 3A notification[1] was published in July 2016. A total of 23 number 3A notifications were published for a total of 392.12 ha area. Similarly, 20 numbers 3D notifications[2] were published between February 2017 and May 2018 for a total area of 263.05 ha. The award declaration (under section 3G of NH Act, 1956) was published between February 2018 and October 2019. Till date 52 awards have been published totalling an area of 180.18 ha of private land. The social surveys conducted for the Project reports that there are 1798 title holders were impacted because of the Project, of which 549 are women titleholders. Further, there are 105 number of encroachers (households) who were impacted because of the road widening.

The total compensation amount awarded for acquisition of land for the Project was INR 5.616 billion, corresponding to 180.18 ha of land. Out of this amount, INR 3.747 billion (66.72%) has already been disbursed till October 2019. Further data as available for the disbursements carried out till April 2020 from CALA office records that INR 0.138 billion was deposited for the claimants. The total disbursed amount as per the available data is INR 3.885 billion (69.18%). The details of land acquisition and compensation is presented in a standalone report.

The Project employs large number of labour and workforce for multiple operations throughout its lifecycle. A total of 1,655 employees have been engaged and mobilised presently for the construction activities. As reported by DBL, no female workers or employees have been engaged for the Project. While most of the workers are semi-skilled, the team also represented employees who have worked in designing, planning, testing of material, etc. All these employees were observed to be on DBL's role. It was understood that approximately 30% of the construction manpower are migrant workers who have been provided with accommodation facilities. A team of five (05) HR manager and executives have been stationed the Project to oversee HR and liaison activities. Apart from the above, piece rate/ contract workers were engaged though eleven (11) contractors primarily working with the PQC and Engineering departments. The Project has employed approximately 430 labours to execute construction work.

For ease of construction, the Project highway from Anandapuram–Pendurthi-Anakapalli section from km 681.000 km 731.780 has been divided into two equal parts. There are two site in-charge who looks after their respective packages.

Assessment of Impacts and Mitigation Measures

The environmental and social impacts were identified by accessing the primary and secondary information gathered. Impacts have been identified based on review of available Project information, discussions with representatives of the Project, local community, as well as, sector-specific professionals and subject experts. Impacts anticipated during the construction and operation phase have been included and classified. Identified impacts have been appraised along the criteria of spread, duration, intensity and nature. Chapter 6 identifies the environment and social impacts and Chapter 7 presents the ESMP. A short summary of impacts and mitigation measures proposed are given below.

[1] preliminary notification under NH Act, 1956 to express intent of the government to acquire land
[2] Notification under NH Act, 1956, declaring final list of land parcels to be acquired

Environmental and Social Component	Identified Impact	Summary of Mitigation Measures
Land	Land acquisition, and temporary land requirement	• Construction activities will be restricted within the proposed Corridor of Impact (CoI) or RoW
Soil	Soil Erosion especially along bridge-end fills, steep banks and embankment slopes	• Turfing on slopes with shrubs and grasses • Soil erosion checking measures i.e. formation of sediment basins, slope drains • Proper side drains for storm water
	Loss of Topsoil	• Agricultural areas will be avoided for borrowing of materials • Preservation of top soil • Sprinkling of water during construction
	Compaction of soil	• Construction machinery and equipment will be stationed at designated areas to prevent compaction of soil and trampling of vegetation
	Contamination of soil from fuel and lubricants	• Fuel storage and refueling sites will be kept away from drainage channels and water bodies
Water Resources	Drainage and run off	• Raised road levels to avoid future inundation in the inundated stretches along the corridor • Provision of adequate size and number of cross-drainage structures to ensure efficient cross- drainage
	Contamination of water from construction waste	• Construction work near water bodies will be avoided especially during monsoon periods. • To avoid siltation of water bodies appropriate number and size of silt fencing will be provided where necessary. • All waste arising due to project activities will be disposed off, as per State Pollution Control Board norms
	Contamination of water from fuel and lubricants	• Proper maintenance of vehicles and equipments and refueling at designated places to avoid contamination of water bodies • Oil and grease traps will be provided at workshop to prevent contamination of water
	Sanitation and waste disposal in construction camps	• Sewage system for construction camps will be properly designed and built to prevent water pollution • Adequate house keeping facilities at all times
Air quality	Increase in dust generation	• Asphalt plants, crushers and the batching plants will be sited at an appropriate distance in the downward direction from the nearest settlement. • Hot mix plants will be fitted with dust extraction units. • Vehicles delivering materials will be covered to minimize spillage of construction materials and dust spreading.
Noise Levels	Increase in noise levels during construction	• Plants and equipments used for construction in strict conformance to Central Pollution Control Board • Regular monitoring of vehicles, equipments used for construction. • Workers in the vicinity of high noise levels must wear appropriate PPEs like earplugs, helmets. • Provision of noise barrier
Flora	Trees will be felled for roadside widening	• Trees, which are going to be cut, shall be replaced as per Compensatory Afforestation Policy under the Forest Conservation Act, 1980.
Biodiversity and Ecosystem Services	Loss, degradation and fragmentation of habitat Increase in risk of injury or death due to roadkill	• Reasonable precaution to prevent its workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. • Integrate mechanical speed-control structures, (rumble strips) in proximity to the Kambalakonda Wildlife Sanctuary. • Prohibit avoidable vehicular honking by road-users in the section of the Project alignment situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value. • Plant relatively tall-growing native vegetation along the Project alignment to act as a visual screen and noise absorbent for the benefit of wildlife habitats in the vicinity. This is especially applicable to sections of the project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.
Hazardous Waste Management	Contamination of land and soil	• Hazardous wastes generated such as used transformer oil, will be stored & disposed of to state pollution control board authorized vendor as per provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its amendments.
Human Health	Health and allied facility in work place	• Provision of good and sufficient water supply at work places to avoid water borne diseases. • Provision of adequate drainage, sanitation and waste disposal at workplaces. • Adequate medical care will be provided to workers.
Road Safety	Safety of vehicles Safety of pedestrian	• Design improvements at curves • Segregation of slow moving traffic in congested areas by providing service roads • Provision of proper signage, proper lighting arrangement to avoid accidents. • Traffic management plans at congested places. • Traffic control measures will be strictly enforced. • The public awareness on road safety, noise abetment measures, construct the noise barriers such as walls and tree plantation.

Environmental and Social Component	Identified Impact	Summary of Mitigation Measures
Clean-up Operations, Restoration and Rehabilitation	Chances of accident and closure of project activity	• Prepare site restoration plans, which will be approved by the Independent Engineer/ NHAI. The clean-up and restoration operations are to be implemented by the Concessionaire prior to demobilization. • All construction zones and facilities including culverts, road-side areas, camps, Hot Mix plant sites, Crushers, batching plant sites and any other area used/ affected due to the project operations will be left clean and tidy to the entire satisfaction to the Independent Engineer/ NHAI.

The environmental budget for the various environmental management measures proposed in the EMP has been estimated to be INR **4,40,28,600 (628,980 USD)**. There are several other environmental mitigation measures that have been addressed as part of good engineering practices, the costs for which have been accounted for in the engineering costs (Project cost). The design team has confirmed that the mitigation costs indicated in engineering cost are part of standard contract works.

Stakeholder Engagement and Grievance Redressal Mechanism

To ensure the systematic implementation and execution of the stakeholder engagement process certain resources and framework is required to be in place. Certain defined roles and responsibilities of designated personnel can assist in smooth implementation of the stakeholder engagement process. Chapter 8 presents the stakeholder engagement schedule, frequency of engagement, the areas of interest and influence. It also presents the appropriate methods of communication that can be utilised to engage with different stakeholders and the proposed plan of activities.

A Grievance Redressal mechanism has been suggested in the Project to resolve community complaints concerning the Project performance, its contractors, or employees. The present procedure is applicable to the life cycle of the Project (including construction and operations phase). In effort to develop an effective two-way communication a GRM will be developed by AAHPL as suggested for the Project.

Conclusion

An Environmental and Social Impact Assessment (ESIA) is carried out and most of the adverse impacts of road Project during construction period are temporary in nature. Most of these impacts can be minimized through specific engineering solutions, construction methodology incorporated in the Project design and by implementing mitigation measures as suggested in ESMP. The overall impact on environmental attributes by the proposed Project is unlikely to cause any significant adverse environmental impacts and no further detailed study is required. The ESMP may be updated if deemed necessary as per the site requirement in future.

Any major change in the Project will require updating the environmental assessment document as per the requirement. The updated assessment will have to be submitted to concerned Government authorities and ADB for concurrence before the actual construction commence.

Applying the criteria stipulated by the ADB Safeguard Policies on environmental categorization, the proposed Project is assigned as '**Category B**' on the basis of the available data, review of documents and site visit, and present conditions of the road (50% being completed). The primary data available till date indicates that the environmental risks and impacts of the proposed Project activities are expected to be few in number, generally site-specific, most of them reversible, and readily addressed through mitigation measures as suggested in this report.

1. Introduction

M/s Dilip Buildcon Limited (hereinafter referred to as 'DBL' or the 'Client') a Bhopal based company is one of the leading full-service infrastructure company with construction capabilities in roads and bridges, mining, water, sanitation and sewage, irrigation, industrial, commercial and residential buildings with a presence in over 17 Indian States. DBL is known for its execution capabilities and has completed over 90% of projects before time.

AECOM India Private Limited (hereinafter referred as 'AECOM') has been appointed by M/s Dilip Buildcon Limited (hereinafter referred to as 'DBL' or the 'Client') as an independent consultant to undertake an Environment and Social Impact Assessment (ESIA) including Noise Impact Assessment (NIA) of its six laning of National Highway (NH) 16 (NH 16) (old NH 5) from Anandapuram-Pendurthi- Anakapalli section from kilometer (km) 681.000 (existing km 681.000) to km 731.780 (existing km 742.400) in the State of Andhra Pradesh (hereinafter referred to as 'Project'). The Project has been conceived by National Highways Authority of India (NHAI) under the Bharatmala Pariyojana and is executed as per the Hybrid Annuity Mode (HAM) model of NHAI. The Project is being developed by DBL though it's Special Purpose Vehicle (SPV), M/s Anandapuram Anakapalli Highway Private Limited (AAHPL) a wholly owned subsidiary of DBL.

The Project is a 50.8 km stretch of NH 16 starting at village Anandapuram and concluding at Anakapalli, both falling within Vishakhapatnam district. NH 16 connects Kolkata and Chennai and runs along east coast of India. Presently, the Project is under construction with approximately fifty percent (50%) work is completed till date.

AECOM understands that the Asian Development Bank (ADB) is in the process of evaluating a potential debt investment in the Project as part of its investment process. Therefore, to assess the environment and social impacts an independent Environment and Social Impact Assessment of the Project (hereinafter referred to as this "assignment" or "ESIA study") is required to be undertaken to ascertain the international and national regulatory compliance, risks of Project against the Applicable Reference Framework.

1.1 Project Background

Anandapuram Anakapalli Highways Private Limited (AAHPL) a wholly owned subsidiary of DBL has been appointed by National Highway Authority of India (NHAI) for undertaking the six laning of the Anandapuram- Anakapalli section of NH-16 from 681.000 km to 731.780 km in the State of Andhra Pradesh on Build-Operate- Transfer and Hybrid Annuity Mode (BOT-HAM). Concession Agreement for the Project has been signed between DBL-AAHPL i.e. the Concessionaire and NHAI in April 2018.

AECOM understands that the international multilateral development institution, the Asian Development Bank (ADB) is in the process of evaluating a potential debt investment in the Project. As part of its investment process, an independent Noise monitoring and Impact Assessment of the Project (hereinafter referred to as this "assignment" or "study") is required to be undertaken to ascertain the international and national regulatory compliance and risks of Project against the Applicable Reference Framework as mentioned in **Section 3.2** of this report.

1.2 Purpose and Scope of Work

The overall objectives are to determine the anticipated impacts of the proposed Project related to noise on sensitive receptors during construction and operation phases and to recommend mitigation measures to lessen impacts, within applicable guidelines and standards.

More specifically, the scope of work for this assignment entails:

- Desk Review, Gap Assessment, and Methodology Development
  - Review all existing documentation, detailed project report, concession agreement, government orders/awards relating to land/ RoW acquisition available for the Project in order to:
    - Get an understanding of the Project and associated impacts,
    - Identify gaps with respect to the Project's reference framework.
- To verify that the proposed mitigation measures will mitigate the anticipated impacts of the Project and ensure compliance with the requirements as per the reference framework.
- Preparation of an ESIA report for the Project in line with the applicable reference framework requirement. The report would comprehensively assess the existing baseline, predict impact and propose mitigation

measure for the envisaged impacts (including all the associated facilities and impacts associated with land purchase/ acquisition/ lease). The ESIA would cover the following aspects.

  - Collect, collate and present baseline information on the environmental characteristics of the existing situation along the road stretch with respect to physical, biological and socio-economic environment
  - Identify and describe the pertinent regulations and standards - both local and international, governing the environmental quality, health and safety, protection of sensitive areas, land use control at the national and local levels and ecological and socio-economic issues.
  - Identify the major environmental, social and public health issues of concern and indicate their relative importance to the development project. Identify potential impacts with respect to natural environmental activities and Occupational Health and Safety Concerns.

- Develop a comprehensive Environmental and Social Management Plan (ESMP), which will recommend a set of mitigation, monitoring and institutional measures to eliminate, minimize or reduce to acceptable levels of adverse environmental and social impacts and/or maximize socio-economic benefits.
- Development of Stakeholder Engagement and Grievance Redressal Plan
- A Stakeholder Engagement and Grievance Redressal Plan will be developed for the Project which would be implemented by the project proponents. The Stakeholder Engagement plan should:
  - Identify affected people/groups/communities (stakeholders);
  - Delineated measures to allow meaningful engagement with different stakeholder (in a transparent, accessible manner using culturally appropriate communication methods) so as to facilitate dissemination of information to stakeholder;
  - Suggest differentiated measures to allow effective participation of disadvantaged and vulnerable groups.
  - Provide systems for prior disclosure/dissemination of information and consultation including seeking inputs from affected persons, incorporation of inputs, as applicable, providing feedback to affected persons/groups on whether and how the input has been incorporated;
  - Include mechanisms for feedback and dispute resolution (grievance management and handling system for the project)
  - Documentation, reporting and monitoring procedure.

1.3 Approach and Methodology

The approach and methodology applied for the execution of the impact assessment study is as provided:

- The relevant Project document and Detailed Project Report (DPR) was reviewed to understand the Project requirements;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;
- A detailed social and environmental assessment of site and surround areas was undertaken through the following:
  - Reconnaissance surveys to understand site specific issues;
  - Collation of secondary information on social aspect of the site.
  - Stakeholder mapping and identification;
  - Field surveys and data compilation;
- Assessment of impacts based on understanding of the Project activities and existing baseline status; and
- Preparation of Environment and Social Management Plan.

1.3.1 Delineation of the Study Area/Area of Influence

The total length of the existing road under consideration is about 50.8 km, which starts from Anandapuram (km 681.000) to Anakapalli (km 731.780) section of NH-16 in the State of Andhra Pradesh. The **area of *direct influence*** will be confined in a linear fashion along the corridor where the construction activities takes place, construction campsites and areas which are directly impacted by the Project construction. The road is proposed

to be retrofitted into six- lane for which the Right of Way (RoW) is made available by NHAI and only at some places (bypasses and realigned sections) land acquisition is required (mostly completed and at some places it is undergoing).

However, for various other environmental components, which are likely to have a broader area of influence, i.e., 5 km on either side (10 km in total) from the centre of road (as per the MoEF&CC Notification on Environmental Impact assessment, Government of India, 2006) has been used to define the ***indirect area of Influence***. Thus, the term Project Influence Area (PIA) referred in this report (chapter), therefore, covers both direct and indirect area of influence.

As per ADB SPS, the area of influence encompasses the primary Project site along with related facilities such as access roads, borrow pits and disposal areas, construction camps etc. The area of influence also includes environmental impacts and risks anticipated from relevant stages of the Project cycle, including preconstruction, construction, operations, decommissioning, and post closure activities such as rehabilitation or restoration.

Therefore, for the purpose of the ESIA study, an area of 5 km (aerial distance) has been considered as the Area of Influence (AoI) for identification and assessment of potential environmental and social impacts around the proposed Project.

- Direct Impact Zone (Core Components): The area covering the Project site, associated facility and direct access road to the Project is designated as the area under the direct influence of the Project for environmental, ecological and social impacts.
- Indirect Impact Zone (Associated Facilities): Area outside the direct impact zone of the Project, up to a radius of 5 km, is considered as the indirect influence zone for the Project for environmental, ecological and social impacts.

All the baseline environmental profiling, including environmental monitoring, socio-economic studies and public consultations, have been carried out within the AoI of 5 km. In order to include the farthest anticipated direct receptors of biodiversity-related impacts, AoI for the biodiversity studies was delineated as the proposed project site, along with the area extending outward up to a radius of 10 km from the Project site boundary.

1.3.2 Desktop Review

AECOM carried out a desk-based review of the information shared by the client prior to mobilizing for the site visit for undertaking screening and scoping assessment. As part of the review, the proposed Project area was screened using Google Earth. Based on review of satellite imagery, the environmental and social sensitivities to be covered as part of the site visit were assessed and subsequently scoped in. The desk-based reviews were primarily focussed on but not limited to the following documents:

- Detailed project report (DPR);
- Site layout plan;
- Concessionaire Agreement
- Various land related documents;
- Organizational chart;
- Relevant maps
- Location of site vis-à-vis the key biodiversity areas; and
- Various policies of the company.

1.3.3 Environment Due Diligence

At the initial stage of the impact assessment, a preliminary level screening and scoping assessment of the project and its components was undertaken in the form of a due diligence study including appraisal of environment and social (E&S) risks and screening of the Project site and associated facilities. The due diligence study was conducted to identify the likely impacts of the Project on environment, biodiversity and social conditions in the AoI. The study aimed to establish an understanding of the E&S baseline, stakeholder engagement, impact assessment and environment and social gap assessment from as per applicable reference framework.

The due diligence was undertaken based on the understanding of the objective and scope of work and AECOM's experience of working on road projects. The AECOM team, comprising of one EHS specialist and one Social

specialist undertook a site visit to the Project location between 5th and 9th of November 2019. A separate report was submitted to ADB.

1.3.4 Site Survey

The ESIA Report is based on field surveys and investigations made during site visit. This also include information depicting the existing environment characteristics as well as an assessment of potential impact on the physical and natural environment of the study area. AECOM team conducted a site survey from the 28th February to 7th March 2020. The following activities were undertaken during this visit:

- Undertake environmental assessments to gain an understanding of the following and consultations with site representatives:
  - Site setting assessment of 5 km study area for the project site;
  - Site setting assessment of temporary facilities like construction campsites, quarry areas;
  - Study of key environmental receptors such as large water bodies, forest area, man-made sensitive land uses such as schools, colleges, hospitals etc.;
- Undertake environmental monitoring and collection of baseline environmental data; and
- Undertake biodiversity assessment including collection of biodiversity baseline data and key stakeholder consultations (Forest department, local community, etc.).

1.3.5 Environmental Baseline Data Collection

Environmental baseline data was collected through primary monitoring and reconnaissance surveys of the study area (5 km distance from project site). Secondary information through literature surveys were also collected for the study area. The baseline study include the following:

- Primary environmental baseline data collection within the study area. The primary environmental baseline data was collected with respect to ground water and surface water (depending on its availability), ambient air quality (AAQ), ambient noise level, soil quality, traffic surveys and socio-economics profile.
- The ecology and biodiversity data were also collected as part of the primary data collection;
- The GIS mapping of the study area was done to present details on land use pattern, forest/ vegetation cover, settlements, water bodies, drainage pattern, spot heights and contours; and
- Information on geology, meteorological conditions, water and ecological resources, socio-economic status etc. was collected from secondary sources.

1.3.6 Impact Assessment

Impact identification and prediction are undertaken on the basis of environmental and social baseline data collection. The major processes involved are

- Identification – to define the impacts associated with different phases of the project and the activities undertaken;
- Prediction – to forecast the nature, magnitude, type, duration, extent, scale, frequency likelihood and sensitivity of the major impacts; and
- Evaluation – to determine the significance of residual impacts i.e. taking into account how mitigation will reduce a predicted impact Professional judgement, experience and knowledge of similar projects were used for impact analysis. The extent and potential consequences of the impacts have been compared against applicable reference framework. Mitigation measures have been suggested for each of the identified adverse impacts.

1.3.7 Environmental and Social Management Plan

This section delineates the roles, responsibility and timeline for implementing mitigation measures to prevent the significant impacts arising from activities during different phases of the Project.

1.3.8 Agencies contacted

The agencies consulted by AECOM team during the ESIA study include the following:

- District Forest Office, Vishakhapatnam;
- IMD, Vishakhapatnam;
- Geological Survey of India, Vishakhapatnam; and
- Private institutions.

1.4 Limitations

Professional judgements expressed herein are based on facts and information provided by the client. Wherever AECOM has not been able to make a judgement or assess any process, it has highlighted that as an information gap and suggested a way forward. AECOM shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by the company representatives, contractors, lenders and other relevant stakeholder engaged during the time of this assessment.

AECOM is not engaged in consulting or reporting for the purpose of advertising, sales promotion, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. Client acknowledges this report has been prepared for their and their clients' exclusive use and agrees that AECOM reports or correspondence will not be used or reproduced in full or in part for such purposes and may not be used or relied upon in any prospectus or offering circular. Client also agrees that none of its advertising, sales promotion, or other publicity matter containing information obtained from this assessment and report will mention or imply the name of AECOM.

Nothing contained in this report shall be construed as a warranty or affirmation by AECOM that the site and property described in the report are suitable collateral for any loan or that acquisition of such property by any lender through foreclosure proceedings or otherwise will not expose the lender to potential environmental or social liability.

This report has been prepared by AECOM for the benefit of its Client. AECOM's client may release the information to third parties, who may use and rely upon the information at their discretion. However, any use of or reliance upon the information by any party shall be solely at the risk of such party and without legal recourse against AECOM, its parent, its subsidiaries and affiliates; or their respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort (including the sole, concurrent, or other negligence and strict liability of AECOM), statute, or otherwise.

1.5 Layout of Report

The ESIA Report has been arranged under the following chapters:

1. **Chapter One: Introduction**: (this chapter) provides a background of the Project, the objectives of the study, the scope of work, and approach and methodology of ESIA.
2. **Chapter Two: Project description**: provides details of the Project location, key project components and utilities, land requirements, current project status, etc.
3. **Chapter Three: Environment and Social Regulatory framework**: this chapter encompasses the national administrative requirements, applicable permits, licences, approvals, consents and Project categorisation as per ADB SPS requirement.
4. **Chapter Four: Environmental and socio-economic baseline**: illustrates the environmental baseline, socio-economic baseline and Ecological baseline profile of the study area.
5. **Chapter Five: Analysis of alternatives**: presents the analysis of alternatives for the proposed Project.
6. **Chapter Six: Impact Assessment**: highlights the impact assessment criteria, key environmental and social risks evident in the Project.
7. **Chapter Seven: Environment and Social Management Plan**: this chapter highlights the mitigation measures identified to address the adverse impacts along with organization structure, training, monitoring and key responsibilities.
8. **Chapter Eight**: **Conclusion and Recommendations** provides summary and conclusion of the Project.
9. **List of Appendix.**

2. Project Description

The National Highway Authority of India (NHAI) has awarded the Project contract to DBL Anandapuram Anakapalli Highway Private Limited (the Concessionaire) through Concession Agreement to develop six (06) laning of Anandapuram-Pendurthi- Anakapalli section of NH-16 from km 681.000 (existing km 681.000) to km.731.780 (existing km742.400) in the State of Andhra Pradesh under Bharatmala Pariyojana on Hybrid Annuity Mode. The NH-16 is a major National Highway runs along east coast of West Bengal, Odisha, Andhra Pradesh and terminates at Tamil Nadu. The requirement for this project was long felt as the Kolkata – Chennai NH 16 runs through the Vizag city gets heavily congested in the city limits, particularly during peak hour. The proposed Project will clear most of the traffic on the NH stretch in Visakhapatnam city limits. The Project will facilitate the vehicles coming from Srikakulam which can be diverted at Anandapuram junction to Anakapalli and the vehicles approaching from Rajahmundry can be diverted at Anakapalli to Anandapuram without entering the Visakhapatnam city.

The proposed road passes mostly through agriculture fields with rural and rural/semi-urban settlements. the major settlements/ villages falling close to alignment are Anandapuram, Gandigundam, Mudapaka (Bypass), Pendhurthi, Asakapalli, Batajangpalem (Pallavanipalem), Rampuram and Anakapalle. The Kambalakonda wildlife sanctuary lies in close proximity to the road at km 689.100. (approximately 25 m away from RoW). However, no forest land has been acquired for the Project. Adequate RoW of 60m is available at this place. The Project does not fall under the purview of the Environmental Impact Assessment (EIA) Notification, 2006, as the total length of the road is less than 100 km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignment and bypasses.

2.1 Project Location and Site Setting

The Project road extends from 17°41'21.48"N 83°1'50.34"E to 17°54'2.51"N 83°23'38.72"E. It starts at Anandapuram (existing km 681.000) in Visakhapatnam district and ends at Anakapalli (existing km 742.400) in Visakhapatnam district. The entire stretch passes through Visakhapatnam district with a length of 50.80 km out of which 34.95 km is existing road and rest 15.85 km is bypass and realigned section. The 50.80 km long stretch is characterized by two lane carriageways with earthen shoulders. The general terrain along the road is plain. Most of the land use pattern falls under agricultural and built-up areas. The pavement is entirely of rigid type with width of 13 m. Presently, the road is under construction phase with approximately 50% work is completed. As the Project is under construction no median plantations have been carried out at the site. There is a proposed plan of planting approximately 21,900 trees along the entire stretch. Single row of plantation on both sides is suggested through-out the length of 50.780 km. Figure 2-1 illustrates the Project location and the area of influence.

This entire Project alignment falls within Visakhapatnam district in the State of Andhra Pradesh. The alignment traverses through agricultural fields, barren land and settlements on both sides of the existing carriage way. The entire stretch passes through 35 villages. The Project road does not pass through any wildlife sanctuaries (WLS), costal regulation zone (CRZ) area. The Kambalakonda WLS eco-sensitive area notified under *Section -3* of *the Environmental Protection Act, 1986* is located close to the Project road. A total of 2399 trees have been either cut or in the process of being cut as per the tree felling permission received by NHAI from the Government of Andhra Pradesh, Forest Department vide letter No.811120171S4, dated 04/01/2018.

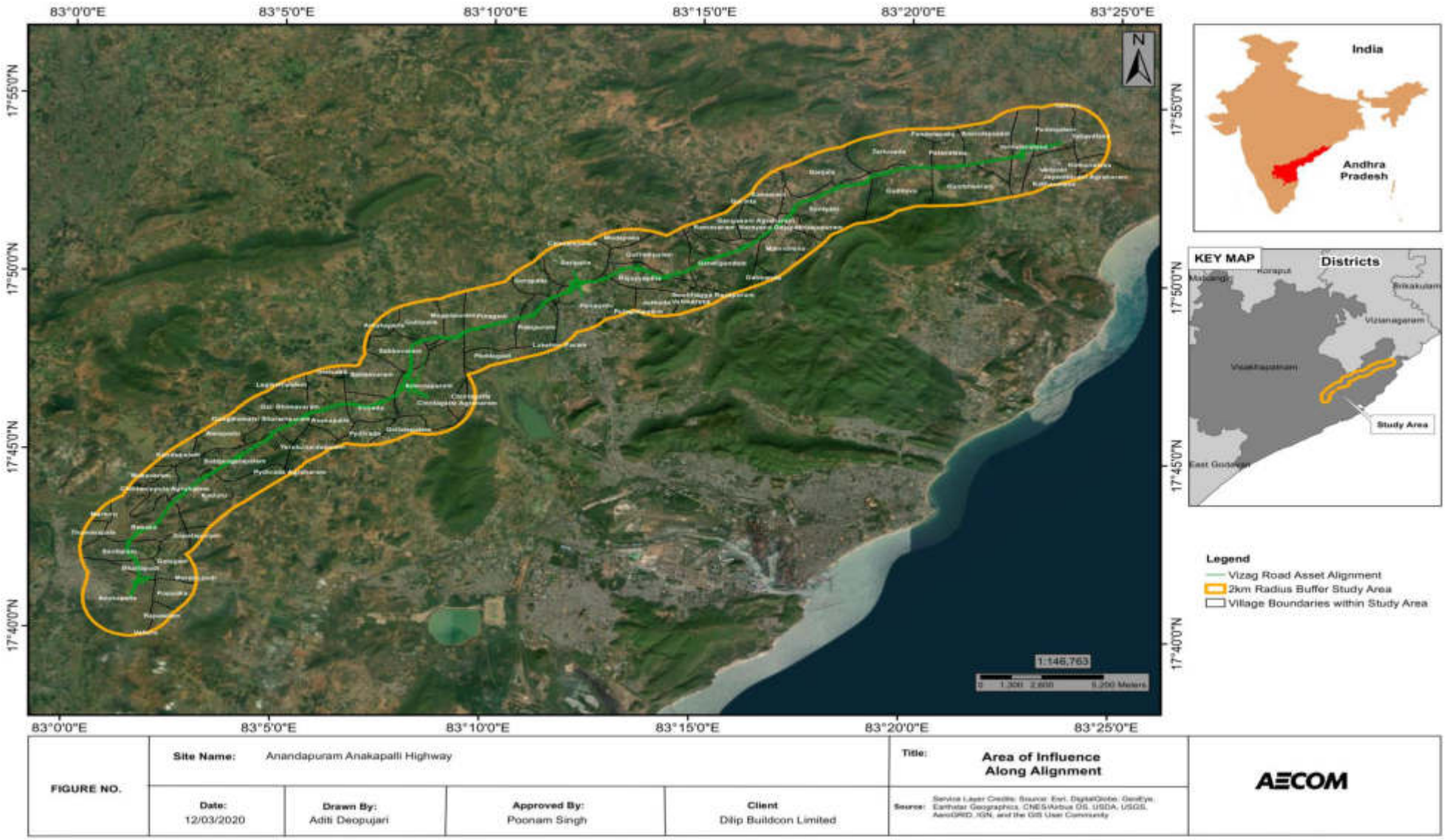

Figure 2-1: Project Location

2.2 Project Overview

2.2.1 Project Components

The road is being developed keeping in view the six-lane cross section along with additional facilities fitted in such a manner that the improvements are accommodated to the maximum extent within the proposed right-of-way of 60m width. The proposed widening is considered keeping in mind the existing road and its facilities that are used to the greater extent and least inconvenience to the traffic during the construction period. Grade separators have been proposed at major junctions. Facilities such as service roads, under/over passes and grade separators have been considered at the reasonable intervals for local traffic including pedestrians. This section of National Highway will be developed as an access-controlled road with limited numbers of access at interchanges without any median opening. The median width has been proposed as 4 m for the entire project stretch except at km 689.900, where a median width of 12 m is proposed (to save one high transmission tower). Table 2-1 is indicative of the key features of the project.

Table 2-1. Salient feature(s) of the Project

Sl. No	Features	Attributes	Remarks
1.	Length of Road	50.78 km	The total length of the road is 50.78km out of which 34.95 km is existing road. Bypass and realignment would compute to 15.83 km.
2.	Right of Way (RoW)	60 m	The existing RoW varies between 25m and 60 m (taking into consideration of the existing ROW as well). The proposed RoW of 60m is provided by NHAI for the entire project road.
3.	Major Bridges	4 Nos	• 1 Nos – Existing • 3 Nos – Proposed
4.	Minor Bridges	24 Nos	• 3 Nos existing (widening only) • 7 Nos proposed for reconstruction • 14 Nos Proposed (new construction)
5.	Culverts	95 Nos	There are 95 culverts comprising of 44 Hume Pipe, and 51 Box Culverts
6.	Grade Separator	21 Nos	Underpasses
7.	Railway Crossing	2 Nos	2 number of ROB Existing 2 number of ROB Proposed
8.	Bus bays & Bus Stops	36 Nos.	Proposed Bus Bays
9.	Truck Lay bye	1 Nos	Proposed- Chainage 715.283 km
10.	Service Road	Throughout the project length	Service road is proposed throughout the project length except at km 730+111 to 730+360 and at km 682+600 to 683+000 (LHS)
11.	Junctions	19 Minor and 1 Major Junctions	At grade intersections at junctions of service roads and all intersecting roads.
12.	Toll Plaza	4 Nos	Chainage 686.483 km, 704.383 km, 714.133 km, and 722.154 km
13.	Flyover	10 Nos	
14.	Borrow pits and Quarry Sites (stone)[3]		• 12 nos. of borrow areas, • 2 nos. Metal quarries and • 2 nos. Sand quarries.

2.2.2 Ancillary Project Operations to support Road Construction

AAHPL is also carrying out ancillary operations to support the road development by operating crusher units, batching plants, Wet Mix Macadam (WMM) plants etc which are housed in two (02) main base camps (Base Camp 1 and Base Camp 2) and two (02) Sub-Base Camps (Sub-base camp 1 and 2), along with quarrying operations at two sub-leased mines, the Marturu quarry located in Marturu Village and Vavilapadu quarry is located in Vavilapadu Village. The following sub-sections provides a broad summary of these operations in context of the Project. Table 2-2 provides details of construction related ancillary operations.

[3] These are associated facilities for the project from where construction materials are sourced from. These areas are owned by third party agencies and DBL procure construction materials.

Table 2-2: Construction related equipment and support

Sr. No	Features	Attributes	Remarks
1.	Crusher Units	5	• 2xCrushers of 250TPH and 350TPH respectively located in base camp 1 • 2xCrushers of 250TPH and 350TPH respectively located in base camp 2 • Stone Crusher located in Vallipadu Village (Quarry location)
2.	Batching Plants	7	• 2x Batching Plants of 120 and 30 cum/Hr. respectively in Camp 1 • 2x Batching Plants of 120 and 30 cum/Hr. respectively in Camp 2 • 2x batching plants 18 and 120 Cum/Hr located at chainage Km 703+900 • 1xBatching Plant of 18 Cum/Hr located at chainage Km709+400
3.	Wet Mix Macadam (WMM) Plants	2	• WMM plants of 200TPH each located at Base Camp 1 and 2 respectively
4.	Chilling Plant	2	• One each at base camp 1 and 2
5.	Sand classifiers	2	• One each at base camp 1 and 2
6.	Casting yard	4	• One each at base camp 1 and 2 • One each at sub base camp 1 and sub base camp 2
7.	Borewell locations	12	• Ground water abstraction wells located across various locations
8.	Diesel Generator Sets	69	• Generators located across the alignment at different locations

Source: Operation and Maintenance Manual and additional sources

Figure 2-2 is indicative of the chainage-wise distribution of the key construction related infrastructure and support.

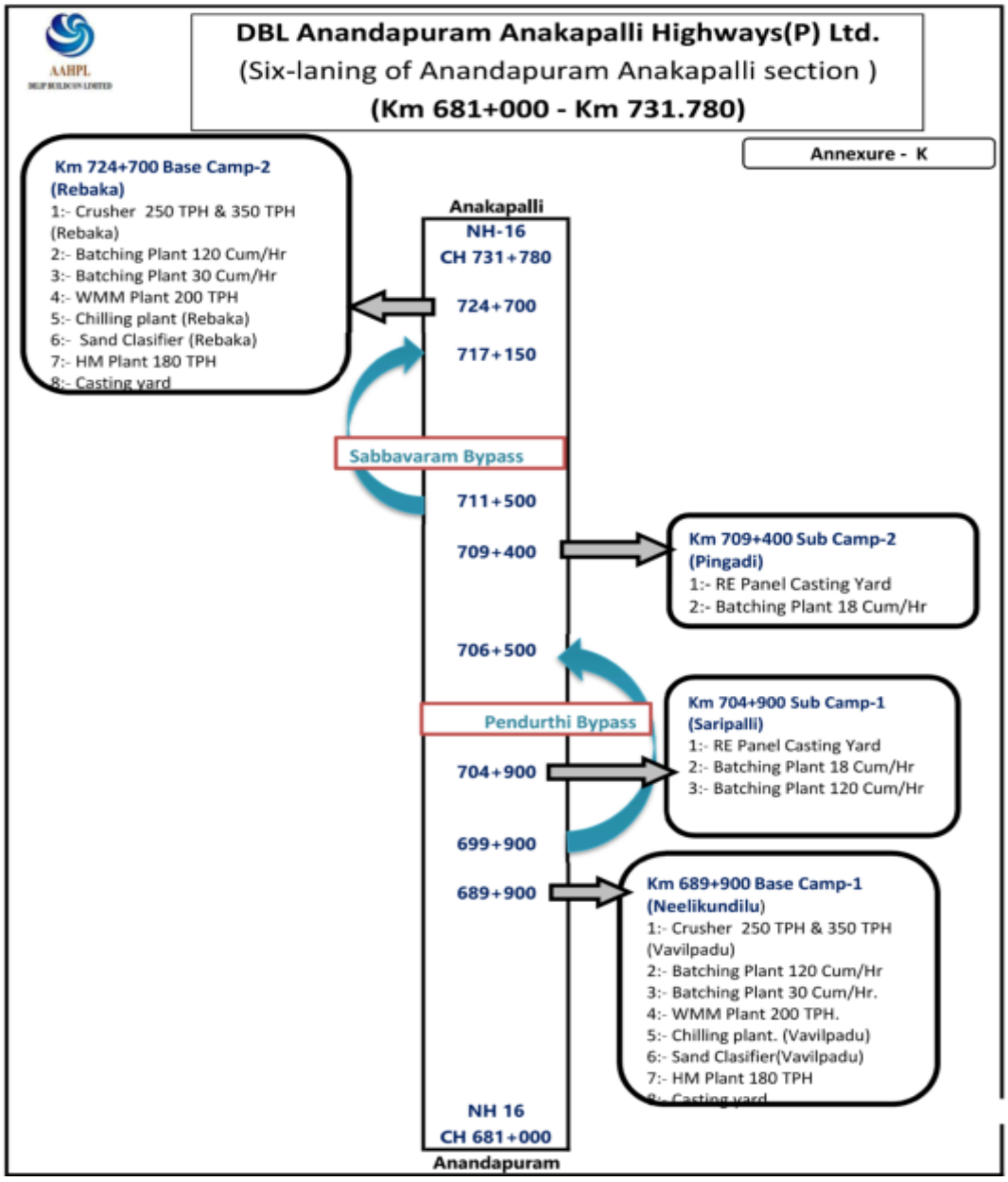

Figure 2-2: Location of construction infrastructure and support for the Project

Source: DBL

2.2.2.1 Marturu Quarry Operations

The Marturu quarry is located in close proximity to Base Camp 2 of the Project at a distance of approximately 7 km in Marturu Village. The quarry is spread across 9 hectare(ha) of area and has been sub-leased to DBL. It was observed that the mining lease for this mine was obtained back in 2009 and the same is valid till 2024. DBL has sub-leased the same from the lease holder by the name of M/s Trendset Rocks Private Limited. The quarrying and transportation operations are carried out directly by DBL with a workforce strength of approximately 85 employees. The quarrying operations are carried out in two shifts. It was observed that an onsite workers camp has been developed for this quarry. Only hilltop quarrying is being carried out and approximately 400 tons per day (TPD) of material is being sent to construction camp 2. All blasting activities are carried out by an external agency in daytime only and prior notification is provided to the local communities in the vicinity through high volume sirens and direct communication with the village gram-panchayat. The following figure showcases the quarry location and its various features.

Figure 2-3: Maturu Query

2.2.2.2 Vavilapadu Quarry Operations

The Valipadu quarry is located at a distance of approximately 50 km from construction camp 1 of the Project at Valipadu village. There are two quarries under operation here. Both the quarries are spread across 15 ha of area and has been sub-leased to DBL and AAHPL. Similar to Marturu quarry, these quarries have also been sub-leased to DBL for this project. These quarries have larger operations and include onsite crushing and sanding operations as well. DBL has engaged two contractors at this site, M/s Vaishnavi Explosives enterprises for carrying out blasting activities and M/s Jai Enterprises for procuring water through their borewells. All onsite operations are carried out directly by DBL with a workforce strength of approximately 50 employees. The quarrying operations are carried out in two shifts. A large off-site workers camp has been developed for the DBL employees working in this quarry. All blasting activities are carried out by an external agency in daytime only with prior notification to the local communities in the vicinity through high volume sirens and direct communication with the village panchayat. The following figure showcases the quarry location and its various features.

2.3 Current Status of the Project

Currently, the Project road is under construction phase with 50% of the work is completed. Two base camp or project/ site offices have been established at km 689+800 (village Gudilova) and at km 724+700 (village Narapadu) in Vishakhapatnam district. The following photographs shows some of ongoing construction activities.

Figure 2-4: Highlights of the road alignment

2.4 Resource Requirement and Procurement

2.4.1 Land Procurement Status

The entire land for the project has been acquired by NHAI through Competent Authority Land Acquisition (CALA) in accordance with the National Highway Act 1956 and the compensation to Project Affected Persons (PAP) have been evaluated on the basis of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. As per the Concession Agreement (CA), NHAI is sole authority responsible for land acquisition and Resettlement and Rehabilitation (R&R). The CA stipulate that land requirements for the Project shall be handed by NHAI to AAHPL free of all encumbrance. AAHPL is responsible for ensuring that there are no encroachments during construction and maintenance period. Table 2-3 is indicative of summary of land procurement status for the Project as of date.

Table 2-3. Land Related Details

Sl. No.	Particular	Unit
1.	Total Land Requirement for the Project	335.68 ha
2.	Total land acquired for the Project as on date	313.56 ha
3.	Remaining amount of land to be acquired	22.12 ha
4.	Percentage of land already acquired (%)	93.41%
5.	Percentage of land pending acquisition (%)	6.58%

Source: DBL

2.4.2 Manpower requirement

The Project employs large number of labour and workforce for multiple operations throughout its lifecycle. A total of 1,655 employees have been engaged and mobilised presently for the construction activities. As reported by DBL, no female workers or employees have been engaged for the Project. While most of the workers are semi-skilled, the team also represented employees who have worked in designing, planning, testing of material, etc. All these employees were observed to be on DBL's role. It was understood that approximately 30% of the

construction manpower are migrant workers who have been provided with accommodation facilities. A team of five (05) HR manager and executives have been stationed the Project to oversee HR and liaison activities. Apart from the above, piece rate/ contract workers were engaged though eleven (11) contractors primarily working with the PQC and Engineering departments.

For managing land related aspects, a land team of three (3) members have been deputed at site who manage and oversee all land acquisition related aspects and undertake necessary liaison with the NHAI and the community groups including the land sellers, encroachers, squatters, community representatives etc.

2.4.3 Water Requirement

The daily water requirement in the Project is approximately 400 KLD, which is sourced from both ground water and water supply through secondary market (vendors). It is reported that ground water accounts for approximately 95 KLD and rest 305 KLD is procured by DBL from water vendors from nearby areas. DBL has obtained water drawl permission for 95 KLD from twelve (12) borewells. Of the total water use, domestic water consumption is approximately 66 KLD and rest 334 KLD is for road construction purpose.

2.4.4 Implementation Schedule

For ease of construction, the Project highway from Anandapuram–Pendurthi-Anakapalli section from km 681.000 km 731.780 has been divided into two equal parts. There are two site in-charge who looks after their respective packages. At present, approximately 50% construction work is completed. The estimated completion timeline is July 2021.

3. Environment and Social Regulatory Framework

This section highlights the environmental and social regulations applicable to the Project. The section broadly focuses on the institutional framework, national administrative/ regulatory requirements, applicable environment, health and safety and social legislative requirements, ADB Safeguard Policies and IFC Performance Standards relevant to the Project.

3.1 Applicable Reference Framework

The present assignment has been undertaken against the following reference framework:

- ADB Safeguard Policy Statement (SPS), 2009;
- ADB Gender and Development Policy, 1998;
- ADB Access to Information Policy, 2019;
- International Covenant on Economic, Cultural and Social Rights and relevant ILO Core Labour Standards Conventions;
- ISO 1996-2:2017(en) Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels;
- Applicable local, national and international environmental and social legislation;
- Workers' Accommodation: Processes and Standards Guidance Note - A guidance note by IFC and the EBRD; and
- WBG Environmental, Health, and Safety Guidelines for Construction Materials Extraction.

3.2 National and Regional Enforcement Authorities

In India, National Highway Authority of India (NHAI) is the nodal agency under Ministry of Road Transport and Highways (MoRTH) to manage the highway projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB) along with State Pollution Control Board. The social governance aspects at the micro level are addressed by institutions like panchayats and municipal bodies.

Table 3-1 summarizes the key regulations that are relevant to the Project across its lifecycle.

Table 3-1: Applicable Environment and Social Laws and Regulations

Sl. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
EHS Laws, Acts, Rules and Regulations					
1.	Environmental Protection	• Construction activities will generate air, water and noise emissions; and • Scattering of debris and construction material can contaminate the soil, water and surroundings.	• The Environment (Protection) Act 1986, as amended in April 2003; • EPA Rules 1986, as amended in 2002.	SPCB	As per Section 7 of Environment Protection Act, 1986 and Rule 3 of the Environment Protection Rule, 1986, no person carrying on any industry, operation and process shall discharge or emit any environmental pollutant in excess of prescribed standards. Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act. AAHPL *and the EPC contractor are to ensure that Project implementation adheres to the various clauses laid down in the Act*
2.	Prevention and Control of Water Pollution	Wastewater generation during construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	SPCB	As per the section 24 of the Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 no person shall knowingly cause or permit any poisonous, noxious or polluting matter into any stream or well or sewer or on land.
3.	Prevention and Control of Air Pollution	Movement of vehicles, operation of diesel generators for power at campsite or other construction activities.	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987.	SPCB	As per section 22 of The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987, no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the CPCB.
4.	NOC And Consent to Establish and Operate for Batching Plant	Batching plant operation would lead to emission of fugitives. It also envisages wastewater generation which could lead to contamination of land and water resources. In addition, there would be generation of noise disturbance to the neighbouring villages.	The Water (Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981 & The Noise Pollution (Regulation and Control) Rules, 2000 and subsequent amendments.	SPCB	Applicable. The Project has obtained consent from State Pollution Control Board.
5.	Noise Emissions	Noise generated from operation of construction machinery	• The Noise (Regulation & Control) Rules, 2000 as amended in October 2002; and • As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like, commercial, residential and silence zones etc.	SPCB	As per the Rules 3 and 4 of the Noise (Regulation & Control) Rules, 2000 as amended in October 2002, noise emissions in the project area should not exceed standards specified in the Schedule.
6.	Hazardous Wastes Management	• The proposed project will generate waste oil from diesel generator during construction phase and used transformer oil during operation phase;	Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 as amended in 2019	SPCB	As per the Hazardous Waste and Other Wastes (Management and Trans boundary Movement) Rules 2016 and its amendment, An occupier shall be required to obtain an authorisation under this rule, from the State Pollution Control Board

Sl. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
		• Solvents and chemicals used or cleaning etc.; and Management of other hazardous waste.			Hazardous and other wastes generated by the occupier shall be given to the actual user, waste collector or operator of the disposal facility, in accordance with the Central Pollution Control Board guidelines. However, as per the Rules 4, 6, 8, 17, 18, 19 and 20 of The Hazardous and Other Wastes (Management and Transboundary Movement) rules following compliances are to be ensured: • Authorization for collection, reception, storage, transportation and disposal of hazardous wastes; • Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; and The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment.
7.	Construction and Demolition Waste	Collection, segregation, storage and disposal of construction and demolition (C&D) waste at construction phase of the project.	Construction and Demolition Waste Management Rules, 2016	Gram Panchayat	As per the Construction and Demolition Waste Management Rules, 2016, if waste more than 20 tons or more in one day or 300 tons per project in a month is generated then AAHPL shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition work. AAHPL should also ensure responsible collection, store and disposal of the C&D waste.
8.	Storage of Petroleum products	There will be storage of Diesel at site for operation of generators during construction phase.	• The Petroleum Act 1934, as amended in August 1976 • The Petroleum Rules 1976, as amended in March 2002.	PESO (Chief Controller of Explosives)	As per Section 3 of The Petroleum Act 1934 and Rule 116 of The Petroleum Rules 1976 AAHPL will be required to obtain a license from PESO, if the quantity of the fuel stored exceeds two thousand and five hundred litres and/ or is stored in a receptacle exceeding one thousand litres in capacity.
9.	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	• The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000. • The Central Motor Vehicles Rules 1989, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.	State Transport Authority	As per the Section 39, Motor Vehicle Act, 1988 as amended in 2017 and Rule 47, Motor Vehicle Rule, 1989.

Sl. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
Biodiversity related laws					
10.	Forest Protection	Presence of legally protected forest areas in proximity to the project site	The Indian Forest Act, 1927	State Forest Department	Not Applicable As the project does not pass through any Forest land.
11.	Forest Conservation	Presence of legally protected forest areas in proximity to the project site	The Forest (Conservation) Act, 1980	State Forest Department	Not Applicable As the project does not pass through any Forest land.
12.	Tree cutting permission.	To protect roadside trees wherever feasible and to cut minimum trees that are necessary for widening of road	The Forest (Conservation) Act, 1980	State Forest Department	Applicable A total of 2399 has been either cut or in the process as per the Tree felling Permission received by NHAI from the Government of Andhra Pradesh Forest Department in letter No.811120171s4, Dated.04/01/2018 for the project.
Social and labour-related Laws, Regulations and Acts					
13.	Labour	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Andhra Pradesh Factories Rules, 1950	Department of Labour, Government of and Andhra Pradesh	AAHPL / EPC Contractor shall comply with all requirements of Factories Rules and participate in periodic inspection.
14.	Contract Workers	Engagement of contract workers	The Contract Labour (Regulation and Abolition) Act, 1970 as amended in 2017	Department of Labour, Government of and Andhra Pradesh	As per Section 12 of the Contract Labour (Regulation and Abolition) Act, 1970 a contractor executing any contract work by engaging 20 or more contract labourers has to obtain a licence under the Act.
15.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Department of Labour, Government of and Andhra Pradesh	Section 3 under the Child Labour (Prohibition and Regulation) Act, 1986 (CLA, 1986) including amendment in 2016. No child below the age of 14 years shall be employed in any establishment mentioned in Schedule Part A and Part B of the CLA, 1986.
16.	Bonded Labour	Engagement of Bonded Labour at site	Bonded Labour (Abolition) Act 1976	Department of Labour, Government of and Andhra Pradesh	Rule 4 of the Bonded Labour System (Abolition) Act, 1976 specifies "After the commencement of this Act, no person shall- • make any advance under, or in pursuance of, the bonded labour system, or compel any person to render any bonded labour or other form of forced labour."
17.	Payment of Wages	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Department of Labour, Government of and Andhra Pradesh	Section 12 of the Minimum Wages Act, 1948: The employer shall pay to every employee engaged in a scheduled employment under him wages at a rate not less than the minimum rate of wages fixed by the appropriate Government Authority for that class of employees in that employment without any deductions except as may be authorized within such time and subject to such conditions as may be prescribed. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.

Sl. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
18.	Payment of Wages.	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Department of Labour, Government of and Andhra Pradesh	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature.
19.	Payment of Wages	Engagement of Labour at site	Workmen's Compensation Act, 1923	Department of Labour, Government of and Andhra Pradesh	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.
20.	Women at Workplace	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Department of Labour, Government of and Andhra Pradesh	Section 4 of the Maternity Benefit Act, 1961 including amendment as in Maternity Benefit (Amendment) Act, 2017: - • "No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; • No woman shall work in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; and • Without prejudice to the provisions of section 6, no pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period specified in sub-section (4) any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health." Section 5 of the Maternity Benefit Act, 1961 including as amended in 2017. "As per the amendment in 2017, • Subject to the provisions of this Act, every woman shall be entitled to, and her employer shall be liable for, the payment of maternity benefit at the rate of the average daily wage for the period of her actual absence, that is to say, the period immediately preceding the day of her delivery, the actual day of her delivery and any period immediately following that day; • No woman shall be entitled to maternity benefit unless she has actually worked in an establishment of the employer from whom she claims maternity benefit, for a period of not less than eighty days in the twelve months immediately preceding the date of her expected delivery; • The maximum period for which any woman shall be entitled to maternity benefit shall be twenty-six weeks of which not more than eight weeks shall precede the date of her expected delivery; • A woman who legally adopts a child below the age of three months or a commissioning mother shall be entitled to maternity benefit for a period of twelve weeks from the date the child is

Sl. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					handed over to the adopting mother or the commissioning mother, as the case maybe; and In case where the nature of work assigned to a woman is of such nature that she may work from home, the employer may allow her to do so after availing of the maternity benefit for such periods and on such conditions as the employer and the woman may mutually agree."
21.	Contractor Labour License	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid registration.	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Department of Labour, Government of and Andhra Pradesh	Section 7 of the Act mandates the registration of establishments. AAHPL should ensure that contractor/ sub-contractors have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.
22.	Contract Labour	Principal Employer registration for engaging contract labour through third party is required.	The Contract Labour (Regulation and Abolition) Act, 1970	Department of Labour, Government of and Andhra Pradesh	Section 7 of the Act mandates the Principal Employer registration for engaging contract labour through third party.
23.	Migrant Workmen	Principal Employer registration for engaging migrant labour is required for direct/indirect labour.	The Inter-State Migrant Workmen (Regulation of Employment and conditions of service) Act, 1979	Department of Labour, Government of and Andhra Pradesh	Section 4 of the Act mandates that the Principal Employer registration should be obtained for engaging migrant labour through third party.
24.	Working Conditions	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	Department of Labour, Government of and Andhra Pradesh	Section 16,17,18,19,20 and 21 of the said Act mandates the provision of the principal employer to ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules.

3.3 Policy Framework in India

Policies with respect to the Highway projects in India and Andhra Pradesh, as released by the Government of India and Government of Andhra Pradesh from time to time and applicable to the project are discussed briefly

3.3.1 EIA Notification 2006

The Project does not fall under the purview of the Environmental Impact Assessment (EIA) Notification 2006 as the total length of the Project road is 50.78km out of which 34.95 km is existing road. Bypass and realignment of the project road would compute to 15.83 km. The Project road does not pass through CRZ area and hence no CRZ clearance was also required.

3.3.2 NH Act 1956 for Project Land Acquisition Process

In India, Land for construction and upgradation of National highways are acquired under The National Highways (NH) Act, 1956 and its subsequent amendments. The following procedure to acquire land as per the act and the same was applied to the current project:

- As per the procedure, acquisition of land for the National Highways is initiated with NHAI finalizing the alignment of the road and communicating to the concerned district authority about their land requirements. Per the NH Act, 1956, the District authority formulates a committee i.e. Competent Authority Land Acquisition (CALA) headed by Additional District Collector/Commissioner (ADC). This committee is responsible for entire land acquisition and hand over of the desired Right of Way (RoW) to NHAI free from any encumbrance.
- As per the provision of the section 3A of the NH Act, 1956, CALA publishes land acquisition notice in two local newspapers, one of which should be in vernacular language. After publication of the notification, any person interested in the mentioned land can object to the land acquisition within 21 days of the publication of the notification.
- Post hearing all objections and addressing the concerns, CALA informs the central government about the status of land. As per provision of section 3D of the NH Act, Central government publishes the land acquisition notice in the official gazette. This notice is to be published within one year of publication of 3A notice otherwise the 3A notice is ceased for any action. After publication of this 3D notice, land is to be vested absolutely with central government free from any encumbrance and is to be made available to NHAI for any kind of activity.
- CALA determines the compensation amount for the land based on the calculation process mentioned in LARR Act 2013. Post this, CALA published a public notice in two local newspapers, one of which is required to be of vernacular language, inviting claims from all persons interested in land to be acquired.
- NHAI is required to deposit the compensation amount determined by CALA under section 3G of NH Act, 1956 to a designated account. Thereafter, CALA commences the distribution of compensation amount to the landowners. If any of the landowner is not happy with the compensation and doesn't want to accept the amount determined by CALA, based on the application of the landowner, the case can be forwarded to arbitrator appointed by central government for reconsideration. In this case provision of Arbitration and Conciliation Act 1996 will be applied.
- Per the NH Act, 1956 landowner has the right to express their grievance before CALA after publication of public notice under section 3A and 3G. NHAI does not have any intervention in the whole process.

3.3.3 Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement (LARR) Act 2013- Evaluation of Compensation

The Section 28 of the LARR Act 2013 states that, in determining the amount of compensation to be awarded for land acquired under this Act, the collector shall take into consideration the elements and the calculation presented in the following Table 3-2.

Table 3-2: Compensation calculation as per LARR Act 2013

Reference from the Statute	Particular(s) of Compensation	Amount (INR) Calculation
28(1)	(A) The market value as determined under section 26 and the award amount in accordance with the First Schedule & (B) the Second Schedule	A+B = say "C"
28(2)	Damage to crops or any standing trees	D
28(3)	The depreciation in the value of the claimant's retained interest arising from the severing of the land acquired from the original whole.	E
28(4)	Injurious affection to the retained land may arise as a result of the execution and use of the works; the depreciating effect is to be related to the new works to be situated on the land taken and elsewhere.	F
28(5)	In consequence of the acquisition of the land by the Collector, the person interested is compelled to change his residence or place of business, the reasonable expenses (if any) incidental to such change.	G
28(6)	The damage (if any) bona fide resulting from diminution of the profits of the land between the time of the publication of the declaration under section 19 and the time of the Collector's taking possession of the land.	H
28(7)	Any other ground which may be in the interest of equity, justice and beneficial to the affected families.	J
	Compensation Say "K"	C+D+E+F+G+H+J
30(1)	Solatium Amount at the rate of 100 percent of "K" Say "L"	L
30(3)	12 % interest payable on "A" Say "M" from S. 4(2) SIA notification till the date of the award of the Collector or the date of taking possession of the land, whichever is earlier. (Appropriate reference in the present to be made to the NH Act 1956 for assessing date of award from which interest payment starts)	M
	Total Award	**L+M**

3.4 Applicable International Standards and Guidelines

3.4.1 ADB Safeguard Policy Statement, 2009

In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the project design and implementation.

The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS.

The SPS supersedes ADB's Involuntary Resettlement Policy (1995), Policy on Indigenous Peoples (1998), and Environment Policy (2002). In accordance with the SPS, these previous policies apply to all projects and tranches of multi-tranche financing facility projects that were reviewed by ADB's management before 20 January 2010.The objectives of ADB's safeguards are to:

- Avoid adverse impacts of projects on the environment and affected people, where possible;
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- Environmental safeguards;
- Involuntary Resettlement safeguards; and
- Indigenous Peoples safeguards.

To help borrowers and clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers and clients are required to meet in addressing environmental and social impacts and risks. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment (Appendix 1 of SPS);
- Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS);
- Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS); and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities (Appendix 4 of SPS).

In addition, ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS). Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law.

3.4.1.1 ADB Prohibited Investment Activities List

The following do not qualify for Asian Development Bank financing:

- Production or activities involving harmful or exploitative forms of forced labour, child labour;
- Production of or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements or subject to international phaseouts or bans, such as (a) pharmaceuticals, pesticides, and herbicides, (b) ozone-depleting substances, (c) polychlorinated biphenyls and other hazardous chemicals, (d) wildlife or wildlife products regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and (e) transboundary trade in waste or waste products;
- Production of or trade in weapons and munitions, including paramilitary materials;
- Production of or trade in alcoholic beverages, excluding beer and wine;
- Production of or trade in tobacco;
- Gambling, casinos, and equivalent enterprises;
- Production of or trade in radioactive materials, including nuclear reactors and components thereof;
- Production of, trade in, or use of unbonded asbestos fibres;
- Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests; and
- Marine and coastal fishing practices, such as large-scale pelagic drift net fishing and fine mesh net fishing, harmful to vulnerable and protected species in large numbers and damaging to marine biodiversity and habitats.

The present project is outside the purview of this prohibited list.

3.4.2 ADB Policies

3.4.2.1 Public Communications Policy (2011)

ADB's Public Communications Policy (2011) sets out disclosure requirements for various ADB activities, including safeguard requirement. Safeguard Requirements 2: Involuntary Resettlement (Appendix 2 of SPS); and Safeguard Requirements 3: Indigenous Peoples (Appendix 3 of SPS) sets out the need for meaningful consultation and information disclosure during project preparation and operation to the affected population and other key stakeholders. Key requirements include:

- Information Disclosure: The borrower/client will submit the following documents to ADB for disclosure on ADB's website as per the applicability with respect to the Project:
  - Draft EIA including draft EMP;
  - Final EIA/IEE;
  - Updated EIA/IEE and corrective active plan;
  - Environmental Monitoring Reports;

  - Resettlement Plan (RP); and
  - Indigenous Peoples Plan (IPP).

- Information disclosure to affected people or stakeholders: The borrower/client will provide relevant environmental information in a timely manner, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. For uneducated people, other suitable communication methods will be used.
- Consultation and Participation: The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.

Timing and Frequency for consultation and participation: Meaningful consultation begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle

3.4.2.2 Social Protection Strategy 2001

Social protection is a key step in ADB's battle to have Asia and the Pacific region "free of poverty." The Social Protection Strategy (SPS) spells out the scope of social protection and commitment of the ADB to develop priority interventions in five major elements including:

- Labour market policies and programs designed to generate employment, improve working conditions and promote the efficient operations;
- Social insurance programs to cushion the risks associated with unemployment, ill health, disability, work-related injury and old age;
- Social assistance and welfare service programs for the vulnerable groups with inadequate means of support, including single mothers, the homeless, or physically or mentally challenged people;
- Micro and area-based schemes to address vulnerability at the community level, including micro-insurance, agricultural insurance, social funds and programs to manage natural disasters; and
- Child protection to ensure the healthy and productive development of children.

3.4.2.3 Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions 2011

All ADB operations have social dimensions that need to be taken into account from the country strategy formulation, programming, and project processing phases onward. The key social dimensions, supported by specific ADB policies or strategies, include:

- Participation;
- Gender and development;
- Social safeguards; and
- Management of social risks, especially among vulnerable groups.

As per the policy, ADB operations incorporate social dimensions to ensure the following social development outcomes, especially for the poor, vulnerable, and excluded groups:

- Policies and institutions that recognize and promote greater inclusiveness and equity in access to services, resources, and opportunities;
- Greater empowerment to participate in social, economic, and political life; and
- Greater sense of security and ability to manage risks. In pursuing these social development outcomes, ADB
- Encourages consultation with and participation by stakeholders (including the government, executing and implementing agencies, clients and/or beneficiaries, people affected by ADB-supported projects); provides them with opportunities to engage in key stages of the country strategy formulation, programming, and project cycles; and actively seeks, where appropriate, the cooperation of nongovernment organizations and other civil society groups in formulating, designing, implementing, monitoring, and evaluating projects;
- Addresses gender considerations in relevant aspects of ADB operations, including macroeconomic, sector strategy, country strategy formulation, and programming work, and in key stages of the project cycle; and proposes strategies to promote social inclusion and gender equality and to empower women;

- Integrates social analysis in preparing country partnership strategies and regional strategies and programs; identifies potential social issues during project preparation to ensure that the project design maximizes social benefits and avoids or minimizes social risks, particularly for vulnerable and marginalized groups; and
- Ensures that project design and implementation arrangements include actions to enhance benefits and to monitor and evaluate the distribution of the benefits of the project, with performance targets and indicators for monitoring and evaluating benefits included in the design and monitoring framework of the project performance management system.

3.4.2.4 Gender Mainstreaming Guidelines 2012

The projects of the Asian Development Bank (ADB) have four gender mainstreaming categories:

- Category I: gender equity as a theme (GEN);
- Category II: effective gender mainstreaming (EGM);
- Category III: some gender elements (SGE); and
- Category IV: no gender elements (NGE).

The Gender Mainstreaming Guidelines 2012 provides a detailed overview on the definition, requirements and application of the above gender mainstreaming categories.

3.4.2.5 Core ILO Labour Standards

There are eight core International Labour Organization (ILO) conventions that align with, and further strengthen, the covenant requirements. They cover four 'Core Labour Standards:

- Conventions 29 and 105 ban forced labour and slavery
- Conventions 87 and 98 require countries to allow freedom of association and collective bargaining
- Conventions 100 and 111 ban workplace discrimination
- Conventions 138 and 182 set a minimum working age of 15 and ban the worst forms of child labour (e.g., bonded labour, hazardous labour, military conscription and sex trade)

3.4.3 ADB Safeguard Categories

3.4.3.1 Environment

Proposed projects are screened according to type, location, scale, and sensitivity and the magnitude of their potential environmental impacts, including direct, indirect, induced, and cumulative impacts. Projects are classified into the following four categories:

- **Category A**. A proposed project is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required.
- **Category B.** The proposed project's potential adverse environmental impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.
- **Category C**. A proposed project is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- **Category FI**. A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities have minimal or no environmental impacts or risks.

3.4.3.2 Involuntary Resettlement

The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will be physically displaced from home or lose 10% or more of their productive or income-generating assets. For those involving involuntary resettlement, a resettlement plan is prepared that is commensurate with the extent and degree of the impacts: the scope of physical and economic displacement and the vulnerability of the affected persons. Projects are classified into the following four categories:

- **Category A**. A proposed project is likely to have significant involuntary resettlement impacts. A resettlement plan, which includes assessment of social impacts, is required.
- **Category B**. A proposed project includes involuntary resettlement impacts that are not deemed significant. A resettlement plan, which includes assessment of social impacts, is required.
- **Category C.** A proposed project has no involuntary resettlement impacts. No further action is required.
- **Category FI**. A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities are unlikely to generate involuntary impacts.

3.4.3.3 Indigenous Peoples

The impacts of an ADB-supported project on indigenous peoples is determined by assessing the magnitude of impact in terms of:

- Customary rights of use and access to land and natural resources;
- Socioeconomic status;
- Cultural and communal integrity;
- Health, education, livelihood, and social security status; and
- The recognition of indigenous knowledge; and
- The level of vulnerability of the affected Indigenous Peoples community.

Projects are classified into the following four categories:

- **Category A**. A proposed project is likely to have significant impacts on indigenous peoples. An Indigenous Peoples Plan (IPP), including assessment of social impacts, is required.
- **Category B**. A proposed project is likely to have limited impacts on indigenous peoples. An IPP, including assessment of social impacts is required.
- **Category C**. A proposed project is not expected to have impacts on indigenous peoples. No further action is required.
- **Category FI**. A proposed project involves the investment of ADB funds to or through a financial intermediary. The financial intermediary must apply and maintain an environmental and social management system, unless all of the financial intermediary's business activities unlikely to have impacts on indigenous peoples.

The categorisation for the present project has been carried out in Section 5.8

3.4.4 WB/IFC EHS Guidelines

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP), as defined in IFC's Performance Standard 2: Labour & working Conditions (Occupational Health and Safety), Performance Standard 3: Resource Efficiency and Pollution Prevention. Following EHS Guidelines were referred for this E&S compliance audit.

- General EHS Guidelines, 2007; and
- EHS Guidelines for Toll Roads, 2007.

3.4.5 Guidelines for Community Noise WHO 1999

According to the WHO Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic; industries; construction and public work; and the neighbourhood. Noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; and interference with intended activities. Hence it become pivotal to access the impact of noise during all facets of the project cycle.

3.4.5.1 Sources of road noise

Noise associated with road development has four main sources: a) vehicles; b) friction between vehicles and the road surface; c) driver behaviour; and d) construction and maintenance

a) **Construction and maintenance**: Road construction generally require the use of heavy machinery, and although these activities may be intermittent and localized, they nevertheless contribute tremendous amount of sustained noise during equipment operation and maintenance activities. Activities such as operation of stone crushers, RMC plant, DG sets, rotating equipment such as grinding machine, Pumps and Compressors etc., along with the heavy machineries to lay down the road.

b) **Vehicle noise**: Vehicle noise comes from the engine, transmission, exhaust, and suspension, and is greatest during acceleration, on upgrades, during engine braking, on rough roads, and in stop-and-go traffic conditions. Poor vehicle maintenance is a contributing factor to this noise source.

c) **Road noise**: Frictional noise from the contact between tires and pavement contributes significantly to over all traffic noise. The level depends on the type and condition of tires and pavement. Frictional noise is generally greatest at high speed and during quick braking.

d) **Driver behaviour**: Drivers contribute to road noise by using their vehicles' horns, by playing loud music, by shouting at each other, and by causing their tires to squeal as a result of sudden braking or acceleration.

3.4.5.2 Road noise impacts

Noise associated with road development affects the environment through which roads pass by affecting human welfare, by sonically vibration and disturbing wildlife.

Human welfare: Even when it is not perceived consciously chronic exposure to road noise can affect hu man welfare in varying degrees, both physiologically and psychologically. Chronic noise exposure can be a source of annoyance, creating communication problems and leading to elevated stress levels as well as associated behavioural and health effects. It can cause auditory fatigue, temporary and permanent lessening of hearing ability, sleep disorders and can even contribute to learning problems in Children.

Vibration: The vibration induced by the resonance of traffic noise can have a detrimental effect on structures standing near the road. This is of particular concern in the case of cultural heritage sites, which may have been standing for many centuries, but which were not designed to withstand such vibration. Makeshift or lightly constructed buildings may be the first to succumb to vibration damage.

Wildlife disturbance: Noise may prevent many animal species from approaching or crossing road corridors because they are afraid. As a result, road corridors become barriers to regular wildlife travel routes, effectively rendering roadside habitat areas inaccessible to some species. Such disturbance reduces the success of these species and contributes to ecological alteration.

The effect of a combination of noise events is related to the combined sound energy of those events (the equal energy principle). The sum of the total energy over some time period gives a level equivalent to the average sound energy over that period. Thus, LAeq, T is the energy average equivalent level of the A-weighted sound over a period T. LAeq, T should be used to measure continuing sounds, such as road traffic noise or types of more-or-less continuous industrial noises.

3.4.5.3 Guidelines Values for Community Noise

A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. It is equally important to measure the maximum values of noise fluctuations, preferably combined with a measure of the number of noise events. If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low-frequency components are present, noise measures based on A-weighting are inappropriate. The difference between dB(C) and dB(A) will give crude information about the presence of low- frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health. WHO has issued guideline values for community noises in specific environment which are exemplified in Table 3-3.

Table 3-3: Guideline Values for Community Noise in Specific Environments (WHO 1999)

Specific environment	Critical health effect(s)	LA_{eq} [dB(A)]	Time base [hours]	LA_{max} fast [dB]
Outdoor living area	• Serious annoyance, daytime and evening • Moderate annoyance, daytime and evening	• 55 • 50	• 16 • 16	- -
welling, indoors Inside bedrooms	• Speech intelligibility & moderate annoyance, daytime & evening • Sleep disturbance, night-time	• 35 • 30	• 16 • 8	- 45
Outside bedrooms	• Sleep disturbance, window open (outdoor values)	• 45	• 8	60
School classrooms & pre-schools, indoors	• Speech intelligibility, • disturbance of information extraction, • message communication	• 35	During class	-
Pre-school bedrooms, indoor	• Sleep disturbance	• 30	sleeping time	45
School, playground outdoor	• Annoyance (external source)	• 55	During play	-
Hospital, ward rooms, indoors	• Sleep disturbance, night-time • Sleep disturbance, daytime and evenings	• 30 • 30	• 8 • 16	40
Hospitals, treatment rooms, indoors	• Interference with rest and recovery	• #1[1]	-	-
Industrial, commercial shopping and traffic areas, indoors and outdoors	• Hearing impairment	• 70	• 24	110
Ceremonies, festivals and entertainment events	• Hearing impairment (patrons:<5 times/year)	• 100	• 4	• 110
Public addresses, indoors and outdoors	• Hearing impairment	• 85	• 1	• 110
Music and other sounds through headphones/ earphones	• Hearing impairment (free-field value)	• 85 #4	• 1	• 110
Impulse sounds from toys, fireworks and firearms	• Hearing impairment (adults) • Hearing impairment (children)	-	-	• 140 • #2 • 120 • #2
Outdoors in parkland and conservations Areas	• Disruption of tranquility	• #3		•

Source: Guidelines for Community Noise- Who 1999

3.5 IFC and World Bank Guidelines

The IFC-WB (2007) provides guideline values on noise, which apply beyond the property boundary of facilities. The noise emitted beyond the facility should not exceed the values provided in Table 3-4 or result to increase of 3 dBA from the background noise of the nearest receptor. IFC-WB (2007) guideline values on noise were based on the World Health Organization (WHO), 1999.

Table 3-4: IFC-World Bank Group noise level Guidelines

Receptor	One Hour (L_{Aeq}) (dBA)	
	Day time	Nighttime
Residential; institutional; educational	55	45
Industrial; Commercial	70	70

Note: Noise impacts should not result in a maximum increase in background levels of 3 dBA at the nearest receptor location off-site.

Source: IFC-WB, 2007

3.6 National Regulations for Noise Impact

Guidelines by the Central Pollution Control Board (CPCB), New Delhi, India suggest that noise levels should not exceed 75 dB in daytime and 70 dB during night in industrial areas, while the corresponding levels for commercial area are 65 dB in day and 55 dB in night. In residential areas noise levels should not exceed 55 dB in day and 45 dB at night; corresponding values for silence zones in day time is 50 dB and 40 dB at night.

As per the Noise Pollution (Regulation and Control) Rules, 2000, Central Pollution Control Board (CPCB) has defined the following standards in Table 3-5.

Table 3-5: Ambient Air Quality standards in respect to Noise

Area Code	Category of area zone	Limits in dB(A)L_{eq}	
		Day time	Night time
A.	Industrial area	75	70
B.	Commercial area	65	55
C.	Residential area	55	45
D.	Silence Zone	50	40

Source: Noise Pollution Regulations in India CPCB

3.7 Applicability Matrix of the Project to respective ADB Safeguards Requirements

The various EHS and Social aspects that have been considered while assessing the project, the governing ADB safeguards and their applicability to the project is indicated in the below mentioned table.

Table 3-6: Applicability of ADB safeguard standards and IFC Performance Standards

Sl. No.	EHS and Social Aspect under consideration	ADB Safeguard Requirement	Requirements/Tenets of the Safeguard/ PS	Applicability to the Project
1.	Assessment and Management of Environmental and Social Risks and Impacts	Safeguard Requirements 1: Environment	Aims to assesses the existing social and environmental management systems of a company/project and to identify the gaps with respect to their functioning, existence and implementation of any Environmental and Social Management Plan (ESMP) and procedures, a defined EHS Policy, organization chart with defined roles and responsibilities, risk identification and management procedures as well as processes like stakeholder engagement and grievance management.	Applicable The proposed project is a Highway project and will have environmental and social impacts associated with the same which have to be adequately identified and mitigated through various EHS and Social procedural protocols and on-ground implementation by the project proponent. Effective stakeholder engagement and grievance redressal is required to be undertaken for the project.
2.	Labour and Working Conditions	ADB Core Labour Standards	Covers following themes: human resource policy and management, workers' organization, non-discrimination and equal opportunity, retrenchment, protecting the workforce and occupational health and safety. It applies to workers directly engaged by the client (direct workers), workers engaged through third parties to perform work related to core business processes of the project for a substantial duration (contracted workers), as well as workers engaged by the client's primary suppliers (supply chain workers).	Applicable. The project employs large number of labour and workforce for multiple operations throughout its lifecycle. A total of 1655 employees have been engaged and mobilised presently for the construction activities.
3.	Environmental Pollution Risks and Controls	Safeguard Requirements 1: Environment	Key themes covered under are: pollution prevention, resource conservation and energy efficiency, wastes, hazardous materials, emergency preparedness and response, greenhouse emissions, pesticide use and management.	Applicable Assessment is required to ascertain how AAHPL intends to minimize water pollution (from wastewater generated during construction/operation phase, lockage of fuel/lubricants from storage areas, maintenance, etc.), noise emission (from maintenance procedures); municipal solid waste from base camps and guest houses and other areas; hazardous wastes generated from basecamp, other location. What management plans and systems are in place, and what measures it plans to take to conserve and use resources more efficiently.

Sl. No.	EHS and Social Aspect under consideration	ADB Safeguard Requirement	Requirements/Tenets of the Safeguard/ PS	Applicability to the Project
4.	Community Safety Security and Health	Safeguard Requirements 1: Environment Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions 2011	Key areas of compliance screened includes infrastructure/equipment safety, hazardous material safety, natural resource issues, exposure to disease, emergency preparedness and response, and security personnel.	Applicable Coverage of safety of the road users, the local community along the ROW and emergency response system planned to be followed by AAHPL for road accident events. An Emergency preparedness plan has been developed to capture the relevant elements and the assessment of the adequacy of the same has been carried out. .
5.	Land Acquisition and associated impacts	Safeguard Requirements 2: Involuntary Resettlement Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions 2011	The key themes covered under this are: compensation and benefits for displaced persons, consultation and grievance mechanism, resettlement planning and implementation, physical displacement, economic displacement. The ADB/PS safeguards prescribes private sector responsibility to supplement government actions and bridge the gap between governments assigned entitlements and procedures and the requirements these financial institutions.	Applicable The entire land for the project has been procured by NHAI through a government acquisition process which is involuntary in nature and has associated social and economic implications for the Project Affected Families and persons. Although compensation was paid for the acquired land, no Resettlement or Rehabilitation was carried out for this project as reported. It was observed that the land acquisition process is still underway and certain percentage of land is yet to be acquired for the project.
6.	Ecology and Biodiversity	Safeguard Requirements 1: Environment	The key themes covered are: natural habitat, critical habitat, legally protected areas, international introduction of alien species, and living natural resources (natural and plantation forest, aquatic resources etc.) are sustainably managed.	Applicable. Kambalakonda Wildlife Sanctuary is in close proximity to the road. But no forest land has been acquired for the purpose of the project. However, there could be a risk of roadkill hazard to domesticated animals. Also, periodic Wild animals' encounters cannot be ruled out.
7.	Impact on Ethnic and Indigenous Community	Safeguard Requirements	The key themes covered are: avoidance of adverse impacts, consultation and informed participation, impacts on traditional or	Not applicable

Sl. No.	EHS and Social Aspect under consideration	ADB Safeguard Requirement	Requirements/Tenets of the Safeguard/ PS	Applicability to the Project
		3: Indigenous Peoples Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions 2011	customary lands under use, relocation of IPs from traditional or customary lands, and cultural resources.	It was reported by site representatives that no tribal land was acquired for this project and no Scheduled Tribe (ST) population (falling within the definition of Indigenous People) was affected from the acquisition process. Furthermore, the project alignment doesn't pass through any of the Vishakhapatnam District Mandals that have been classified as Vishakhapatnam Agency areas (protected tribal areas)
8.	Local Cultural Heritage and Traditions	Safeguard Requirements 3: Indigenous Peoples Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions 2011	Cultural heritage refers to (i) tangible forms of cultural heritage; (ii) unique natural features or tangible objects that embody cultural values; and (iii) certain instances of intangible forms of culture that are proposed to be used for commercial purposes.	Applicable The project has affected multiple religious structures falling within the alignment and ROW which has demolition and relocation of these structures.

4. Environmental and Socio-Economic Baseline

This section of the report presents information on the baseline condition of the physical, chemical, biological and social environment within the Project influence area. The baseline information were collected through primary surveys, discussion with project staffs, regulatory authorities, and scientific literature (both published and unpublished), engineering studies and technical reports. Activities that facilitated establishment of the baseline data in the report include site survey, ecological survey, environmental monitoring, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department (IMD) and Census of India amongst others.

4.1 Physiography

Visakhapatnam district is one of the north coastal districts of Andhra Pradesh. The district is situated between the Eastern Ghats and Bay of Bengal. Paderu and Araku in the district are having broad picturesque valleys with an altitude of about 900 meter (m) Above Mean Sea Level (AMSL). Araku valley is inhabited by aboriginal tribes with different sects. The Araku valley is famous for its beauty, bracing climate and orchards.

4.2 Drainage

The most important rivers drained in the district are Machikund, Tandava, Varaha, Sarada and Gostani. Most of the rivers are ephemeral in nature. However, some of the tributaries of Machikund are perennial with indications of substantial ground water discharge. Almost all the rivers and streams experience flash floods during rainy season. A good number of springs exist in Paderu and Araku areas. The district is characterized by sub-dendritic to dendritic nature of drainage pattern and is of course texture. In general, the density is in the range of 0.6 to 1/ square kilometer. Many of the hill streams in Paderu valley disappear on entering the plains due to high permeability of the pediment gravels. The disappearance of streams in and along the hill slopes is contributing to the ground water, which is again discharged through the silty soils at lower elevations.

4.3 Land use and Land Cover

The Land Use and Land Cover (LULC) of the Project area were determined for 5 km radius along the road asset from the centre of the carriageway. LULC was classified for following categories (Refer Table 4-1) based on the ResourceSat1 LISS III satellite data and Google Earth Imageries. Based on the geographic coordinates of the Project area, the satellite imagery was geo-registered and geo-referenced with respect to limited control points from GPS. Satellite images were processed in ERDAS for preparation of land use land cover using classification technique. The digitally classified map was verified for the accuracy assessment for major land-use classes present in the study area and accordingly, land use land cover map has been finalized.

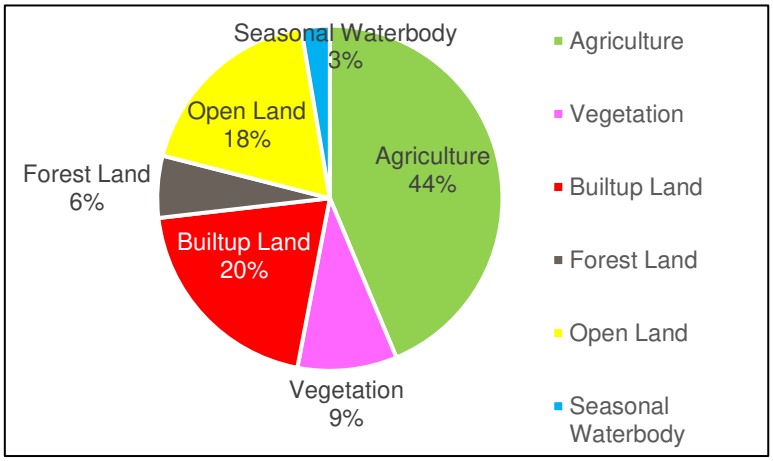

Figure: Area of Land use

Table 4-1: Land Use and Land Cover

Sl. No	Land use Class	Total Area (sq.km)	Percent Area
1.	Agriculture	96.04	43.70
2.	Vegetation	20.50	9.32
3.	Built-up Land	44.29	20.15
4.	Forest Land	12.76	5.80
5.	Open Land	40.36	18.36
6.	Seasonal Waterbody	5.86	2.67
7.	Grand Total	219.81	100

The LULC map is shown in above, Figure 4-1 and presented in Table 4-1. The Project alignment traverses mostly through agricultural fields followed by built up area comprising of rural/ semi-urban settlements.

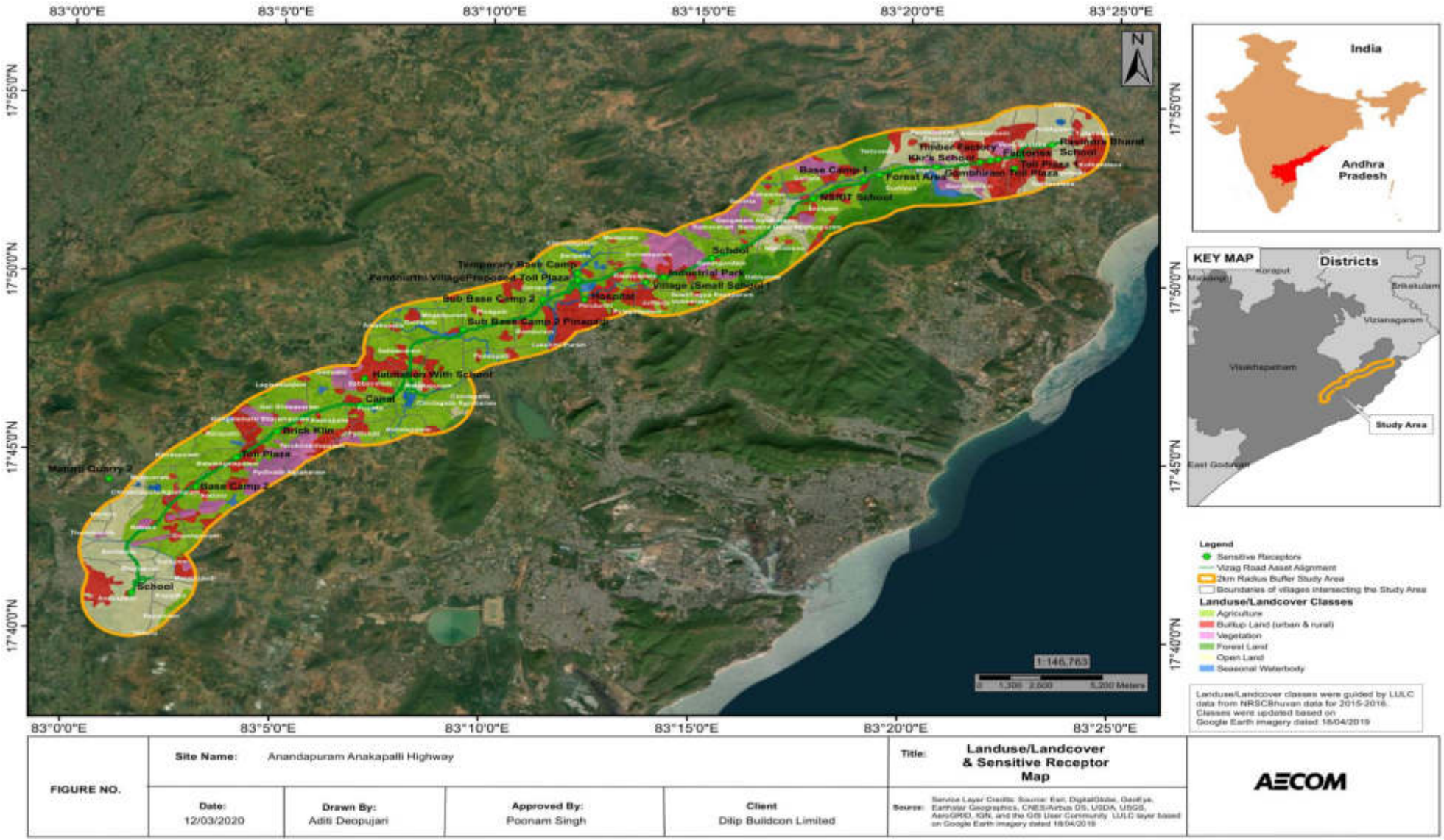

Figure 4-1: Land use and Land Cover

4.4 Geomorphology and Soil

Geomorphologically the Visakhapatnam district can be divided into three regions, viz., Northern hilly terrain with valleys, Middle pediplains and Alluvial coastal plains. The northern half of the district is mainly occupied by the structural hills and valleys, which is part of the Eastern Ghats. The hill range trends parallel to the coast. The average altitude of hills is over 900 m AMSL and the hills are densely forested. By virtue of their topography, these hilly terrains largely form run off areas and are not suitable for ground water development. The valley areas underlain by weathered formations in the Araku and Paderu areas possess high infiltration and high permeability. These areas form good to moderate aquifers depending on their thickness. There is not much surface drainage in the plains because of the high infiltration and permeable characteristics of the sediments. The district has a coastline of about 132 km. The coastal plain is a feature of the marine deposition, which is very extensive, wide and even extends to several kilometres inland. The coastline is broken by a number of bold headlands, which protect the land against constant erosion by the sea.

The different soils in the district are red loams, sandy loams, sandy soils and black cotton soils. Red loamy soils are predominating and occupy about 70% in the district and predominant in Project area. Sandy loamy soils are largely confined to the coastal areas and to certain stretches in the interior *mandals* of Chodavaram, Narsipatnam, K.Kotapadu and Madugula. Black cotton soils occur in parts of K.Kotapadu, Devarapalli, Chedikada, Paderu and Hukumpeta mandals.

4.5 Hydrogeology

The district is underlain by variety of geological formations from the oldest Archaeans to recent alluvium. The Archaean group of rocks includes Khondalites and Charnockites of Eastern Ghat super group and Granitic gneisses of Migmatite group. The Gondwana rocks which are represented by sandstones are in very limited aerial extent. The recent alluvium is prevalent along the rivers. Prominent lineaments are trending in NE-SW, NW-SE and ENE-WSW. Figure 4-2 represents the Hydrogeology in Vishakhapatnam district.

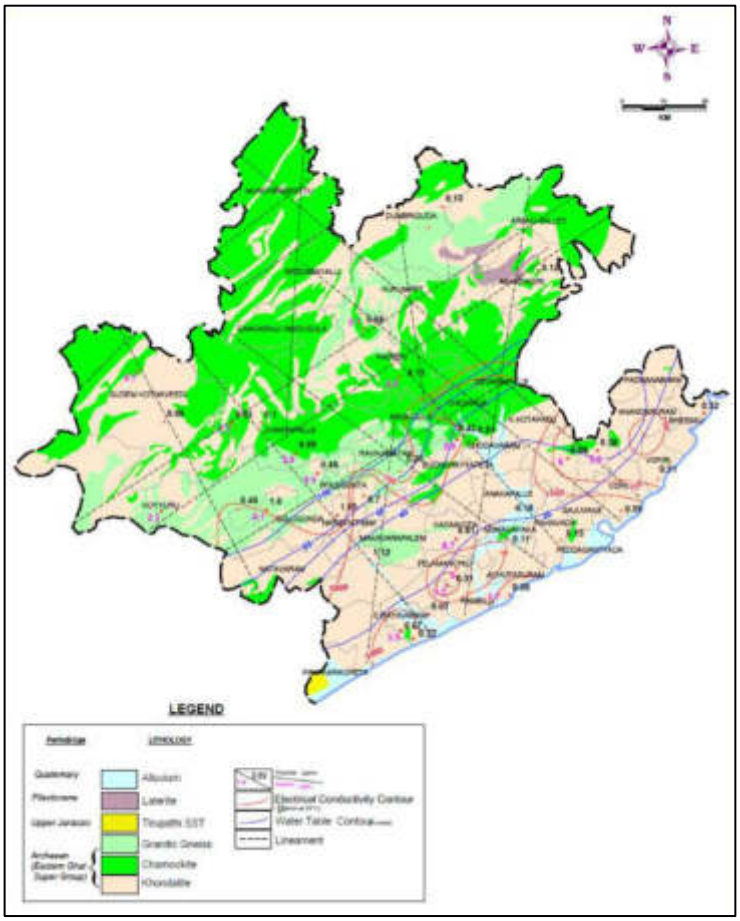

Figure 4-2: Hydrogeology in Vishakhapatnam District

Ground Water

Ground water occurs in almost all geological formations. From the ground water point of view, the aquifers in the district can be broadly classified into hard formations (khondalites, charnockites, granitic gneisses etc.) and soft formations (sand stones and alluvium). Ground water occurs under unconfined to semi-confined conditions in the hard formations, while it occurs under unconfined to confined conditions in soft formations. The yields in the weathered zones of hard formations range from 25 to 100 m^3/day. The borewells drilled in the hard formations, generally tap the fractured and fissured zones. The yields of the borewells in these formations range between 5 to 25 m^3/hr. Sand stones are exposed in the small isolated places around Nakkavanipalem and Elamanchili. In these formations, ground water occurs under both unconfined and confined conditions. The depth of borewell in alluvium formations ranges from 2 to 10 meters below ground level (mbgl) and the yields generally ranges from 40 to 250 m^3/day. The depth of tube well varies from 9 to 35 m with discharges ranging from 15 to 30 m^3/hour. The transmissivity values of the aquifers in the consolidated formations generally vary from 1 to 772 m^2/day.

Water Level Scenario

Based on the water level data (2012) of ground water monitoring wells, pre and post monsoon depth to water levels maps are represented in Figure 4-3 and Figure 4-4 respectively. The depth to water level maps shows varied water level zones due to underlying terrain and also different geological set up with complex type of hydrogeomorphic structures present in the district.

Pre-monsoon (May 2012) depth to water level map reveals, in general, the water levels are deep particularly in the hilly area of the district. Depth to water levels varies from 5 to 10 mbgl, except at Chintapalli, where water level recorded 15.78 mbgl. In the southern part of the district i.e., near to the coast, the water levels are comparatively shallow (<5.00m) except in Payakaraopeta and Nakkapalli *mandals* where it is in between 5 and 10 mbgl.

During the post monsoon period (November 2012), in general, the water levels follow nearly same trend. Water levels in the most part of northern area show less than 5 m except at Potinamallaya Palem (5.8 m). The shallow water levels, <2m, were observed in South-Western part of the district. The shallow water level was recorded at Addaroddu (0.30 m). The shallow water levels in the area might be due to location of wells close to surface water bodies/ in topographic low levels. From the trend of both pre and post monsoon levels it can be safely concluded that the Project area, in general, is not prone to water logging.

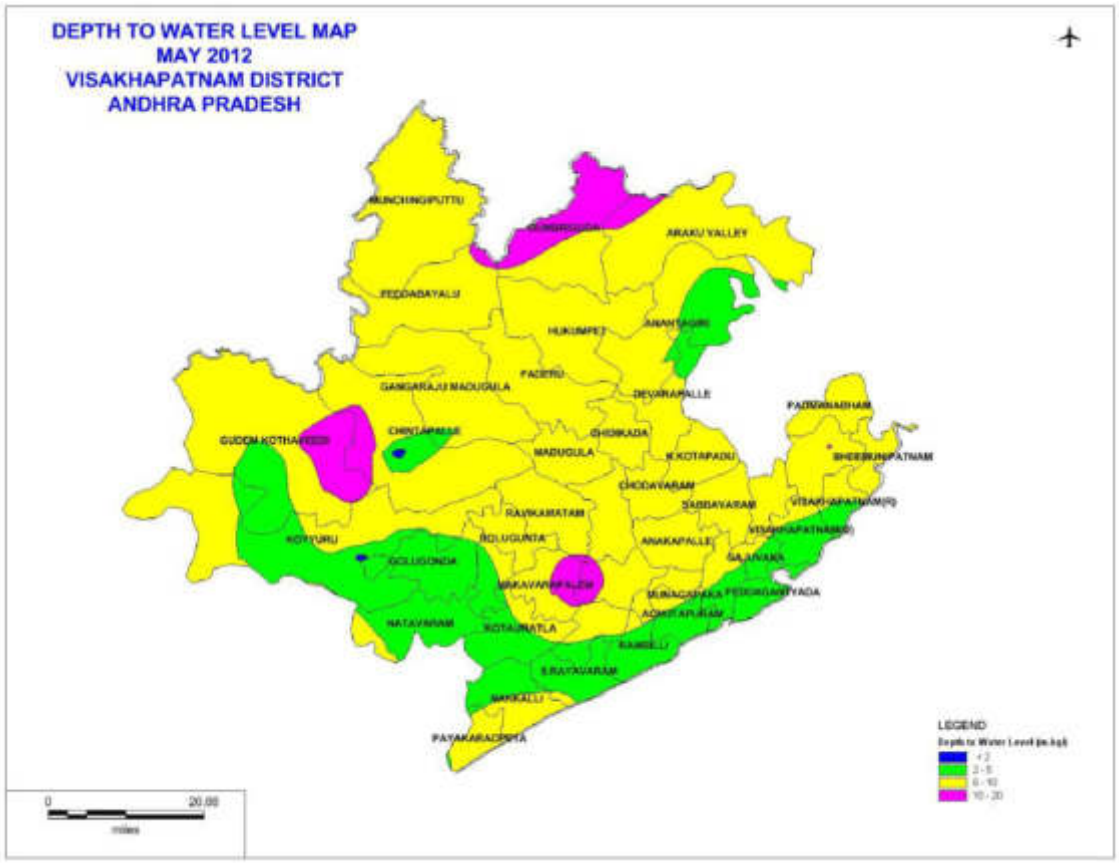

Figure 4-3: Depth to Water Level – Pre-Monsoon (May 2012)

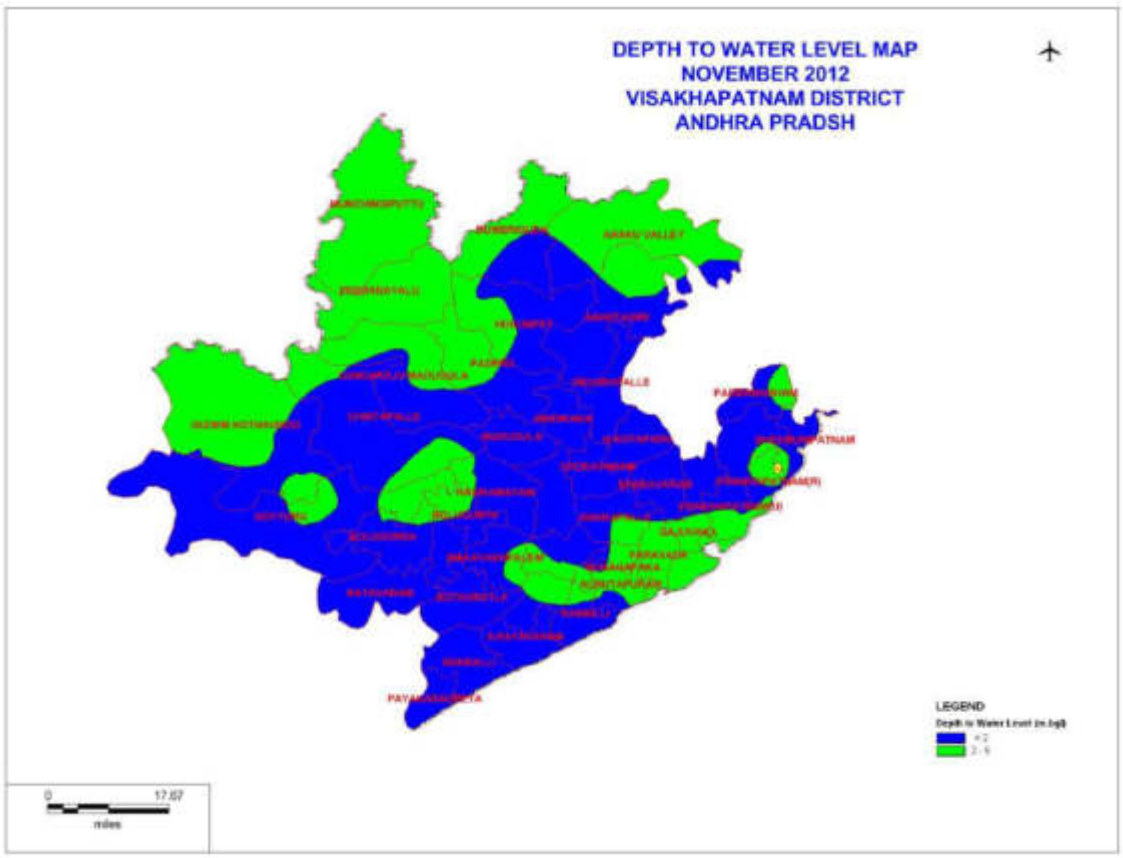

Figure 4-4: Depth to Water Level – Post-Monsoon (Nov 2012)

4.6 Climate and Rainfall

The climate of the Project area is characterised by high humidity almost throughout the year with oppressive summer. The summer season extends from mid-February to first week of June. This is followed by south-west monsoon season lasts up to end of September. October and November constitute the post monsoon period. December to mid-February is winter season with fine weather conditions.

Since the project runs parallel to coast, therefore, the temperature variation is similar to Visakhapatnam. The difference between daily maximum and minimum temperature is very less. Before onset of monsoon, maximum temperature is recorded in the month of May or early part of June. After withdrawal of south-west monsoon in early October, temperature begins to decrease progressively. Generally, May is the hottest month with temperature of 43^0C and December is the coldest month with daily mean temperature of 19^0C. The maximum rainfall in the region occurred from July to December. About 72% rainfall occurred during south-west monsoon. The project road being near coast experiences higher relative humidity. Minimum relative humidity has been recorded in June (62%) followed by May (70%). The maximum relative humidity has been recorded in December (more than 80%).

4.7 Natural Disasters

4.7.1 Wind and Cyclone Hazard

The Project location is prone to storms and depressions originating in the Bay of Bengal during the post-monsoon season across the east coast. Thunderstorms are common between March and November. Visakhapatnam being a coastal district in Andhra Pradesh, is frequently subjected to cyclones and storm surge. As per the Wind and Cyclone Hazard Map of India, Visakhapatnam lies in Moderate Risk Zone – B (Vb = 39 m/s), Moderate Risk Zone – A (Vb = 44m/s) and Very High Damage Risk Zone – B (Vb = 50m/s).

Figure 4-5: Wind Hazard Map of India

4.7.2 Flood Risk

The Visakhapatnam district has a coastline of about 132 km which is frequently subjected to cyclones and storm surge. The most important rivers drained in the district are Machikund, Tandava, Varaha, Sarada and Gostani. Most of the rivers are ephemeral in nature. However, some of the tributaries of Machikund are perennial with indications of substantial ground water discharge. Almost all the rivers and streams experience flash floods during rainy season.

4.7.3 Earthquake Risk

As per the Earthquake Hazard Map of India, published by the BMTPC, the project area is located falls in Zone II: Low Damage Risk Zone (MSK VI or Less).

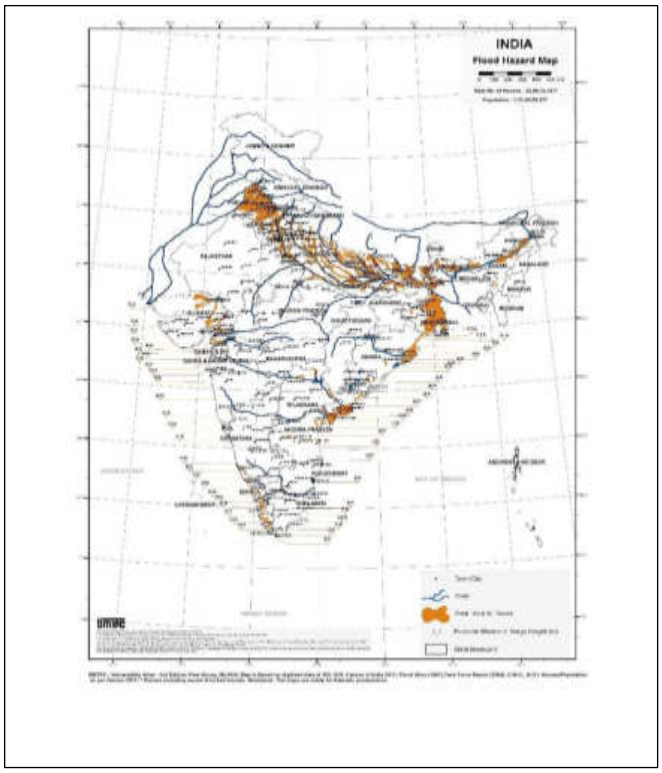

Figure 4-6: Flood Hazard Map of India

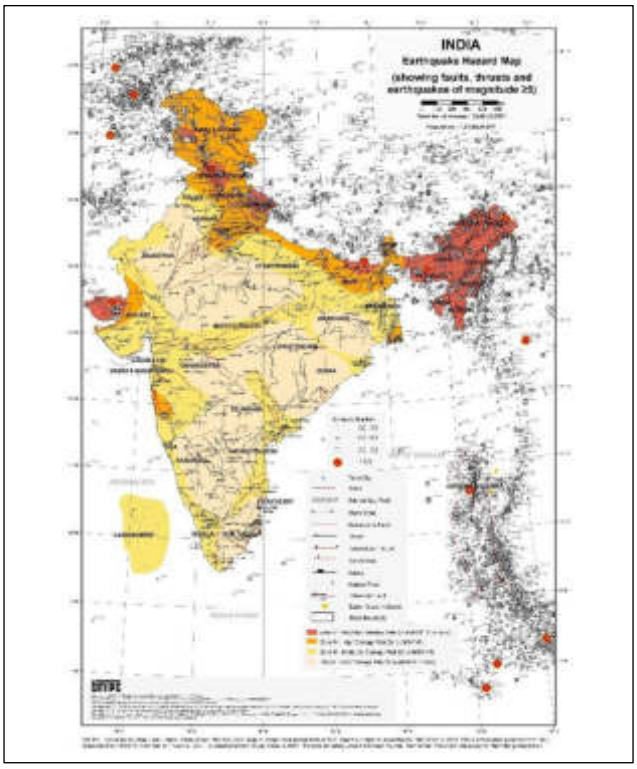

Figure 4-7: Seismic Map of India

4.8 Environmental Baseline

AECOM had appointed Netel (India) Limited to conduct baseline environmental monitoring along the Project road. A two (2) member team of Environment, Health and Safety (EHS) expert from AECOM along with Netel (India) Limited, a National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory carried out environmental monitoring including baseline air, noise meteorological assessment, water quality and soil quality along the Project corridor. The accreditation certificate of Netel from NABL and MoEF&CC along with instrument calibration is attached as Appendix I.

4.8.1 Ambient Air Quality

The air quality of the Project area is influenced by emissions from stationery sources like industries, domestic sources from the various settlements, brick kilns operating in and around the area and mobile sources like transport vehicles plying along various roads. All these sources contribute to the local air shed pollution level to various extents. Further, the local climatic factors induce dispersion of these pollutants to farther areas.

The monitoring locations along the Project road were selected based on the sensitivity of the receptors to vehicular traffic and to obtain baseline concentrations of the various representative land uses. The selection of the receptors was based on the following considerations:

- Covering entire Project road
- Representative location of regional background
- Covering land use characteristics and socio-economic conditions
- Major settlements
- Highway intersections
- Influence on urban activities

In order to establish the baseline air pollution status ambient air quality monitoring was carried out at six (06) locations along the Project Corridor and at two quarry areas (refer Figure 4-9). The results obtained have been shown in Table 4-2.

Amongst the six air quality monitoring stations, the particulate matter (PM) was found to be within permissible concentrations at all places. The maximum values found at Pendurthi village and near Gambhiram toll plaza due to presence of other polluting activities like commercial development and presence of mixed landuse in the vicinity. It is seen, that the present PM_{10} level is in a safer range from 50.6 µg/m^3 to 70.8 µg/m^3 and anticipated that widening of the road will lead to lower levels of particulate matter for the same volume of traffic, due to reduced congestion at these locations. The $PM_{2.5}$ level is varying from 18.3 µg/m^3 to 24.9 µg/m^3 which is within the stipulated limit as prescribed under NAAQS.

The SO_2 level was found to vary in the range of 6.5- 12.8µg/m^3. None of the locations recorded higher SO_2 levels with respect to National Ambient Air Quality Standards (NAAQS) for residential, industrial, rural and other areas.

The NOx level was found to vary in the range of 11 - 19 µg/m^3 along the Project road. Anandapuram village recorded the maximum level followed by Gulapetha and Pendurthi. However, none of the monitoring locations show higher concentration of NOx with respect to National Ambient Air Quality Standards for residential, industrial, rural and other areas.

CO concentration was found to vary in the range 0.65 - 0.98 mg/m^3 in the monitoring locations. It is seen that none of the above locations exceed the NAAQS laid for CO for residential, industrial, rural and other areas.

Lead particulates level was found in the range of 0.1-0.42 µg/m^3 in the monitoring locations. Comparison with NAAQS reveals that none of the sampling locations exceed in lead concentration to prove it hazardous.

Among other pollutants, Benzene, Ammonia, Ozone, Benzo - a - Pyrene (BaP), Arsenic and Nickel all are found to be within NAAQS laid for residential, industrial, rural and other areas. The study area being located close to coastal area, the local climatic factors induce dispersion of these pollutants to farther areas.

Table 4-2: Air Monitoring Location

Date of Sampling	Unit	Duration	NAAQS	Ravindra Bharat School	Anandapuram Village	Near Gambhiram Toll Plaza	Base Camp 1	Pendurthi Village	Maturu Quarry	Batajangpalem Village	Vavilpadu Quarry
Location Code	-		-	AAQ1	AAQ2	AAQ3	AAQ4	AAQ5	AAQ6	AAQ7	AAQ8
Chainage				681+400 (LHS)	682+900 (RHS)	686+900 (RHS)	689+800 (RHS)	704+000 (LHS)		724+500 (LHS)	
Date of Monitoring	-		-	2 Mar 2020	5 Mar 2020	4 Mar 2020	3 Mar 2020	4 Mar 2020	5 Mar 2020	6 Mar 2020	1 Mar 2020
Particulate Matter (PM_{10})	$\mu g/m^3$	24 Hours	100	59.7	66.8	70.8	52.9	60.4	57.8	53.4	50.6
Particulate Matter ($PM_{2.5}$)	$\mu g/m^3$	24 Hours	60	18.3	24.9	21.4	24.3	24.5	22.3	19.2	19.8
Sulphur Dioxide (SO_2)	$\mu g/m^3$	24 Hours	80	9.0	11.9	7.8	12.7	12.8	6.5	10.8	8.6
Oxides of Nitrogen (NO_x)	$\mu g/m^3$	24 Hours	80	11.8	19.0	11.0	12.7	12.7	14.1	14.0	11.8
Carbon Monoxide (CO)	mg/m^3	8 Hours	2	0.79	0.69	0.68	0.94	0.98	0.65	0.87	0.96
Benzene (C_6H_6)	$\mu g/m^3$	24 Hours	5	2.3	3.8	3.3	4.2	3.8	3.3	3.1	2.8
Ammonia (NH_3)	$\mu g/m^3$	24 Hours	400	12.4	12.6	10.4	14.1	17.9	12.2	14.4	16.2
Ozone (O_3)	$\mu g/m^3$	8 Hours	100	8.7	9.1	7.4	12.1	11.4	7.4	12.0	6.9
Benzo - a - Pyrene (BaP)	ng/m^3	24 Hours	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead (Pb)	$\mu g/m^3$	24 Hours	1	0.20	<0.1	<0.1	0.42	<0.1	0.29	0.26	<0.1
Arsenic (As)	ng/m^3	24 Hours	6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nickel (Ni)	ng/m^3	24 Hours	20	1.16	1.26	1.05	1.44	1.88	1.31	1.36	1.17

Source: Primary Environmental Monitoring, March 2020

4.8.2 Ambient Noise Quality

The baseline noise monitoring was conducted at sixteen (16) locations over a period of 48 hours, split between weekends (Saturday and Sunday) and weekdays (Monday and Tuesday) between 29th February and 4th March 2020.

There are sixteen (16) units of Sound Level Meters (SLM), were mounted on a tripod and positioned about 1.5 m above ground level. Finally, before taking down the equipment and leaving the site, be sure to record all needed information on the data sheet and take any needed site photographs.

The measured sound level data are compiled in a noise study report table including site number, site address, date, time duration, Leq etc. Meteorological conditions (data) have also been recorded. The monitoring locations along with its justification is provided in Table 4-3 and represented in Figure 4-9.

During site visit, chainage wise sensitive areas along the Project road were identified based on sensitive receptors categorised as per Guidelines on Community Noise WHO 1999 such as group of dwellings, schools and preschools, hospitals, parkland and conservation areas etc.

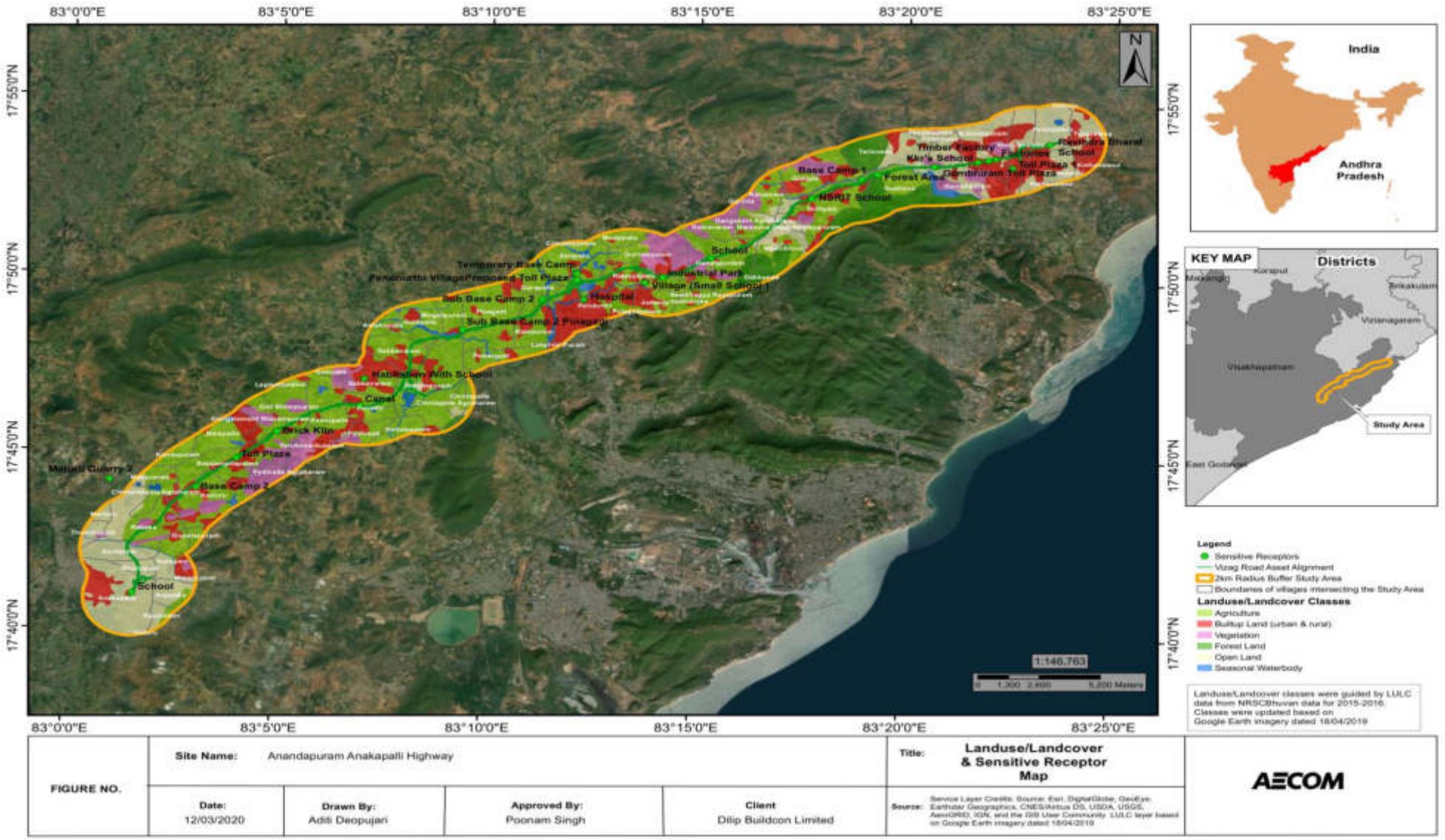

Figure 4-8: Sensitive Receptors along the Project Alignment

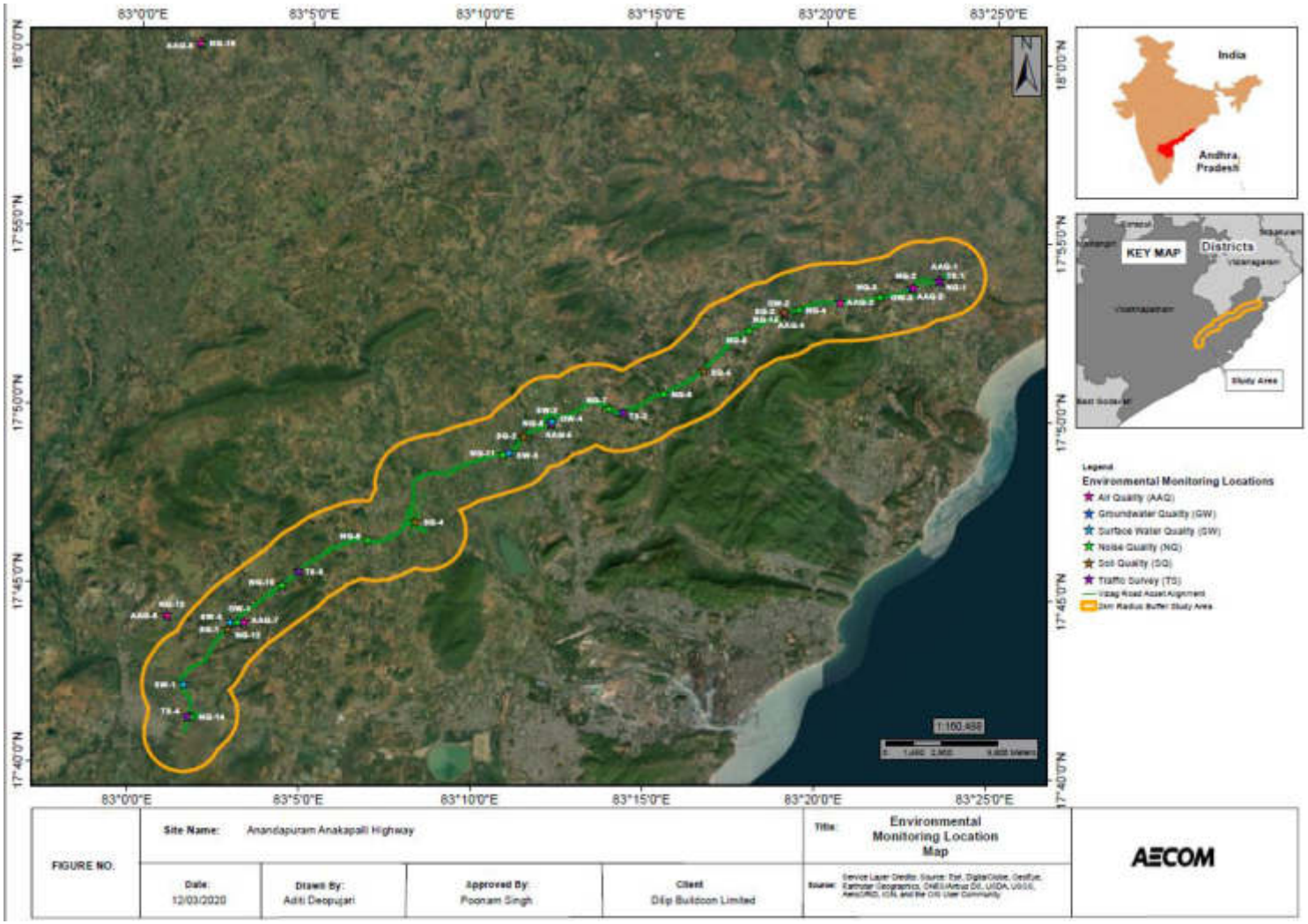

Figure 4-9: Location of Monitoring Stations

Table 4-3: Noise Monitoring Location- Site section

Sl. No	Noise Quality Location	Location Name	Chainage	Coordinates	Surrounding Land use	Type of Receptor	Justification for site selection
1)	NQ 1	Ravindra Bharat School	681+400 (LHS)	17°53'56.44"N 83°23'24.58"E	Open land use and Residential	Silence Zone	This area is near Vellanki village near start of Project road. Though the broad land-use is residential and open area, there is a school located on LHS. This location covers Ravindra Bharat School which represents a sensitive receptor. The school boundary is located about 33 m from the road centerline and actual school is approximately 90m from centerline. The site was selected for air and noise monitoring as this represents sensitive receptor and access to power supply for air sampler. Monitoring was conducted on boundary and main gate of the school at a distance of about 35m from road centerline.
2)	NQ 2	Anandapuram Village	682+900 (RHS)	17°53'44.63"N 83°22'39.11"E	Commercial and Residential	Residential	This is a major commercial cum residential establishment along the Project road, which is Anandapuram village. The first row of houses on ground floor represents commercial activities while the first floor is put to residential use. AECOM also observed that informal daily market (haat) happens in morning (7 AM to 12 PM) in addition to usual business activities in and around the village. The Project road will be at grade with height of approximately 5-6m. The site was selected for air and noise monitoring as this represents commercial land use and access to power supply for air sampler. Monitoring was conducted on first floor (12 feet) of a house on first row just after the RoW at a distance of about 35m from road centerline.
3)	NQ 3	KKR Gautham school	684+800 (RHS)	17°53'27.91"N 83°21'41.54"E	Residential cum commercial	Silence Zone	This area is near proposed Gambhiram toll plaza and represents open area with two small factories. The area has KKR Gautham school is located near the road. The school boundary is located about 30 m from the road centerline and actual school is approximately 50m from centerline. The site was selected for noise monitoring as this represents a varied land use including a sensitive receptor. Monitoring was conducted on school KKR boundary at a distance of about 30m from road centerline. Also, air monitoring was conducted as power supply was made available.
4)	NQ 4	Near Kambalakonda forest/ Wildlife Sanctuary	689 (LHS)	17°53'2.92"N 83°19'20.28"E	Open Land	Silence Zone	This is an open area, no close by receptors (near forest area). A hillock present on left hand side of road which is Kambalakonda forest and Wildlife Sanctuary at a distance of beyond 40m. The It is open area with a small hillock on left hand side. The forest is not affected by the Project road. Though there are no receptors, noise monitoring was conducted beyond RoW at a distance of about 35 m to record the baseline data.

Sl. No	Noise Quality Location	Location Name	Chainage	Coordinates	Surrounding Land use	Type of Receptor	Justification for site selection
5)	NQ 5	NSRIT School	691+900 (RHS)	17°52'27.80"N 83°17'52.80"E	Residential	Silence Zone	This area is primarily a scattered residential area and NSRIT School boundary is located along the highway at a distance of about 35m and actual school is approximately 110m from centerline.
6)	NQ 6	Gandigundam Village	697+500 (LHS)	17°50'38.46"N 83°15'26.14"E	Residential	Residential	This location is Gandigundam village located next to ROW. There are scattered houses and a village school was seen nearby. Noise monitoring was conducted at a distance of approximately 35m from centerline and represents residential zone.
7)	NQ 7	Mudapaka Village (Bypass)	700+600 (LHS)	17°50'10.99"N 83°13'50.18"E	Residential	Residential	This location is Akkiredi (Mudapaka) on Pendhurthi Bypass. Presently the bypass construction work is progress and vehicles are not plying. On LHS there are many houses and on RHS tree plantations. There were no major noises sources on day of monitoring. This area represents pristine residential zone and noise monitoring was conducted at a distance of about 35m from centerline after RoW.
8)	NQ 8	Pendhurthi Village	704+000 (LHS)	17°49'43.47"N 83°12'9.63"E	Commercial	Commercial	Pendhurthi represents extremely heavy habitation with all kinds of receptors including residences, hospitals, market, schools etc. in the main town. A bypass is proposed adjacent to the town. Noise monitoring was conducted at a marketplace above first floor of market complex. The monitoring location and the surrounding 200m were observed to be commercial area and hence this location has been categorized as commercial area and not mix land use. The proposed bypass would intercept the crossroad at the monitoring location. The Project road will be at grade with height of more than 6m above the crossroad. This noise and air monitoring location represents commercial zone with lots of varied activities.
9)	NQ 9	Asakapalli Village	716+400 (RHS)	17°46'22.29"N 83° 6'52.93"E	Residential	Residential	This location is Asakapalli village located after ROW. There are scattered houses located approximately 50-150 m from road centerline. Noise monitoring was conducted at a distance of approximately 35m from centerline and represents residential zone.
10)	NQ 10	Batajangpalem (Pallavanipalem Village)	721+500 (RHS)	17°45'4.56"N 83° 4'24.52"E	Residential	Residential	This location is Batajangpalem (also known as Pallavanipalem village) village. The houses are located approximately 50-100 m from road centerline. Noise monitoring was conducted at a distance of approximately 35m from centerline and represents residential zone.
11)	NQ 11	Rampuram Village	707+000 (LHS)	17°48'50.03"N 83°10'46.22"E	Residential	Residential	This location is Rampuram village. Noise monitoring was conducted at a distance of approximately 35m from centerline and represents residential zone.

Sl. No	Noise Quality Location	Location Name	Chainage	Coordinates	Surrounding Land use	Type of Receptor	Justification for site selection
12)	NQ 12	Base Camp 2	724+500 (LHS)	17°44'0.34"N 83° 3'8.05"E	Open land	Industrial	The Base Camp 2 houses crusher plant, batching plant, construction equipment's etc. and the second campsite with labor facilities, construction work and material stockyard. There is no residential houses located close by. A village is located beyond base camp 2 at a distance of about 100m. This base camp will continue to function till end of construction period and after that it will be decommissioned. Noise monitoring was conducted to capture baseline data and represents industrial land use.
13)	NQ 13	Maturu Quarry	-	17°44'9.14"N 83° 1'3.58"E	Industrial	Industrial	Maturu quarry area is about 3-4 km away from the Project road and is a source of construction material for the Project. the quarry area is located approximately 250-350 m from Maturu Village. This is a secluded area. The site was selected for air and noise monitoring as this represents industrial receptor and access to power supply for air sampler. Further, a baseline data has been generated for this location.
14)	NQ 14	Anakapalle Village	730+800 (LHS)	17°41'20.00"N 83° 1'48.96"E	Industrial	Industrial	The location represents lot of developments in and around the area with primarily mixed land use along with few small industries, parking of vehicles and end of Project road. Near Anakapalle one educational institution, Dadi Institute of Engineering and Technology located about 700 m from road (boundary wall at 40m from centerline). This site represents mixed landuse and can be considered as industrial in nature.
15)	NQ 15	Base Camp 1	689+800 (RHS)	17°52'55.47"N 83°18'54.31"E	Open land	Industrial	The Base Camp 1 houses crusher plant, batching plant, construction equipment's etc. and the second campsite with labor facilities, construction work and material stockyard. There is no residential houses located close by. This base camp will continue to function till end of construction period and after that it will be decommissioned. Noise and air monitoring was conducted to capture baseline data and represents industrial land use.
16)	NQ 16	Vavilpadu Quarry labor Camp	-	18° 0'9.27"N 83° 1'45.19"E	Industrial	Industrial	Vavilpadu quarry area is more than 30 km away from the Project road and is a source of construction material for the Project. The labor camp is located approximately 850 m from the quarry area. The site was selected for air and noise monitoring as this represents industrial receptor, and access to power supply for air sampler and to capture baseline data.

Table 4-4: Noise Monitoring Results for Weekend

Location Code	Location	Zone	IFC and World Bank Guidelines		WHO 1999 Standards[4]	NAAQS		day Time dBA (Leq)	Night Time dBA (Leq)	Lmin	Lmax	Leq
			Day Time	Night-time	LAeq dB(A)	Daytime (Ldn) dB (A)	Night-time dBA (Leq)					
NQ 1	Ravindra Bharat School	Silence Zone	55	45	55[5]	50	40	61.4	59.6	58.2	63.2	60.9
NQ 2	Anandapuram Village	Residential	55	45	55[6]	55	45	60.4	55.3	52.1	63.4	59.4
NQ 3	KKR Gautham school	Silence Zone	55	45	55	50	40	51.3	46.3	45.2	54.3	50.3
NQ 4	Near Kambalakonda Wildlife Sanctuary	Silence Zone	55	45	-[7]	50	40	53.9	50.7	39.5	59.9	53.2
NQ 5	NSRIT School	Silence Zone	55	45	55	50	40	53.3	49.9	45.2	58.2	52.6
NQ 6	Gandigundam Village	Residential	55	45	55	55	45	65.9	63.1	59.4	69.6	65.2
NQ 7	Mudapaka Village (Bypass)	Residential	55	45	55	55	45	50.3	44.5	37.5	56.0	49.2
NQ 8	Pendhurthi Village	Commercial	70	70	70[8]	65	55	72.7	68.1	62.5	79.7	71.7
NQ 9	Asakapalli Village	Residential	55	45	55	55	45	57.5	47.9	43.1	63.7	56.2
NQ 10	Pallavanipalem Village	Residential	55	45	55	55	45	58.6	56.7	52.4	62.1	58.1
NQ 11	Rampuram Village	Residential	55	45	55	55	45	61.6	56.2	54.4	64.5	60.6
NQ 12	Basecamp 2	Industrial	70	70	70	75	70	63.0	56.5	48.5	69.1	61.9
NQ 13	Maturu Quarry	Industrial	70	70	70	75	70	60.1	58.0	49.7	67.0	59.6
NQ 14	Anakapalle Village	Industrial	70	70	70	75	70	57.1	55.6	46.9	60.9	56.7
NQ 15	Base Camp 1	Industrial	70	70	70	75	70	53.9	51.5	46.9	60.6	53.4
NQ 16	Vavilpadu Quarry labor Camp	Industrial	70	70	70	75	70	66.9	61.9	59.3	75.5	66.0

[4] https://www.who.int/docstore/peh/noise/Comnoise-4.pdf
[5] As per WHO specific Environment: School, playground outdoor
[6] As per WHO specific Environment: Outdoor living area
[7] As per WHO specific Environment: Background noise should be maintained.
[8] As per WHO specific Environment: Industrial, commercial, shopping and traffic areas, indoors and Outdoors

Noise Analysis for weekend

Table 4-4 shows the measured noise levels at each of the monitoring stations during the weekends. The plots of noise levels against the National Ambient Air Quality Standards (NAAQS) in respect of noise for Day and Night are shown in Figure 4-10 and Figure 4-11 respectively. The major inferences are drawn below:

- The measured noise levels at a few sampling stations were higher than the prescribed noise limit. These include a considerable noise levels at NQ 1, NQ 6 and NQ 8,
- At locations NQ 2, NQ 3, NQ 4, NQ 5, NQ 9, NQ 10 and NQ 11 the difference in noise level as compared to NAAQS is minimal.
- Apart from this all other locations such as, , NQ 7, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits.
- Intermittent high noise levels greater than the ambient standards were primarily due to due to passing vehicles, construction machineries, habitation noise etc. and from other noise sources (playing of children and other background noise).
- The measurements were done at locations adjacent to roads wherein noise from vehicles were the significant sources along with other sources such as base camps (housing crusher, RMC plant, DG set etc.) and quarry area etc.
- In accordance with the IFC and World Bank Guidelines and WHO 1999 Standards NQ1, NQ2, NQ 6, NQ8, NQ9, NQ10, NQ11 were observed to be higher than the prescribed limits. Whereas NQ 3, NQ 4, NQ 5, NQ 7, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits.

At night-time in which noise levels are expected to be lower, reduction in noise levels are seen at all location as compared to daytime noise levels. The locations that show an acute noise level higher than the permissible limits are NQ 1, NQ 6 and NQ 8, where as a minuscule difference higher then permissible limit is observed at locations NQ 2, NQ 4, NQ 5, NQ 8, NQ 9, NQ 10 and NQ 11. All other locations were observed to be within permissible limits.

In accordance with the IFC and World Bank Guidelines NQ 7, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits. All other locations were observed to be higher than the prescribed limits.

Whereas as per WHO 1999 Standards NQ1, NQ6, NQ8, NQ10, NQ11 were observed to be above prescribed limits, whereas all other locations were within permissible limits.

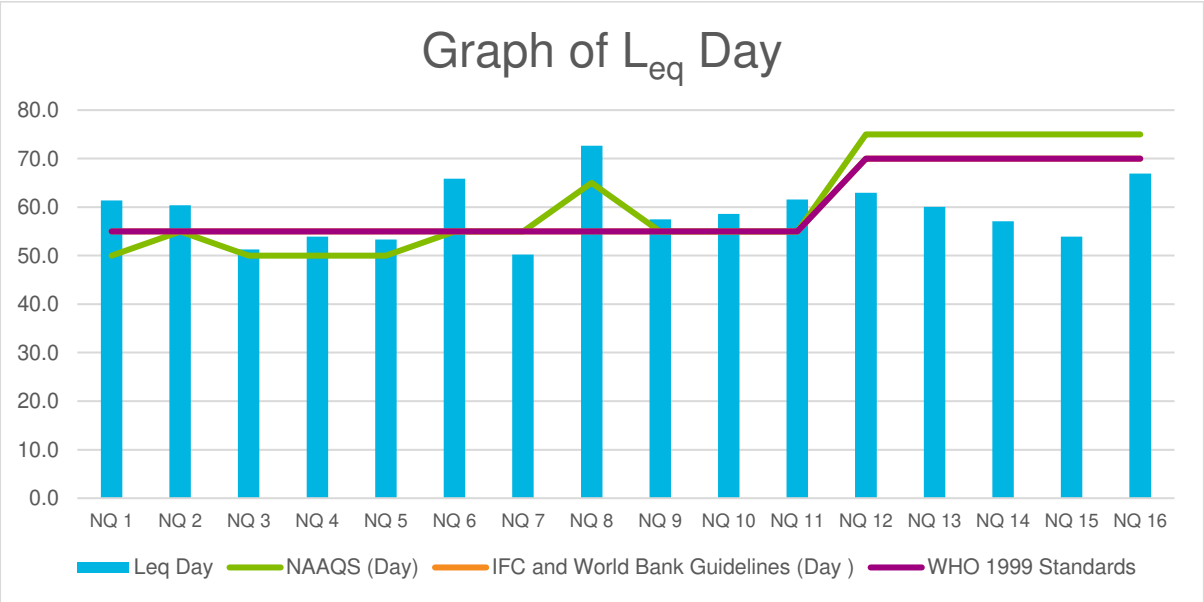

Figure 4-10: Noise Monitoring Results for L_{eq} Day Weekend

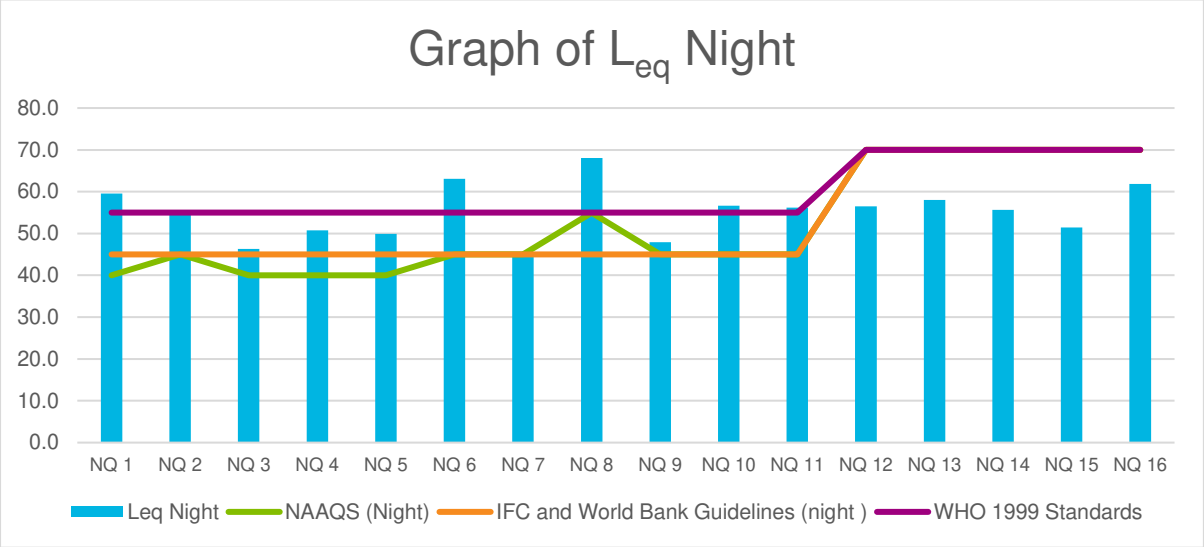

Figure 4-11: Noise Monitoring Results for L_{eq} Night Weekend

Table 4-5: Noise Monitoring Results for Weekday

Location Code	Location	Zone	IFC and World Bank Guidelines		WHO 1999 Standards	NAAQS		Daytime dB(A)	Night times dB(A)	Lmin	Lmax	Leq
			Day Time	Night-time	LAeq dB(A)	Daytime (Ldn) dB (A)	Night-time dBA (Leq)					
NQ 1	Ravindra Bharat School	Silence Zone	55	45	55	50	40	67.2	65.1	62.5	69.9	66.7
NQ 2	Anandapuram Village	Residential	55	45	55	55	45	61.2	59.9	56.2	64.7	60.9
NQ 3	KKR Gautham school	Silence Zone	55	45	55	50	40	58.0	53.1	43.7	68.8	57.0
NQ 4	Near Kambalakonda Wildlife Sanctuary	Silence Zone	55	45	55	50	40	53.0	50.4	45.8	58.3	52.4
NQ 5	NSRIT School	Silence Zone	55	45	55	50	40	49.5	44.5	42.6	51.3	48.5
NQ 6	Gandigundam Village	Residential	55	45	55	55	45	66.5	61.6	57.3	69.4	65.5
NQ 7	Mudapaka Village (Bypass)	Residential	55	45	55	55	45	52.3	49.0	40.6	55.6	51.6
NQ 8	Pendhurthi Village	Commercial	70	70	70	65	55	73.5	68.7	57.9	77.2	72.6
NQ 9	Asakapalli Village	Residential	55	45	55	55	45	57.6	53.5	49.8	60.1	56.7
NQ 10	Pallavanipalem Village	Residential	55	45	55	55	45	57.0	46.6	37.1	63.5	55.7
NQ 11	Rampuram Village	Residential	55	45	55	55	45	61.2	52.5	49.0	65.7	60.0
NQ 12	Basecamp 2	Industrial	70	70	70	75	70	62.6	55.4	48.5	68.3	61.4
NQ 13	Maturu Quarry	Industrial	70	70	70	75	70	60.0	60.2	53.2	65.3	60.1
NQ 14	Anakapalle Village	Industrial	70	70	70	75	70	57.0	49.7	42.6	59.9	55.9
NQ 15	Base Camp 1	Industrial	70	70	70	75	70	57.0	56.4	47.9	61.2	56.8
NQ 16	Vavilpadu Quarry labor Camp	Industrial	70	70	70	75	70	62.1	60.1	59.3	68.0	61.6

Noise Analysis for weekday

Table 4-5 shows the measured noise levels at each of the monitoring stations during the weekdays. The plots of noise levels against the NAAQS standards for Day and Night are shown in Figure 4-12 and Figure 4-13 respectively. The major inferences are drawn below:

- The measured noise levels at a few sampling stations were higher than the prescribed limit of ambient Noise. These include a considerable noise levels at NQ 1, NQ 6 and NQ 8,
- At locations NQ 2, NQ 3, NQ 4, NQ 9, NQ 10 and NQ 11 the difference in noise level as compared to NAAQS is minimal.
- Apart from this, all other locations such as, NQ 5, NQ 7, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits.
- Intermittent high noise levels greater than the ambient standards were due to passing vehicles, construction machineries, habitation noise etc. and from other noise sources. Measurements were done at locations adjacent to roads wherein noise from vehicles were the significant sources along with other sources such as Base camps (Containing Crusher, RMC plant, DG set etc.) quarry etc.
- In accordance with the IFC and World Bank Guidelines and WHO 1999 Standards NQ1, NQ2, NQ 3, NQ 6, NQ8, NQ9, NQ10, NQ11 were observed to be higher than the prescribed limits. Whereas, NQ 4, NQ 5, NQ 7, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits.

At night-time in which noise levels are expected to be lower, reduction in noise levels are seen at all location as compared to daytime noise levels. Locations that show an acute noise level higher than the permissible limits are NQ 1, NQ 6 and NQ 8, whereas a minuscule difference higher than permissible limit is observed at location NQ 2, NQ 3, NQ 4, NQ 9, NQ 10 and NQ 11. All other locations were observed to be within permissible limits.

In accordance with the IFC and World Bank Guidelines NQ 5, NQ 12, NQ 13, NQ 14, NQ 15 and NQ 16 were within permissible limits. All other locations were observed to be higher than the prescribed limits.

Whereas as per WHO 1999 Standards NQ1, NQ2, NQ6 and NQ8 were observed to be above prescribed limits, whereas all other locations were within permissible limits.

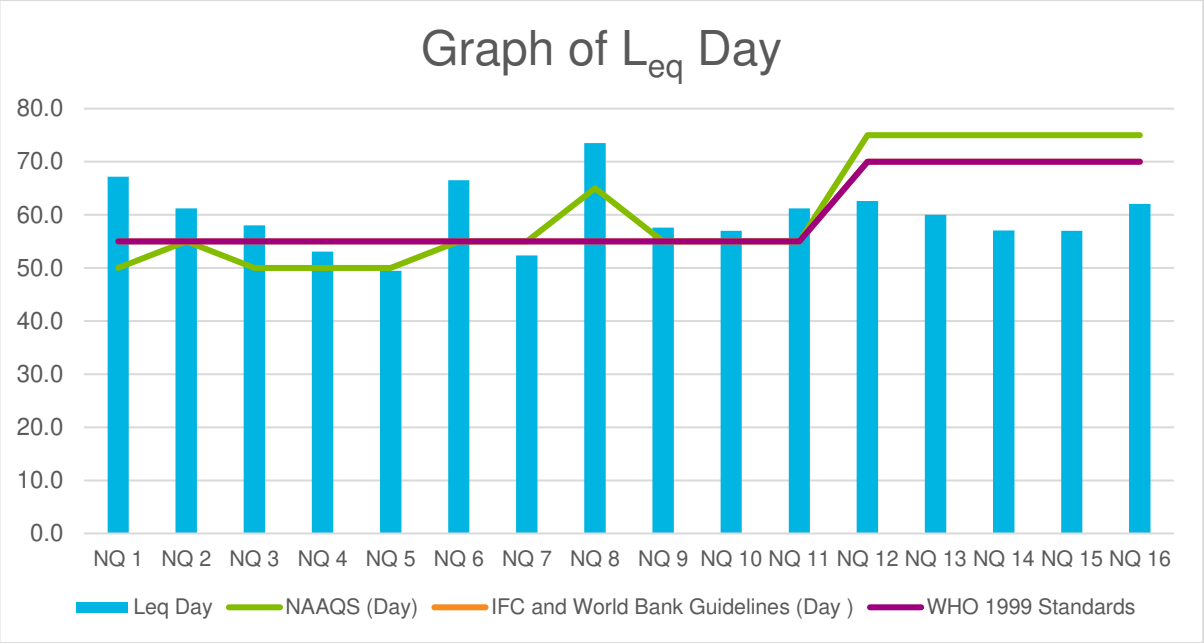

Figure 4-12: Noise Monitoring Results for L_{eq} Day Weekday

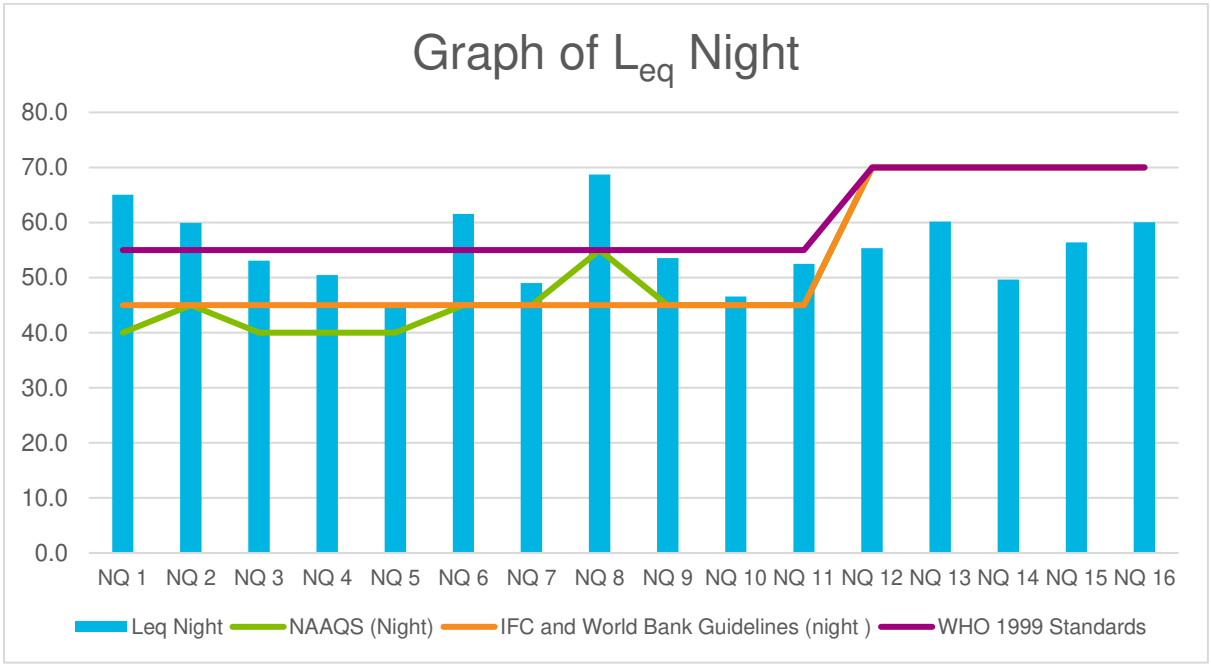

Figure 4-13: Noise Monitoring Results for L_{eq} Day Weekday

4.8.2.1 The Noise Modelling

The Federal Highway Administration's Traffic Noise Model (FHWA TNM) is used in this study to simulate the propagation of construction equipment noise levels to help predict construction operational impacts, where the levels would be implemented in construction noise prediction models or methods. Also, existing noise levels are established during construction; this would help to establish noise levels during the construction phase, particularly for receivers that may be highly noise sensitive.

4.8.2.2 Environmental Considerations

The model inputs were the meteorological parameters (air temperature, humidity, and atmospheric pressure) and simulations were also performed on scenarios with and without noise barrier. Elevation points were derived from the Shuttle Radar Topography Mission (SRTM) data, which were extracted and processed using AERMAP View, a terrain pre-processor of AERMOD View Air Dispersion Modelling. Elevation points (x, y, z) were then imported in AutoCAD and converted to *.dxf (AutoCAD format). The annual average meteorological parameters used in the simulations are given below.

- Air temperature = 28 °C,
- Relative Humidity = 70%; and
- Atmospheric pressure = 1009 mb

Satellite imageries from Google Earth covering the modelling domains were imported in AutoCAD and used as base maps. Houses, commercial buildings, and roads within the modelling domain were digitized in AutoCAD and converted to *.dxf format, which were then imported in FHWA TNM.

4.8.2.3 Traffic Considerations

Five classes of vehicle are used in this FHWA model; they are automobiles, medium trucks, heavy trucks, buses and motorcycles. The five TNM vehicle types are defined as follows:

1. Automobiles: all vehicles with two axles and four tires
2. Medium trucks: all cargo vehicles with two axles and six tires
3. Heavy trucks: all cargo vehicles with three or more axles
4. Buses: all vehicles designed to carry more than nine passengers; and
5. Motorcycles: all vehicles with two or three tires and an open-air driver/passenger compartment.

Vehicle Speed Consideration

- 4-Wheeler: 60 kmph
- LCV: 60 kmph
- 2-Wheeler: 60 kmph
- Medium sized vehicles: 50 kmph
- Multi axle vehicles: 45 kmph

4.8.2.4 Other Considerations

One of the regional aspects considered during noise assessment is land use zoning regulations near Project corridor among the published sources and consultation with local people and with the client. Though some parts of Project area (Pendurthi) falls in Greater Visakhapatnam Municipal Corporation limit, however, specific and localised land use zoning close to Project highway (within 100 meters) is not evident. Moreover, the Project road being a National Highway, the RoW is protected and minimum width of 60m is considered. Also, during site visit no such major developments were evident.

Other parameters considered are:

- Width of Road: 21m (main CW)
- RoW considered is 60m
- Type of pavement: Average: An average pavement is a pavement type consisting of Reference Energy Mean Emission Levels (REMEL) data measured on Dense-graded asphalt concrete (DGAC) and Portland cement concrete (PCC) pavements combined. In this project PCC pavement is considered.
- Noise reduction Goal: 8dB to 15dB
- Height of receiver above ground level: 1.5m (average)
- Height of barrier: 3m for analysis purpose and 8m for comparison
- Length of Barrier: 150m along the road
- Barrier type: Wall
- Default Ground type: Field Grass

4.8.2.5 Results and Discussion

The summary of the results of the simulations are presented in Table 4-6. The simulations for the noise levels are done for years 2025, 2030, 2035 and 2040, these stimulations are done without noise barrier as well as with noise barriers of about 3m height and 150 m in length to understand the reduction in noise levels.

The noise exceedance values are highlighted in red font at respective places. There are three schools (NQ1, NQ3 and NQ5) situated approximately 90 m from the central line of the highway. Hence, the noise modelling for NQ1, NQ3 and NQ 5 has been conducted for 90m as well as 30m distance from road centreline. The noise level values predicted at 30m from centreline has been provided in the table and the values predicted at the 90m from the centreline has been provided in the footnote.

Table 4-6: Noise Modelling Results

Location	Place	Type of Receptor	NAAQS	Baseline Weekday Noise Level	Baseline Weekend Noise Level	Predicted Weekday Noise Level (dBA)Without Barrier @30m from C/L				Predicted Noise Level (dBA) with Barrier_3m height @ 30m from C/L				Noise Reduction (dBA) with Barrier 3m height @30m from C/L				Peak Hour Traffic Considered for Noise Modelling				
				2020	2020	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2020	2025	2030	2035	2040
NQ 1	Ravindra Bharati School	Silence Zone	50	69.9	63.2	72.1[9]	**73.5**	**74.9**	**76.2**	63	64.5	65.9	67.2	9.1	9	9	9	2,556	3,537	4,831	6,536	8,803
NQ 2	Anandpuram Village (near Surya Traders) (Flyover proposed)	Residential	55	64.7	63.4	**74.4**	**75.8**	**77.2**	**78.5**	65	66.4	67.8	**69.2**	9.4	9.4	9.4	9.3	2,556	3,537	4,831	6,536	8,803
NQ 3	Opposite Dr. KKRS Gowtham School[10]	Silence Zone	50	68.8	54.3	69.4	70.3	71.6	**73**	61.8	62.8	64 .2	65.5	7.6	7.5	7.4	7.5	2,556	3,537	4,831	6,536	8,803
NQ 4	Labour hutment beside (Forest area)	Silence Zone	50	58.3	59.9	**67.6**	**69.1**	**70.4**	**71.8**	61.8	63.2	**64.7**	**66**	5.8	5.9	5.8	5.9	2,556	3,537	4,831	6,536	8,803
NQ 5	Gommidivanipalem Village (NSRIT College[11])	Silence Zone	50	51.3	58.2	**70.9**	**72.3**	**73.7**	**75**	**63.4**	**64.9**	**66.3**	**67.6**	9.6	7.4	7.4	7.4	2,556	3,537	4,831	6,536	8,803
NQ 6	Godigundam village (LVUP @ 697+840)	Residential	55	69.4	69.6	61.3	62.7	64.1	65.5	58.6	60.1	61.5	62.8	2.6	2.6	2.6	2.7	2,556	3,537	4,831	6,536	8,803

[9] Noise level values predicted at 90m from centreline without noise barrier is 2025: 66.0 dBA, 20230: 67.5 dBA, 2035: 68.8 dBA, 2040: 70.2 dBA.
Noise level values predicted at 90m from centreline without noise barrier with height of 3m is 2025: 62.3 dBA, 2030: 63.8 dBA, 2035: 65.2 dBA, 2040: 66.5 dBA.

[10] Noise level values predicted at 90m from centreline without noise barrier is 2025: 64.1 dBA, 20230: 65.6 dBA, 2035: 67.0 dBA, 2040: 68.3 dBA.
Noise level values predicted at 90m from centreline without noise barrier with height of 3m is 2025: 61.7 dBA, 2030: 63.2 dBA, 2035: 64.6 dBA, 2040: 65.9 dBA.

[11] Noise level values predicted at 90m from centreline without noise barrier is 2025: 66.4 dBA, 20230: 67.9 dBA, 2035: 69.3 dBA, 2040: 70.6 dBA.
Noise level values predicted at 90m from centreline without noise barrier with height of 3m is 2025: 61.3 dBA, 2030: 62.8 dBA, 2035: 64.1 dBA, 2040: 65.5 dBA.
Noise level values predicted at 90m from centreline without noise barrier with height of 8m is 2025: 60.6 dBA, 2030: **62.0** dBA, 2035: **63.4** dBA, 2040: **64.7** dBA.

Location	Place	Type of Receptor	NAAQS	Baseline Weekday Noise Level	Baseline Weekend Noise Level	Predicted Weekday Noise Level (dBA)Without Barrier @30m from C/L				Predicted Noise Level (dBA) with Barrier_3m height @ 30m from C/L				Noise Reduction (dBA) with Barrier 3m height @30m from C/L				Peak Hour Traffic Considered for Noise Modelling				
				2020	2020	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040	2020	2025	2030	2035	2040
NQ 7	Akkiredi (Mudapaka) on Bypass (LVUP @ 700+800)	Residential	55	55.6	56	52.9	54.3	55.6	56.9	51.2	52.6	53.9	55.2	1.7	1.7	1.7	1.7	1,300	1,791	2,445	3,312	4,470
NQ 8	Pendarthi (Bypass is at grade above the existing road)	Commercial	65	77.2	79.7	58.5	59.9	61.2	62.5	57.2	58.6	59.9	61.2	1.3	1.3	1.3	1.3	1,300	1,791	2,445	3,312	4,470
NQ 9	Askapali village	Residential	55	60.1	63.7	59.8	61.2	62.5	63.8	58.6	60	61.3	62.6	1.2	1.2	1.2	1.2	1,300	1,791	2,445	3,312	4,470
NQ 10	Batajangpalem	Residential	55	63.5	62.1	**67.6**	**69**	**70.3**	**71.5**	60	61.3	62.6	63.9	7.6	7.7	7.7	7.6	945	1,294	1,756	2,365	3,175
NQ 11	Ramapuram	Residential	55	65.7	64.5	**69.3**	**70.7**	**72**	**73.3**	60.9	62.3	63.6	64.9	8.4	8.4	8.4	8.4	1,300	1,791	2,445	3,312	4,470
NQ 12	Base Camp 2	Industrial	75	68.3	69.1	68.3[12]	61.9	63.2	64.5	58.5	59.8	61.1	62.4	9.8	2.1	2.1	2.1	945	1,294	1,756	2,365	3,175
NQ 13	Maturu Mining (Crusher)	Industrial	75	65.3	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NQ 14	Ankapale (Inter Change)	Industrial	75	59.9	60.9	72.7	74.1	75.5	76.9	60.5	61.9	63.3	64.6	12.6	12.6	12.6	12.7	945	1,294	1,756	2,365	3,175
NQ 14	Ankapale[13] (school)	Silence Zone	50	59.9	60.9	**72.7**	**74.1**	**75.5**	**76.9**	60.5	61.9	63.3	64.6	12.6	12.6	12.6	12.7	945	1,294	1,756	2,365	3,175
NQ 15	Base Camp 1	Industrial	75	61.2	60.6	64	**65.5**	**67.4**	**68.2**	62.6	**64.1**	**66**	**66.8**	1.4	1.4	1.4	1.4	2,556	3,537	4,831	6,536	8,803
NQ 16	Vavilapada	Industrial	75	68	75.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[12] For 2025 the noise level has been considered as baseline noise level. Since the campsite would be decommissioned by end of 2021, the background noise level generated from construction campsite will go away.

[13] The Noise level values at school (Dadi Institute of Engineering and Technology) predicted at 30m from centreline with noise barrier with height of 8m is 2025: 53.4 dBA, 2030: 54.8 dBA, 2035: **56.2** dBA, 2040: **57.6** dBA.

Table 4-6 shows he baseline noise levels arising from the simulations with and without the noise barrier. Few of the locations predicted noise levels were observed to be greater than the permissible ambient standards set for residential areas, sensitive areas like schools/ colleges, forest area, commercial areas etc. With noise barriers, there were substantial reduction of modelled noise levels depending on the height of the walls. The proposed heights of the noise barrier have been set to 3m and the length has been considered as 150m. Assuming use of noise barrier walls that blocked the construction equipment, i.e., retractable noise barriers, with the nearest households, there were reduction of predicted noise levels at the facades of houses or buildings fronting the equipment. With the addition of noise barriers there have been reduction ranging of noise level ranging from 1.3 dBA at Pendurthi to 13.6 dBA at Akkiredi village. This study referred to the IFC-WB (2007) noise guidelines that specifies limit of +3dBA from the background noise of the nearest receptor. Noise location where the noise levels are higher the +3dBA from the background noise have been highlighted.

- **NQ 1**: At NQ 1, Ravindra Bharat School the baseline noise levels arising from the simulations showed that the noise levels were above the prescribed standard at all years until 2040. As per the IFC-WB (2007) Guidelines +3dBA from the background noise has been found to exceed only after the year 2030. Since the school is observed to be at 90m away from the noise monitoring stations (end of RoW), this would reduce even further. With noise barrier, a reduction of approximately 9 dBA was observed. It is understood that to provide additional wall/ barrier, the permission of NHAI is required as this would be out of scope of concession agreement. Therefore, it is recommended to make a continuous boundary wall of minimum 3m height of the school (along with increasing the height) would act as the noise barriers. In this regard, AAHPL needs to have a discussion with the school authorities and decide. It has been observed that at 2040 the noise level with noise barrier will be above +3dBA from the background noise. It is assumed that at 2040, the concession period will be over and hence the impact of noise may have to be assessed again by the new concessionaire. If required, the noise barrier will be refurbished along with increasing height of barrier.
- **NQ 2**: At NQ 2, Anadpuram Village is a marketplace along with residential area. As per the IFC-WB (2007) Guidelines +3dBA from the background noise has been found to exceed from the base year (2020) itself, therefore, noise barrier is proposed at 2020. However, simulation with Noise barrier have shown a reduction of 9.4 dBA for the year up to 2040. It is recommended to proposed High-Density Acoustical Material Noise barrier of 3m height is proposed (at grade). After 2035 monitoring of noise level needs to be carried out to access the noise levels and appropriate refurbishing of the noise barrier needs to be validated.
- **NQ 3**: At NQ 3, KKR Gautham School, the baseline noise levels arising from the simulations shows that the noise levels were below +3dBA from the background noise as per the IFC-WB (2007) Guidelines at all years until 2035. Since simulation with noise barrier, a reduction of approximately 7.5dBA was observed, hence, a proposal to thicken the compound wall of the school along with increasing the height which would act as the noise barriers of minimum 3m height of the school (along with increasing the height) would act as the noise barriers.
- **NQ 4**: NQ 4 is an open area without human receptor and includes a forest area, which is a sensitive zone. The baseline noise levels arising from the simulations shows that the noise levels were above the +3dBA from the background noise as per the IFC-WB (2007) guidelines at all years from 2025. Increase in noise levels could have adverse impacts on the biodiversity present in the area by altering predator or prey detection and avoidance, interfere with reproduction and navigation, and contribute to hearing loss. However, as observed at the site it is a buffer area (eco sensitive zone) wherein it has been informed that no wild animals have been observed near the alignment. It is also been observed that a dense cover of vegetation, which would lead to some level of absorption of noise and hence reducing the level of noise levels in forest area. As FHWA TNM does not provide modelling of noise based on vegetative barrier, hence the predicted noise could not be validated.

  During construction phase, temporary retractable noise barriers could be considered, while during operation phase a thick belt of afforestation could be considered at the ROW to increase the vegetative cover. As the ESZ covers upto 200m from road alignment, and the presence of hillock (approximately 25m height) would act as a natural noise barrier, the noise impact would not be much at the forest area. Due to non-presence of human establishments no further noise barrier is recommended at present. However, to prevent accident of wild animals a retaining wall of approximately 1.5m height may be proposed at forest area from km 689.200 to km 689.500. The cost of retaining wall is not considered in EMP budget. Additional suggested mitigation measures to be taken at forest area include the followings.

  – Install signages, suitably including vernacular language(s) and non-verbal symbols, to alert road-users regarding the possible presence of wild species on the Project alignment.
  – Prohibit avoidable vehicular honking by road-users in the section of the Project alignment situated in proximity to the Kambalakonda Wildlife Sanctuary.
  – Plant relatively tall-growing native vegetation along the Project alignment to act as a visual screen and noise absorbent for the benefit of wildlife habitats in the vicinity. This is especially applicable to sections of the project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.

- **NQ 5**: At NQ 5, NSRIT college, the baseline noise levels arising from the simulation shows that the noise levels were above the +3dBA from the background noise as per the IFC-WB (2007) Guidelines at all years from 2020. The simulation with noise barrier, a reduction of approximately 7.4 dBA can be achieved. Hence, a proposal to thicken the compound wall of the school along with increasing the height (3 m) would act as the noise barriers.
- **NQ 6**: At NQ 6, Godigundam village, is a residential area with a small number of habitations. There is a proposed vehicular underpass at this location. The simulation for prediction of noise level is carried out keeping in mind the road above proposed underpass, hence, the reduction in predicted noise levels noise levels as compared to the current baseline noise levels. The baseline noise levels arising from the simulations shows that the noise levels were below the +3dBA from the background noise as per the IFC-WB (2007) Guidelines at all years until 2040. Hence no noise barrier is proposed.
- **NQ 7**: At NQ 7, Akkiredi is a village located on proposed bypass and the baseline noise levels confirms to present accepted noise level stipulated by CPCB. The noise level prediction till 2040 have shown a steady rise in levels. The proposed alignment is at grade above the existing road. However, the noise levels have been found to be below the +3dBA from the background noise has been as per the IFC-WB (2007) Guidelines at all years from 2025. Hence no noise barrier is proposed.
- **NQ 8**: At NQ 8, Pendurthi Village, which is a commercial area and hence the baseline for 2020 has been observed to be higher than the prescribed limits. However, the proposed bypass is at grade above the existing road, owing to this the height difference, would play a major part in dissipating the noise levels. Hence, the baseline noise levels arising from the simulations from 2025-2040 will be within the +3dBA from the background noise has been as per the IFC-WB (2007) Guidelines and so no noise barrier is proposed.
- **NQ 9**: At NQ 9, At Askapali there is a proposed vehicular underpass. The simulation for prediction of noise is carried out keeping in mind the noise at above the proposed underpass. Therefore, the reduction in predicted noise levels as compared to the current baseline noise levels would be less. Hence no noise barrier is proposed.
- **NQ 10**: At NQ 10, Batajangpalem is a dense habitation and the baseline noise levels arising from the simulations showed that the noise levels will be above +3dBA from the background noise as per the IFC-WB (2007) Guidelines at all years from 2020. The simulation with noise barrier, a reduction of 7.7 dBA was observed. Keeping in mind, the Batajangpalem being a large habitation and close to proposed toll plaza, a proposal high-density acoustical material noise barrier of 3m height is recommended.
- **NQ 11**: At NQ 11, Ramapuram village, is a small village and the predicted noise levels arising from the simulations shows that the noise levels will be above the +3dBA from the background noise as per the IFC-WB (2007) Guidelines at all years from 2020. With adoption of noise barrier, a reduction of 8.4 dBA can be achieved. A proposal for high-density acoustical material noise barrier of 3m height is recommended. Since Ramapuram is a small habitation and noise dissipation occur. However due to the noise levels being greater than the +3dBA from the background noise hence proposal for high-density acoustical material noise barrier of 3m height is recommended. The noise barrier should be placed in such a way that only the impacted receptors are protected.
- **NQ 12**: At NQ 12, Base camp 2, is an area which houses crusher, batching plant, WMM plant etc and hence considered as industrial area as per the CPCB. The base camp will be decommissioned within 1.5 to 2 years. Post decommissioning, the land would be handed over to the owner and put to normal usage (may be open stockyard/ godown). There is no immediate receiver within 100m of basecamp and, therefore, the impact of noise will not be evident. The noise levels arising from the simulations shows that the incremental noise for all years until 2040 would not be evident and impacted on any receiver. Though noise barrier is not provisioned at this place, however, as per the conditions of Consent for Operation (CFO) cladding and kirby sheets of 20 feet height needs to be fenced all around the suspected fugitive periphery around the RMC, HMM, stone crusher etc. This is to be enforced immediately. After the decommissioning of the Base Camp, the land would be returned back to the owner in its original form. As the future land use cannot be decided at present, AAHPL may have to re-access its noise levels against the changed land use. If the noise levels go beyond the standards along with a threshold limit of 3dBA as prescribed by IFC, appropriate mitigations would need to be adopted by AAHPL. After decommissioning of the base camp, the change in land use could vary from an industrial use (the owner could give it for the purpose of an industry) or could be used for residential purposes. As the predicted noise levels would remain unchanged the noise stands would vary. If the land continues to be under industrial zone then the mitigation measure would remain unchanged but if the area comes under residential use then there would be further mitigations measures required.
- **NQ 14**: At NQ 14, Anakapalli is end of Project road and a major junction. This junction would be at grade. Ankapalli village lies about 700m away from the actual alignment. The broad landuse of the area along the alignment was observed to be industrial. The noise level arising from the simulations predicts that the noise levels would be above the +3dBA from the background noise has been as per the IFC-WB (2007) Guidelines for all years until 2040. However, the proposed bypass is at grade above the existing road, owing to this height difference, would play a major part in dissipating the noise levels. The present noise level is less than the noise level of industrial category NAAQS, the proposed noise barrier is not considered as predicted noise level does not exceed more than +3 dBA from NAAQS for industrial category (75dBA) for all years.

At about 500m from this place, there is a school (DADI Institute of Engineering and Technology) where the school boundary and school building is located about 40m from 150m from centreline respectively. As the school area comes under silence zone, the noise level of +3 dBA will exceed the present level at 2020. Therefore, noise barrier of 3m high is proposed at 2020. By the year 2035, the noise will exceed the stipulated standard and height of boundary is recommended to be raised wall will be raised. However, it is suggested to thicken the compound wall of the school along with increasing the height (3 m) would act as the noise barrier for the school.

- **NQ 15**: At NQ 15 Base camp I, is an area which includes crusher, batching plant, WMM etc. and hence considered as industrial area as per the CPCB. The base camp will be decommissioned within 1.5 to 2 years. Post decommissioning, the land would be handed over to the owner and put to normal usage (may be open stockyard/ godown). The noise levels arising from the simulations shows that the noise levels will be 64dBA by 2025 without barrier. Though noise barrier is not provisioned at this location, however, as per the conditions of Consent for Operation (CFO) cladding and kirby sheets of 20 feet height needs to be fenced all around the suspected fugitive periphery around the RMC, HMM, stone crusher etc. This is to be enforced immediately. After the decommissioning of the Base Camp, the land would be returned back to the owner and after that the present landuse might change.

  In case of change of landuse, AAHPL would have to reassess noise impact and monitor the noise levels against the changed land use at that moment. If the noise levels go beyond the standards along with a threshold limit of 3dBA as prescribed by IFC, appropriate mitigations would need to be adopted by AAHPL. After decommissioning of the base camp, the change in land use could vary from an industrial use (the owner could give it for the purpose of an industry or open warehouse) or could be used for residential purposes. As the predicted noise levels would remain unchanged the noise stands would vary. If the land continues to be under industrial zone, then the mitigation measure would remain unchanged but if the landuse (area) comes under residential (or other uses) then there might be further mitigations measures require which will be implemented appropriately.

- **NQ 13 and NQ 16**: For NQ 13 and NQ 16 (Maturu and Vavilipadu quarry areas respectively), noise modelling has not been carried out, as these sites are presently on lease from third parties and will be abandoned immediately once the construction materials are sourced. As informed by DBL, the quarry areas will be closed within six months and hence would not require further predictions for the same. However, the bassline was observed to be within the prescribed limits against industrial standards.

4.8.3 Water Quality

In order to establish a baseline and to know the impact, an inventory of water resources and their quality were monitored. The location details of the surface water and ground water samples collected along the Project road is presented in Table 4-7 and shown in Figure 4-8A.

Surface Water: The water quality of the surface water samples collected and analysed for all essential characteristics and for most of the desirable characteristics specified in IS 2296 and are analysed in accordance with the standard methods specified by IS codes. Table 4-7 gives water quality results of surface water samples.

Ground Water: The water quality of the ground water samples collected and analysed for all essential characteristics and for most of the desirable characteristics specified in IS 10500: 1991 and are analysed in accordance with the standard methods specified by IS codes. Table 4-7 gives water quality results of surface water samples.

The analytical values of water quality reveal that pH of water in the project corridor varies between 7.3 – 8.5 and does not exceed the standard of 6.5 – 8.5. All the samples show permissible turbidity of 5 NTU except for Ramapuram and Balijipatem surface water, which is not used for drinking purpose. The Total Hardness of all the water samples are found to be within permissible range. Though the Total Dissolved Solid in ground water is found to exceed the acceptable limit at three places (Base Camp 2, Anandapuram and Pendurthi), however, the same has been within permissible limits in absence of alternate sources of drinking water[14].

The BOD of the surface water bodies varies between 3-9, which is an acceptable range for bathing purpose or other non-drinking purposes.

Similarly, other parameters such as Nitrates, Chlorides, Fluorides, Sulphates, Iron, Zinc, Manganese and Lead Concentrations of these water samples are found to be in a much lower side compared to Indian Standards for drinking water. It is noticed that all the surface water bodies are contaminated with Total Coliforms, is attribute

[14] The IS 10,500 standard specifies the acceptable limits and the permissible limits in the absence of alternate source, which is a technical standard and adopted by adopted by the Bureau of Indian Standards.

that it is difficult to stop such contamination because cattle regularly use these water bodies and people are found to dump wastes along banks of these water bodies.

Tube well water sample was collected from both Base Camps, Anandapuram and Pendurthi were analysed for required parameters to judge its potability. The analytical table reveals that most of the parameters are in a safer range as compared with Indian Standards specifications for drinking water.

Table 4-7: Water Sample Collection Locations

Sl. No.	Parameter / Location Code	Unit	Acceptable Limit (IS 10500 and IS 2296)	Permissible limit in Absence of alternate Source	Base Camp-2 Ground water GW 1 – Km 724+500 (LHS)	Base Camp-1 Ground water GW 2 – Km 689+800 (RHS)	Anandapuram Village Ground water GW 3 – Km 682+900 (RHS)	Pendurthi Ground water GW 4 – Km 704+000 (LHS)	Chintanipullam Agraharam Surface water SW 1 – Km 729+000 (LHS)	Pendurthi Surface water SW 2 – Km 704+000 (LHS)	Ramapuram Surface water SW 3 – Km 706+700 (LHS)	Balijipatem Surface water SW 4 – Km 724+800 (RHS)
	Date of Sample	---	-	-	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020
1	Temperature	°C	-	-	25.6	26.2	26.4	26.5	25.8	25.4	25.5	25.2
2	Colour	Hazen	5	25	12.8	11.7	11.1	8.2	11.2	16.5	18.2	57.5
3	Odour	–	Unobjectionable	-	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
4	Taste	–	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	pH	-	6.5-8.5	No relaxation	8.01	7.37	7.50	8.00	7.61	8.35	8.14	8.03
6	Turbidity	NTU	5	10	0.1	0.3	0.4	0.5	8.8	5.0	70.4	93.6
7	Total Dissolved Solids	mg/l	500	2000	970.4	438.0	768.5	568.5	205.0	437.5	458.7	232.0
8	Total Suspended Solids	mg/l	-	-	<5	<5	<5	<5	<5	<5	54	55
9	Total Alkalinity	mg/l	200	600	510.4	497.2	460.5	523.4	198	462	500.1	281.6
10	Total Hardness	mg/l	300	600	497.2	252.2	434.8	201.7	104.7	166.8	248.3	100.8
11	COD	mg/lit	-	-	16	<10	<10	<10	16	24	32	20
12	BOD	mg/l	3	3	<5	<5	<5	<5	<5	6.0	9.0	<5
13	Chloride	mg/l	250	1000	445.8	77.9	283.9	97.9	29.9	119.9	189.9	23.9
14	Free Chlorine	mg/l	0.2	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Sulphate	mg/l	200	400	150.6	13	55.3	41.4	12.2	51.8	39.6	16.2
16	Sulphide	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
17	Fluoride	mg/l	1	1.5	1.20	0.70	0.90	1.00	0.50	1.00	1.00	0.90
18	Nitrate	mg/l	200	400	3.8	0.5	9.6	0.9	<0.5	<0.5	<0.5	<0.5

Sl. No.	Parameter / Location Code	Unit	Acceptable Limit (IS 10500 and IS 2296)	Permissible limit in Absence of alternate Source	Base Camp-2 Ground water	Base Camp-1 Ground water	Anandapuram Village Ground water	Pendurthi Ground water	Chintanipullam Agraharam Surface water	Pendurthi Surface water	Ramapuram Surface water	Balijipatem Surface water
	Location Code				GW 1 – Km 724+500 (LHS)	GW 2 – Km 689+800 (RHS)	GW 3 – Km 682+900 (RHS)	GW 4 – Km 704+000 (LHS)	SW 1 – Km 729+000 (LHS)	SW 2 – Km 704+000 (LHS)	SW 3 – Km 706+700 (LHS)	SW 4 – Km 724+800 (RHS)
	Date of Sample	---	-	-	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020
19	Ammonical Nitrogen	mg/l	-	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
20	Iron	mg/l	0.3	1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Manganese	mg/l	0.1	0.3	BDL	BDL	BDL	BDL	0.05	0.06	0.11	0.10
22	Cadmium	mg/l	0.01	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Silver	mg/l	0.1	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Lead	mg/l	0.05	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc	mg/l	5	15	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Aluminium	mg/l	0.03	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27	Copper	mg/l	0.05	1.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Nickel	mg/l	0.02	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Total Chromium (as Cr)	mg/l	0.05	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Arsenic	mg/l	0.05	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Cyanide	mg/l	0.05	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Magnesium	mg/l	30	100	93.4	26.0	61.5	29.8	13.9	23.3	28.8	13.0
33	Boron	mg/l	1	5	0.7	<0.4	<0.4	<0.4	<0.4	0.4	<0.4	<0.4

Sl. No.	Parameter / Location Code	Unit	Acceptable Limit (IS 10500 and IS 2296)	Permissible limit in Absence of alternate Source	Base Camp-2 Ground water	Base Camp-1 Ground water	Anandapuram Village Ground water	Pendurthi Ground water	Chintanipullam Agraharam Surface water	Pendurthi Surface water	Ramapuram Surface water	Balijipatem Surface water
	Location Code				GW 1 – Km 724+500 (LHS)	GW 2 – Km 689+800 (RHS)	GW 3 – Km 682+900 (RHS)	GW 4 – Km 704+000 (LHS)	SW 1 – Km 729+000 (LHS)	SW 2 – Km 704+000 (LHS)	SW 3 – Km 706+700 (LHS)	SW 4 – Km 724+800 (RHS)
	Date of Sample	---	-	-	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020	06.03.2020
34	Chromium (as Cr6+)	mg/l	0.05	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Barium	mg/l	1	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
36	Calcium	mg/l	75	200	100.8	57.4	148.9	31.0	18.6	27.9	51.2	18.6
37	Mercury	mg/l	0.001	No relaxation	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
38	Anionic Detergents	mg/l	0.02	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
39	PAH	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
40	Oil & Grease	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
41	Pesticides	mg/l	Absent	0.001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
42	Phosphorus	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
43	BTEX	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44	Chroamines	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
45	Total Petroleum hydrocarbo(TPH)	mg/l	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
46	Total Coliform	MPN/100ml	0	0	0	0	0	0	>1600	0	>1600	>1600
47	E Coli	-	0	0	Absent	Absent	Absent	Absent	Present	Absent	Present	Present

Source: Primary Environmental Monitoring, March 2020

BDL: Below detectable limit

4.8.4 Soil Environment

For the assessment of the baseline soil quality, soil samples were collected at 5 locations from agricultural fields, basecamps along the Project road. Details of the soil sampling locations are presented in Table 4-8 and Figure 4-9. Soil samples were collected up to a depth of 60 cm.

Table 4-8: Soil Sample Collection Locations

Sl. No	Sample Code	Location Name	Chainage	Landuse	Date of Sample
1.	SQ 1	Base Camp-2	km 724+500 (LHS)	Mixed Landuse	06 March 2020
2.	SQ 2	Mudapaka village	km 706+600 (RHS)	Agricultural Field	06 March 2020
3.	SQ 3	Base Camp 1	km 689+800 (RHS)	Mixed Landuse	06 March 2020
4.	SQ 4	Pinagadi	km 713+800 (LHS)	Agricultural Field	06 March 2020
5.	SQ 5	Ayappa Swami Temple	km 695+100 (LHS)	Agricultural Field	06 March 2020

The Project area is largely located in a flat land and in general the soil along the road alignment is red loamy soil. All these soil samples collected along the Project road were analysed for the physical and chemical properties. The characteristics of the soil along the Project road is presented in below table.

Table 4-9: Soil Quality Results

Sl. No.	Parameter	Unit	Base Camp-2	Mudapaka Village	Base Camp 1	Pinagadi Village	Ayappa Swami Temple
	Location Code		SQ1	SQ2	SQ3	SQ4	SQ5
1	Particle size distribution						
	i. Sand	%	82.2	87.7	81.8	78.7	85.0
	ii. Slit	%	10.1	3.1	10.6	1.8	4.2
	iii. Clay	%	7.8	9.2	7.6	19.5	10.8
2	Texture	---	Loamy Sand	Loamy Sand	Loamy Sand	Sandy Loam	Loamy Sand
3	pH (1:10 suspension)	---	6.79	6.77	7.93	6.18	7.68
4	Permeability	--	0.03	0.04	0.03	0.06	0.05
5	Porosity	%	18.3	45	12.8	23.6	19.6
6	Conductivity	mmhos/cm	0.33	0.37	0.75	0.32	0.25
7	Cation Exchange Capacity	Meq/100gm	25	21.3	50.9	26.3	18
8	Nitrite	mg/kg	0.1	0.06	0.03	0.55	0.09
9	Nitrate	mg/kg	0.5	1.5	BDL	1.5	BDL
10	TPH	mg/kg	BDL	BDL	BDL	BDL	BDL
11	Phosphate	mg/kg	<1	<1	1.2	<1	<1
12	PAH	mg/kg	BDL	BDL	BDL	BDL	BDL
13	Iron	mg/kg	23250	16770	24310	30350	23880
14	Lead	mg/kg	11.8	18.8	21.5	13.6	16.1
15	Manganese	mg/kg	207.8	434.9	1904	529.1	340.5
16	Nickel	mg/kg	23.6	22.4	26.7	22	23.6

Sl. No.	Parameter	Unit	Base Camp-2	Mudapaka Village	Base Camp 1	Pinagadi Village	Ayappa Swami Temple
	Location Code		SQ1	SQ2	SQ3	SQ4	SQ5
17	Barium	mg/kg	74.9	99.8	769.5	63.9	34.3
18	Zinc	mg/kg	1.59	5.57	11.7	5.9	1.62
19	Copper	mg/kg	21.4	14.8	17.3	18.3	15.6
20	Cadmium	mg/kg	1.05	1.01	1.1	0.1	0.9
21	Chromium	mg/kg	29.3	23.5	32.9	33.8	27.7
22	Arsenic	mg/kg	BDL	BDL	BDL	BDL	BDL
23	Mercury	mg/kg	BDL	BDL	BDL	BDL	BDL
24	Total Hydrocarbon	mg/kg	BDL	BDL	BDL	BDL	BDL
25	Trace Metal	mg/kg	BDL	BDL	BDL	BDL	BDL
26	Organic Matter	%	0.21	2.24	0.75	1.31	1.15

Source: Primary Environmental Monitoring, March 2020

BDL: Below detectable limit

The analytical values of soil samples shows that the pH value ranges between 6.18 and 7.9 at all locations. The soil analysed from Base Camps shows that there are no elements of heavy metals observed. From the results it can be observed that the soil in the Project area is fertile with moderate to high agricultural productivity.

4.9 Traffic and Road Safety

There are many settlements along the existing road. Close to major settlements there are proposed bus shelters and junction improvements at these locations along with service roads and pedestrian paths are proposed. The Project has incorporated engineering and adequate traffic safety in highway design.

During site visit, classified volume count survey was conducted for 24 hours from 5th March to 6th March 2020 at four locations to know the existing traffic. The purpose of traffic survey was to ascertain the baseline volume and projected traffic for noise and air quality modelling. Table 4-10 shows the summary of traffic along the highway and projected traffic from 2020 to 2040.

Table 4-10: Traffic Volume on Project Road (number of Vehicles)

Location Chainage	Cars/ Jeep/ Van	3- Wheeler	2- Wheeler	Mini-Bus	Bus	L.C.V.	2-Axle	3-Axle	Multi Axle Vehicle	Tractor	Tractor with Trailer	Cycle	Cycle- Rickshaw	Hand - Cart	Animal- Drawn	Others	Total
681+000	1128	789	2368	77	218	822	1428	2036	2234	34	15	5	4	0	0	12	11170
699+800	2488	3371	8611	261	791	960	2014	2565	2683	120	52	125	22	1	1	1	24066
720+500	1307	1528	3690	82	212	645	1759	3799	2686	48	17	57	2	0	0	1	15833
730+800	9166	3634	8245	418	2348	1719	3460	4145	6560	214	11	17	1	0	0	0	39938

4.10 Community Facilities and Cultural Properties

The buildings of public/ semi-public use are very few in number close to the RoW. The project has affected multiple religious structures falling within the alignment and RoW which were demolition relocated. The details of such properties were covered in detail in Social Impact Assessment (SIA) report prepared for the Project.

4.11 Biodiversity Baseline

This section provides a summary of the biodiversity assessment carried out towards the ESIA for the Project. It delineates the area subjected to the assessment, states the methodology used for the assessment and describes the biodiversity baseline of the area assessed in terms of species, habitats and ecosystem services. This baseline data forms the basis for predicting the potential impacts of the Project on the biodiversity of the study area and suggesting mitigation measures to manage the predicted impacts.

4.11.1 Delineation and Description of the Study Area

The area of influence of the Project is expected to include the direct physical footprint of the proposed Project alignment, along with the area extending 1km outwards from the Project alignment. This area of influence has been estimated considering the farthest known receptors of potential biodiversity-related impacts of the Project. The footprint of the proposed Project infrastructure is referred to hereafter in this section as the 'Project Site'. The estimated area of influence of the Project on biodiversity is referred to hereafter in this section as the 'Study Area'.

The Project Site is situated in the northern Eastern Ghats region of Andhra Pradesh. It intersects the Simhachala Hill Range, an eastern off-shoot range of the Eastern Ghats. The terrain of the study area varies from flat to undulating, with agriculture on the plains and intermittent hills and hillocks. The overall slope is from west to east, with elevations ranging from 20m to 60m above mean seal level. The reported dominant natural vegetation of the Study Area is composed of tropical dry evergreen and tropical moist deciduous forests. The reported floristic and faunal profiles of the Study Area are characterized by species of forests and shrublands.

4.11.2 Methodology

The methodology used for assessing biodiversity is based on both primary and secondary data sources. The primary data is limited to preliminary observations recorded during the site visit, while the secondary data used in this assessment was obtained through consultation with local forest department officials, as well as, from sources in the public domain, including research journals, standard field guides, scientific reports and websites maintained by internationally recognized conservation organizations, such as International Union for Nature and Natural Resources (IUCN), Alliance for Zero Extinction, World Wide Fund for Nature (WWF-India), Birdlife International and Wetlands International. The primary and secondary data collection with respect to species was limited to the higher flora, namely angiosperms, and the higher fauna, namely vertebrates.

4.11.3 Species Profile of the Study Area

The following forest types, as described by the Champion and Seth Classification of Indian Forests, are reported from the Study Area:

Type 3B/C1b [Sub-type C2 – Southern Moist Mixed Deciduous Forest of Sub-group 3B – South Indian Moist Deciduous Forests]

The main forest-type occurs in all parts of India experiencing medium rainfall and can be found in many regions situated eastwards of the Western Ghats. These forests are typically found on hilly terrain, but this trend is attributed to destruction of the forest on the flatter and, hence, relatively more cultivable tracts in the region. These forests occur on nearly all soil-types of the Indian tropics, from recent sandy alluvium to old red soils. Associated soils are usually fluvial or aeolian deposits in various stages of consolidation, often saline and interspersed with blown sand.

This forest-type is characterized by a closed, high canopy formed by mostly deciduous dominant species. Lower storeys contain predominantly evergreen species, which give the forest a more or less evergreen appearance during most of the year. Bamboo undergrowth is characteristic. Climbers are abundant and large. There can be heavy growth of grasses where the canopy is open.

Species associated with this forest-type include:

Trees such as *Adina cordifolia, Anogeissus latifolia, Bombax malabarica, Dalbergia latifolia, Diospyros spp., Emblica officinalis, Ficus spp., Flacourtia indica, Garuga pinnata, Grewia tiliaefolia, Lagerstroemia parviflora, Lannea coromandelica, Madhuca indica, Mangifera indica, Polyalthia cerasoides, Pterocarpus marsupium, Schrebera swietenoides, Terminalia bellerica, Terminalia tomentosa* and *Xylia xylocarpa*.

Bamboos such as *Bambusa arundinacea* and *Dendrocalamus strictus*;

Shrubs such as *Callicarpa tomentosa, Carissa spp., Casearia graveolens, Grewia spp., Helicteres isora, Ixora sp., Leea sp., Pogostemon sp., Randia spp.* and *Ziziphus oenoplia*;

Herbs such as *Desmodium gangeticum*;

Climbers such as *Acacia spp., Eleagnus sp., Jasminum sp. and Ziziphus spp.*; and

Grasses such as *Aristida spp.* and *Cymbopogon sp.*

Type 7/C1 [Sub-type C1 – Tropical Dry Evergreen Forest of Group 7 – Tropical Dry Evergreen Forests]

This forest-type is characterized by a low forest with a complete canopy, which is formed mostly by small, coriaceous-leaved evergreen trees with short boles and spreading crowns. There is a shrubby underwood composed of many spiny species. Bamboos are rare or absent. Climbers are numerous. Grasses are present, but not conspicuous.

Species associated with this forest-type include:

Trees such as *Acacia leucophloea, Albizzia amara, Albizzia lebbek, Atalantia monophyla, Azadirachta indica, Borassus flabellifer, Buchanania lanzan, Canthium dicicum, Cordia dichotoma, Crataeva religiosa, Diospyros chloroxylon, Ficus spp., Flacourtia indica, Gmelina arborea, Lagerstroemia parviflora, Lannea coromandelica, Mangifera indica, Manilkara hexandra, Memecylon edule, Mimusops elengi, Ochna squarrosa, Phoenix sylvestris, Pterospermum suberifolium, Sapindus emarginatus, Strychnos nux-vomica, Strychnos potatorum, Tamarindus indica* and *Xylia xylocarpa*.

Shrubs such as *Carissa congesta, Dodonaa viscosa, Flacourtia indica, Grewia spp., Glycosmis pentaphylla, Gymnosporia spp., Ixora arborea, Maba buxifolia, Randia dumetorum, Strobilanthes* and *Webera sp.*; and

Climbers such as *Acacia spp., Asparagus spp., Calamus viminalis, Combretum sp., Derris scandens, Hemidesmus indicus* and *Ziziphus oenoplia.*

Reported Floristic Species

At least 73 tree species, 32 shrub species, 10 herb species, 16 climber species and 2 bamboo species are reported from in and around the Study Area[15].

Appendix A lists the floristic species reported from the Study Area, along with the scientific and local name of each species, its habit, the family in which it is placed as per Angiosperm Phylogeny Group-APG-IV classification system for angiosperms and the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN). The woody and non-woody floristic species are listed in separate sections.

Faunal Species

This section of the report presents the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles and amphibians, having recorded ranges that include the Study Area. The detailed species-tables are provided as appendix to this report. Each annexed table gives the scientific and common names of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed.

[15] *Source: Champion, H. G., Seth, S. K. (1968) Revised Survey of the Forest Types of India. Manager of Publications, Government of India, Delhi; Wildlife Management Plan of the Kambalakonda Wildlife Sanctuary*

Mammals

At least 56 species of mammals have reported ranges that include the Study Area. Species of conservation concern with respect to the IUCN Red List include 9 species designated as globally threatened or near-threatened, including 2 species designated as Endangered (EN), 5 as Vulnerable (VU) and 2 as Near Threatened (NT). Species of conservation concern with respect to the WPA include 8 species listed in Schedule I.

Table 4-11 presents the species of mammals designated as globally threatened or near-threatened as per the IUCN Red List, as well as, those listed in Schedule I of the WPA.

Table 4-11: Mammals of Conservation Concern of the Study Area

Sl. No.	Scientific Name	Common Name	IUCN Category	WPA Schedule
1	Cuon alpinus	Dhole	EN	II
2	Manis crassicaudata	Indian Pangolin	EN	I
3	Lutrogale perspicillata	Smooth-coated Otter	VU	II
4	Aonyx cinereus	Asian Small-clawed Otter	VU	II
5	Tetracerus quadricornis	Four-horned Antelope	VU	I
6	Rusa unicolor	Sambar	VU	III
7	Panthera pardus	Leopard	VU	I
8	Miniopterus schreibersii	Schreiber's Bent-winged Bat	NT	-
9	Prionailurus rubiginosus	Rusty-spotted Cat	NT	I
10	Mellivora capensis	Honey Badger	LC	I
11	Prionailurus bengalensis	Leopard Cat	LC	I
12	Moschiola indica	Indian Chevrotain	LC	I
13	Canis lupus	Grey Wolf	LC	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered.*

Appendix B lists the mammal species found in the Study Area.

Birds

At least 200 species of birds including 151 resident and 49 migratory species have reported ranges that include the Study Area. Species of conservation concern with respect to the IUCN Red List include 13 species designated as globally threatened or near-threatened, including 2 species designated as Critically Endangered (CR), 3 as Endangered (EN), 1 as Vulnerable (VU) and 7 as Near Threatened (NT). Species of conservation concern with respect to the WPA include 19 species listed in Schedule I.

Table 4-12 presents the species of birds designated as globally threatened or near-threatened as per the IUCN Red List, as well as, those listed in Schedule I of the WPA.

Table 4-12: Birds of Conservation Concern of the Study Area

Sl. No.	Scientific Name	Common Name	IUCN Category	WPA Schedule
1	*Gyps bengalensis*	White-rumped Vulture	CR	I
2	*Gyps indicus*	Indian Vulture	CR	I
3	*Neophron percnopterus*	Egyptian Vulture	EN	IV
4	*Aquila nipalensis*	Steppe Eagle	EN	I
5	*Sypheotides indicus*	Lesser Florican	EN	I

6	*Antigone antigone*	Sarus Crane	VU	IV
7	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT	IV
8	*Sterna aurantia*	River Tern	NT	IV
9	*Pelecanus philippensis*	Spot-billed Pelican	NT	IV
10	*Limosa limosa*	Black-tailed Godwit	NT	IV
11	*Circus macrourus*	Pallid Harrier	NT	I
12	*Anhinga melanogaster*	Oriental Darter	NT	IV
13	*Mycteria leucocephala*	Painted Stork	NT	IV
14	*Elanus caeruleus*	Black-winged Kite	LC	I
15	*Pernis ptilorhynchus*	Oriental Honey Buzzard	LC	I
16	*Spilornis cheela*	Crested Serpent Eagle	LC	I
17	*Circus aeruginosus*	Western Marsh Harrier	LC	I
18	*Accipiter badius*	Shikra	LC	I
19	*Haliaeetus leucogaster*	White-bellied Sea Eagle	LC	I
20	*Haliastur indus*	Brahminy Kite	LC	I
21	*Milvus migrans*	Black Kite	LC	I
22	*Butastur teesa*	White-eyed Buzzard	LC	I
23	*Ciconia ciconia*	European White Stork	LC	I
24	*Pandion haliaetus*	Osprey	LC	I
25	*Pavo cristatus*	Indian Peafowl	LC	I
26	*Circus melanoleucos*	Pied Harrier	LC	I
27	*Falco peregrinus*	Peregrine Falcon	LC	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered.*

Appendix C lists the resident birds and the migratory bird species found in the Study Area.

Reptiles

At least 22 species of reptiles have reported ranges that include the Study Area. Species of conservation concern with respect to the IUCN Red List include 3 species designated as globally threatened, both as Vulnerable (VU). Species of conservation concern with respect to the WPA include 1 species listed in Schedule I.

Table 4-13 presents the reptiles designated as globally threatened as per the IUCN Red List, as well as, those listed in Schedule I of the WPA.

Table 4-13: Reptiles of Conservation Concern of the Study Area

Sl. No.	Scientific Name	Common Name	IUCN Red List Category*	WPA Schedule
1	*Ophiophagus hannah*	King Cobra	VU	II
2	*Geochelone elegans*	Indian Star Tortoise	VU	IV
3	*Crocodylus palustris*	Mugger	VU	II
4	*Varanus salvator*	Common Water Monitor	LC	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered.*

Appendix D presents a comprehensive list of the reptile species found in the Study Area.

Amphibians

At least 16 species of amphibians have reported ranges that include the Study Area. None of these species is designated by the IUCN as globally threatened or near-threatened or is listed in Schedule I of the WPA.

Appendix E D presents a comprehensive list the amphibian species found in the Study Area.

Invasive Alien Species

At least 5 species having reported ranges that include the Study Area, comprising 2 plant species and 3 faunal species, are known to be invasive with respect to India.

Table 4-14 lists the invasive floristic and faunal species reported from the study area.

Table 4-14: Invasive Alien Species of the Study Area

Scientific Name	Common Name	IUCN Category*
Floristic Species		
Lantana camara	Sitammavari poda	-
Mimosa pudica	Attipatti	LC
Faunal Species		
Birds		
Columba livia	Rock Pigeon	LC
Pycnonotus jocosus	Red-whiskered Bulbul	LC
Reptiles		
Hemidactylus frenatus	Common House Gecko	LC

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern and NA – Not Assessed.*
Sources: IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2; Global Invasive Species Database, Invasive Species Specialist Group, IUCN; CABI Invasive Species Compendium; Invasive Alien Species of India, National Biodiversity Authority, Ministry of Environment, Forests and Climate Change, Government of India.

4.11.4 Habitat Profile of the Study Area

The Study Area is composed of natural, near-natural and modified habitats. The chief habitat-fragmenting features of the Study Area consist of a few metalled roads and many dirt roads. The aerial envelope of the Study Area is interrupted mainly by power transmission lines.

4.11.4.1 Natural Habitats

The natural habitats of the Study Area mainly consist of dense to light forest and scrub on the slopes and tops of hills and hillocks. Such natural habitats occupy a small portion of the Study Area. The vegetation therein is likely to range from near natural to slightly modified tropical moist deciduous forest or tropical dry evergreen forest.

4.11.4.2 Modified Habitats

The modified habitats of the Study Area mainly consist of habitation and cultivation on plains. The cultivation mainly includes fields of rice (*Oryza sativa*), maize (*Zea mays*), great millet (*Sorghum vulgare*) and sugarcane (*Sachharum officinarum*), orchards of mango (*Mangifera indica*), cashew (*Anacardium occidentale*) and banana (*Musa spp.*), as well as, plantations of *Casuarina equisetifolia.*

4.11.4.3 Critical Habitats

Habitats, either natural or modified, that are critical for the survival of IUCN-designated Critically Endangered (CR) or Endangered (EN) species, migratory species, congregatory species and endemic or restricted range species are considered as critical habitats. This section lists such species having recorded ranges that include the study area and, therefore, are potential Critical Habitat triggers with respect to the Study Area.

Critically Endangered or Endangered Species

At least 7 IUCN-designated Critically Endangered or Endangered species have reported ranges that include the Study Area. Table 4-15 presents the details of the Critically Endangered or Endangered species of the Study Area, including the scientific name and common name of each species, along with its IUCN Red List status and the WPA Schedule in which it is listed.

Table 4-15: Critically Endangered and Endangered Species of the Study Area

Scientific Name	English Name	IUCN Red List Category[16]	WPA Schedule[17]
Mammals			
Cuon alpinus	Dhole	EN	II
Manis crassicaudata	Indian Pangolin	EN	I
Birds			
Neophron percnopterus	Egyptian Vulture	EN	IV
Gyps bengalensis	White-rumped Vulture	CR	I
Gyps indicus	Indian Vulture	CR	I
Aquila nipalensis	Steppe Eagle	EN	I
Sypheotides indicus	Lesser Florican	EN	I

** Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered.*
Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2.

Migratory Species

The entire Indian subcontinent, including the Study Area, falls within the limits of the Central Asian Flyway (CAF), a major global flyway. The CAF connects a large swathe of the Palaearctic region with the Indian subcontinent and contains several well-established routes along which a number of bird-species migrate annually. This flyway covers a large part of the continental area of Eurasia and includes the whole of the Indian sub-continent. Thus, the Study Area is very likely to be situated in the annual cyclical flightpaths of the various winter, summer and passage visitor-birds migrating either to or through the region in which it is situated.

At least 49 species of migratory birds have reported ranges that include the Study Area.

Appendix C2 presents a comprehensive list of the migratory bird species reported from the Study Area.

Congregatory Species

Congregatory species include species that gather in globally significant numbers at a particular site and at a particular time in their life cycle for feeding, breeding or mid-migration resting.

At least 21 congregatory species have reported ranges that include the Study Area. The details of congregatory species are given in Appendix C3.

Endemic/ Restricted Range Species

None of the species reported from the Study Area are known to be endemic to or have ranges restricted to a particular region which includes the Study Area.

4.11.5 Designated Areas

Designated areas include nationally designated legally protected areas, such as National Parks, Wildlife Sanctuaries, Reserve Forests, Protected Forests, Community Forests and Conservation Areas notified by the

[16] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where CR – Critically Endangered and EN– Endangered.*

[17] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972*

Government of India, as well as, internationally recognized areas, such as Ramsar Wetlands, Important Bird Areas, Key Biodiversity Areas or UNESCO World Heritage Sites. There is one (01) designated area which is situated partially within the Study Area, but completely outside the Project alignment.

4.11.5.1 Legally Protected Area

The nearest legally protected area with respect to the Project Site is the nationally designated Kambalakonda Wildlife Sanctuary (WLS). The legally protected area is composed of a Protected Area (PA) of 71.39 sq.km., which forms the core protected area, and an Eco-sensitive Zone (ESZ) of 30.51 sq.km., which is intended to serve as a buffer to most of the core protected area. Kambalakonda has been declared as Eco-sensitive Zone (ESZ), vide S.O. 1366(E), dated 28th April 2017 by MoEF&CC. The ESZ is spread over an area of 30.51 square kilometer and includes 14 villages of 2 *Mandals, i.e.,* Anandapuram and Chinagadhili in Visakhapatnam district.

The ESZ extends 0 km to 4.33 km outwards from the boundary of the PA (excluding the project highway). As indicated by the ESZ notification, the ESZ surrounds the PA, excepting points where the PA boundary is situated adjacent to (land occupied by or reserved for) a state or national highway. The Project Site represents such land. Thus, no overlap is anticipated between the Project Site itself and any part of the PA or ESZ. However, parts of the PA, as well as, the ESZ are situated within the Study Area (Figure 4-14 and 4-15).

An article, authored by Satyanarayan Mishra, a researcher with the Pangolin Conservation Breeding Centre (Nandankanan, Bhubaneswar, Odisha), and published in the July 2010 edition of a scientific newsletter, mentions 3 cases of mortality of *Manis crassicaudata* (Indian Pangolin: IUCN Red List status: EN) on the existing road, owing to collision with motor vehicles, over a period of 3 months between July-September 2010. The article states that the Kambalakonda WLS, along with an area of approximately 80 sq.km. to its west, owing to its ecological attributes, serves as an excellent habitat for the said species. The article opines that individuals of the said species, as well as, many other species, especially small mammals, are at risk of injury and/or mortality through collision with motor vehicles while negotiating the said road to travel between natural habitats situated on opposite sides of the said road. This is, however, the only data on the subject that could be obtained from the public domain. Hence, additional or more recent records of wildlife injury and/or mortality on the existing road are unavailable to this assessment.

As per inputs received from Forest Department officials during the site visit, the section of the existing road situated adjacent to the PA of the Kambalakonda WLS experiences episodic presence of wild fauna, leading to events of injury and/or mortality of wild fauna owing to collision with motor vehicles traversing the said section. The Forest Department's draft wildlife management plan for the Kambalakonda WLS reflects the same observation. The Management Plan of the Kambalakonda WLS prepared by the Forest Department for the period from 2013-14 to 2022-23 states the same observation and mentions a plan to construct a protective wall along part of the boundary of the WLS to prevent wild fauna from straying onto highways or habitations around it.

As per inputs received from Forest Department officials, the habitats on the far side of the said road-section, with respect to the PA of the Kambalakonda WLS, are not legally protected and are open to development. As indicated by historical Google Earth imagery, a significant proportion of the said habitats appears to have been lost during the period between April and November 2018 owing to large scale clearing of land and construction of buildings. The said loss of habitat area appears to have reduced the previous level of contiguity between natural to near-natural habitats on opposite sides of the said road-section. DBL may consider to provide a retaining wall to prevent wild fauna straying from the sanctuary to highway at forest location from km 689.200 to km 689.500 subject to approval of NHAI and forest department.

4.11.5.2 Internationally Recognized Areas

There is no internationally recognized area situated within or near the Project Site or Study Area. The nearest internationally recognized area with respect to the Project Site is the Coringa Wildlife Sanctuary (WLS), an Important Bird Area (IBA) and Key Biodiversity Area (KBA), which is situated approximately 100 km south of the nearest point on the Project Site alignment.

4.11.6 Ecosystem Services

This section presents an overview of the provisioning, regulating and supporting ecosystem services provided by to the local community in the study area.

4.11.6.1 Provisioning Services

The provisioning ecosystem services provided by the Study Area include water, as well as, cultivated species that provide food, medicine, fodder, fuel, fertilizer, fibre and timber to the local community.

Water

The surface water bodies present in and around the Study Area, including freshwater streams, canals, reservoirs and tanks is harvested by the local community for its drinking, domestic and irrigation water needs. The groundwater reserves in and around the Study Area, accessed through borewells, are also harvested by the local community for drinking, domestic and irrigation water needs.

Cultivated Species

The local community uses the soils of the Study Area to cultivate food species, such as *Oryza sativa* (Rice), *Zea mays* (Maize), *Sorghum vulgare* (Great Millet or Jowar), *Arachis hypogea* (Groundnut), *Sachharum officinarum* (Sugar cane), *Mangifera indica* (Mango), *Anacardium occidentale* (Cashew Nut) and *Musa spp*. (Banana), as well as, timber species, such as *Casuarina equisetifolia* (Australian Beefwood). The Study Area is also likely to be providing fuel wood and timber to the local community through social or community forestry plantations of *Acacia auriculiformes* (Australian Acacia), *Leucaena leucocephala* and *Eucalyptus spp*.

4.11.6.2 Regulating Services

The Study Area provides regulating services to the local community in the form of groundwater recharge, surface-water purification, soil-erosion control, pollination and pest control.

Ground Water Recharge

The vegetation of the Study Area slows down surface run-off, which increases percolation of water into sub-surface layers, thereby promoting groundwater recharge.

Surface Water Purification

The vegetation of the Study Area filters out particulate matter from surface run-off, thereby purifying surface water.

Soil Erosion Control

The vegetation of the Study Area anchors soil-particles, lowering the rate of soil erosion by water and wind. Grasses, in particular, provide ground cover and anchorage to the soil..

Pollination and Pest Control

The vegetation of the Study Area provides habitats to pollinator species, such as, pollen or nectar feeding insects and birds, as well as, insectivorous species, including frogs, lizards, birds and bats. By harboring these species, the Study Area provides pollinator-services and pest-control services to natural, as well as, agricultural plants.

4.11.6.3 Supporting Services

The Study Area provides supporting ecosystem services to the local community in the form of capture and recycling of nutrients, as well as, primary production.

Nutrient Capture and Recycling

The food-chains constituted by the organisms of the Study Area capture, transfer and recycle the macro and micro nutrients in the soil, water and air, making them available in the nutrient-sinks of the local ecosystems.

Primary Production

The photosynthetic organisms of the Study Area produce food that directly or indirectly supports the consumer organisms of the area, including the local human communities.

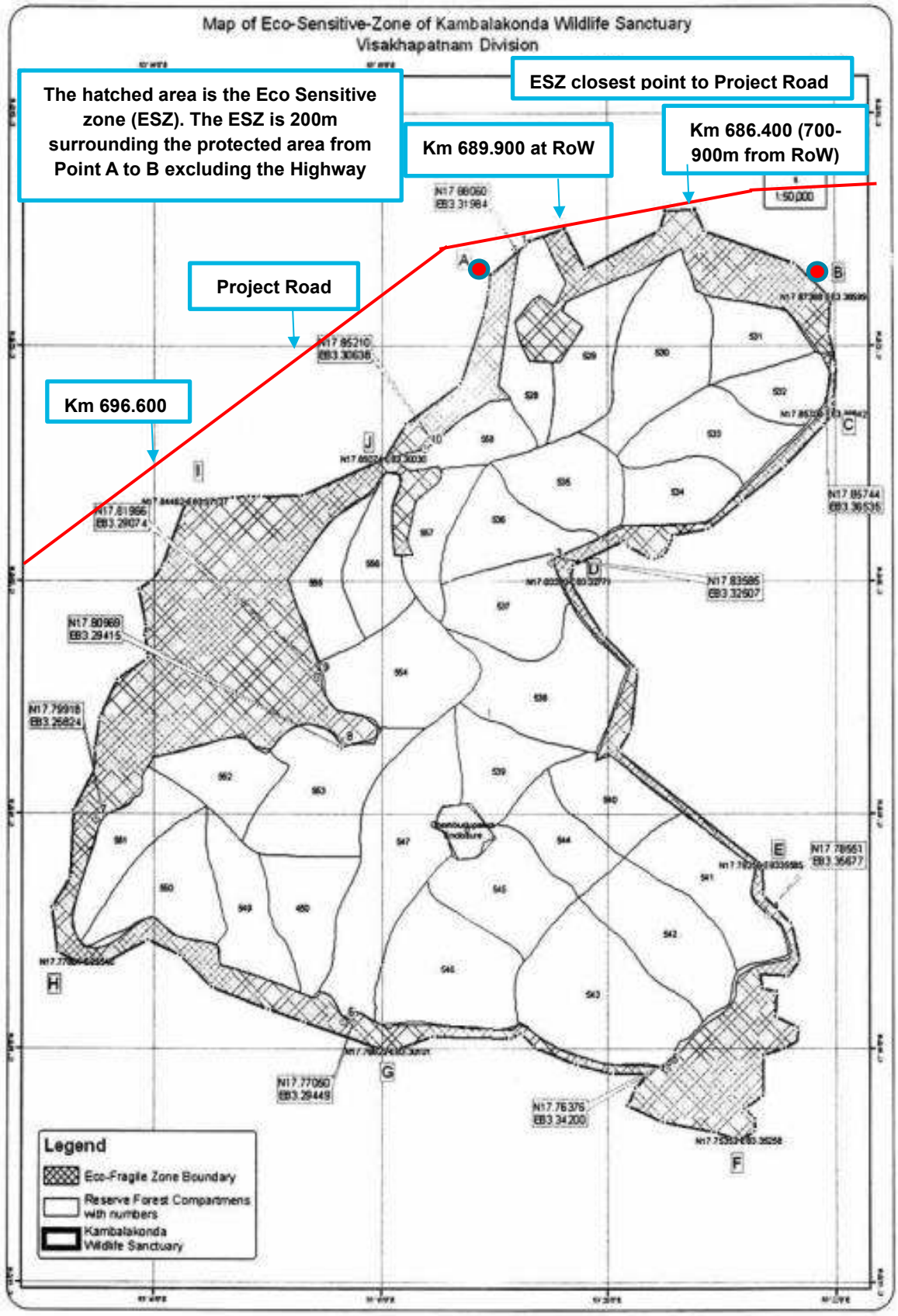

Figure 4-14: Location of LPA of Kambalakonda WLS with respect to the Study

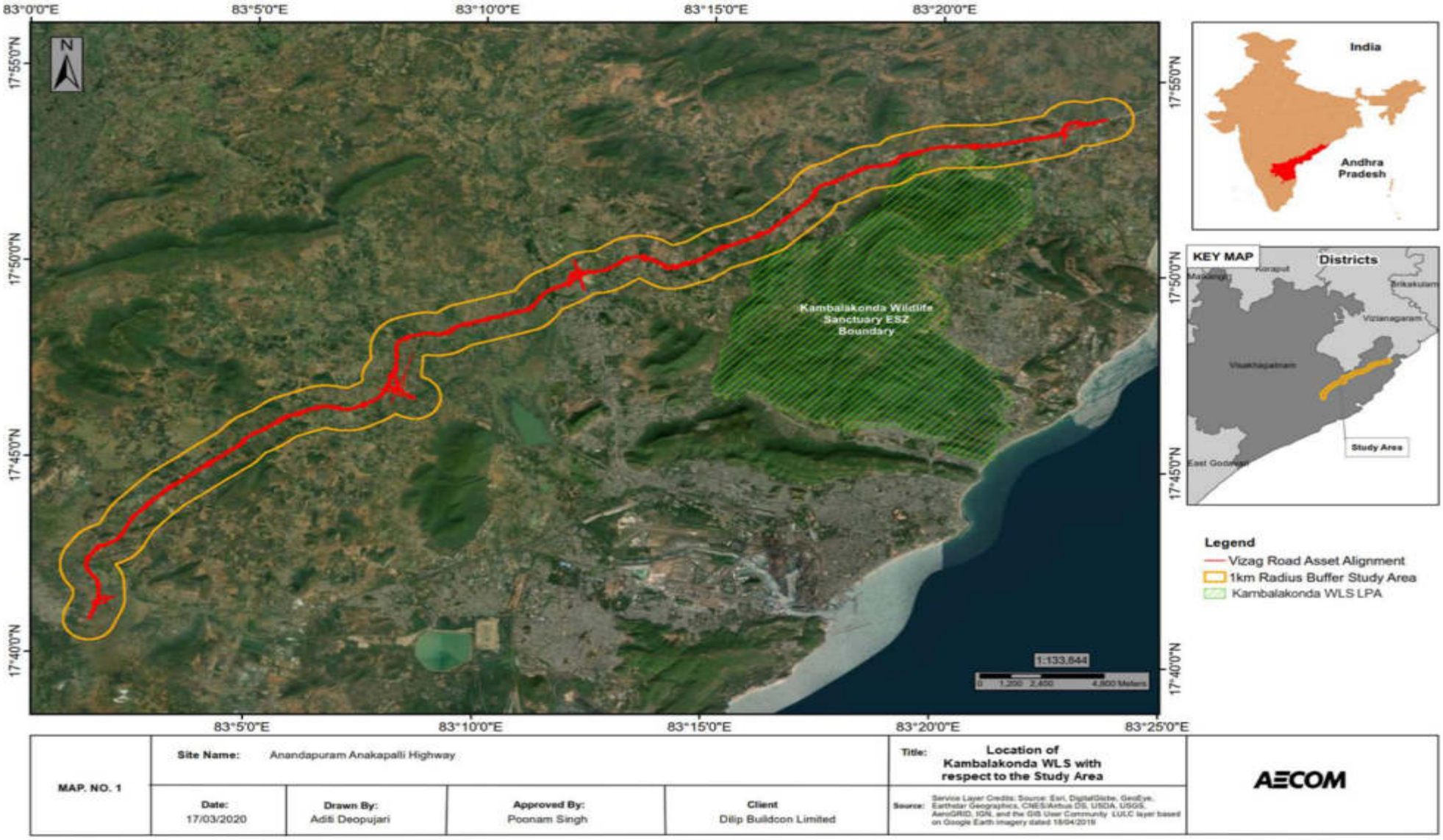

Figure 4-15: Location of LPA of Kambalakonda WLS with respect to the Study Area

4.12 Socio-Economic Baseline

According to the 2011 census Visakhapatnam district has a population of 42,90,589 out of which 57.95% population resides in urban areas. The district has a population density of 384 inhabitants per square kilometre. The Project primarily falls within the *Mandals/ Takula*[18] of Anandapuram, Pendurthi, Sabbavaram, Anakapalli and all these four *Mandals* falls within Vishakhapatnam district. The following table indicates of the villages through which the Project alignment passes. It is noted that none of the four *Mandals* have protected tribal population.

Table 4-16: List of villages through which the Project passes

Sl. No.	Name of Mandal/Taluka	Name of Villages	Total Number
1.	Anandapuram	Vellanki (Exstg NH); Vemulavalasa (Exstg NH); Anandapuram; Palavalasa; Gambheeram; Tarluvada; Gudilova; Sontyam; Gidijala; Narayana Gajapathiraju Puram - Bit 1; Mamidilova; Gangasani Agraharam; Narayana Gajapathiraju Puram - Bit 2; Gandigundam	14
2.	Pendurthi	Gurrampalem; Rajayyapeta; Saripalle; Pendurthi; Gorapalli; Rampuram; Pinagadi	7
3.	Sabbavaram	Mogalipuram; Sabbavaram; Amruthapuram; Iruvada; Pydivada; Askapalli; Gali bheemavaram; Dongalamarri Sitaramapuram; Batajangalapalem	9
4.	Anakapalli	Koduru; Rebaka; Sankaram; Golagam (Batlapudi); Anakapalli	5
		Total Number of Villages	35

Source: DBL

4.12.1 Details of Land acquisition and Project Affected Persons

The details pertaining to land acquisition, project affected persons, affected community facilities etc. dealt in Resettlement Plan Report (submitted separately). A summary of the same is presented below.

The total land requirement for the Project is 335.68 hectares (ha), of which about 304.68 ha is required for RoW and rest 31 ha for interchange, toll plaza and other facilities. The land has been acquired and provided by NHAI for construction of road. As of date approximately 22.12 ha of land acquisition is pending (Table 4-17).

Table 4-17: Land Requirement and Land Acquisition Status

Sl. No.	Description	Area (ha)
1.	Total land required for the Project Road	335.68 ha
2.	Land already available with NHAI	80.00 ha
3.	Land to be acquired for the project road (1-2)	255.68 ha
4.	Government land	59.63 ha
5.	Private land to be acquired	196.05 ha
	Status of pending and acquired private land	
6.	3G[19] awards (for private land) approved so far	180.18 ha20
7.	Balance private land, yet to be acquired (5-6)	15.87 ha
8.	Government Land yet to be transferred	6.25 ha
9.	Total land pending acquisition/ transfer (7+8)	22.12 ha

The land acquisition process for the Project was initiated in 2016. The earliest 3A notification21 was published in July 2016. A total of 23 number 3A notifications were published for a total of 392.12 ha area. Similarly, 20 numbers 3D notifications22 were published between February 2017 and May 2018 for a total area of 263.05 ha. The award declaration (under section 3G of NH Act, 1956) was published between February 2018 and October 2019. Till date 52 awards have been published totalling an area of 180.18 ha of private land. Such details on land acquisition notifications are dealt in Resettlement Plan Report and summary of notifications are provided in Appendix F.

[18] Mandal/ Taluka is an administrative unit typically comprising a number of villages.
[19] Section of National Highway Act,1956 under which land acquisition compensation awards (for private land) are declared
[20] As per summary of 52 declared awards, shared by the office of 'competent authority for land acquisition (CALA)
[21] preliminary notification under NH Act, 1956 to express intent of the government to acquire land
[22] Notification under NH Act, 1956, declaring final list of land parcels to be acquired

The social surveys conducted for the Project reports that there are 1798 title holders were impacted because of the Project, of which 549 are women titleholders. Further, there are 105 number of encroachers (households) who were impacted because of the road widening. Other salient features are given below.

- There are 105 structures currently standing within the RoW;
- Of these, 88 are private and rest are government and community structures;
- The private structures are owned by 95 families;
- Affected private structures include, 2 that are on assigned land (government owned land assigned to poor/ vulnerable families for use without transfer of ownership title), 24 on private land and rest are on government land (encroachment);
- Formal award /ex-gratia has already been declared/ finalized for 38 of the 88 private structures, award preparation is under process for 36 structures and award was already paid to the rest 14 structures during earlier land acquisition exercise;
- There are 65 of the 95 affected families have been found to be vulnerable (on one or multiple vulnerability parameter) who were impacted because of the Project.

The total compensation amount awarded for acquisition of land for the Project was INR 5.616 billion, corresponding to 180.18 ha of land. Out of this amount, INR 3.747 billion (66.72%) has already been disbursed till October 2019. Further data as available for the disbursements carried out till April 2020 from CALA office records that INR 0.138 billion was deposited for the claimants. The total disbursed amount as per the available data is INR 3.885 billion (69.18%). The details of Compensation disbursement status is given in Appendix G.

4.12.2 Labour Work Force

DBL has reported that the Project employs a total of 430 labours to execute construction work. AECOM undertook a site visit to labour camps on 1st and 2nd March 2020 to assess the present labour working conditions, facilities provided, safety and compliance of labour contractors with respect to national legislative requirements (related to contract labour, minimum wages, employment of child labour etc).

There are six labour camps, of which four (04) are located along the road and two at quarry area. As informed during site visit, DBL informed that there are no female labour workforce involved in this Project, all labour workforce are male members. The details of labour camps are given below.

Table 4-18: Labour Workforce on the Project

Labour Camp Location	Chainage	Number of Male Labourers	Number of Female Labourers	Number of Rooms	Expected Date of Demobilization
Base Camp 1	689+900	135	0	33	1st July 2021
Base Camp 2	724+700	165	0	37	1st July 2021
Sub Base Camp 1	703+500	48	0	12	1st July 2021
Sub Base Camp 2	709+500	48	0	12	1st July 2021
Maturu Quarry	-	20	0	3	1st July 2021
Vavilapadu Quarry	-	14	0	2	1st July 2021
Total	-	430	0	99	1st July 2021

Labour camps inspection

During site visit following observations were made with respect to labour camps[23].

- The living facilities are located in camp site (campsite 1 and 2) and sub base camp (1 and 2). Primary these sites are away from water courses and thereby avoids risk of flooding.
- The living facilities are built with bricks and galvanized iron sheets and floors are made with concrete flooring. Each room has a window and door which can be locked from both inside and outside. The ceiling height is found to be 10 feet.

[23] AECOM visited labour accommodation and living condition of M/s Tapas Paria (engaged for PQC work), M/s Sarif Biswas (engaged for PQC work), M/s Ranjit Singh (engaged for structure work), M/s Kothakapu Raghava Reddy (engaged for highway work) and M/s Rajkamal (engaged for structure work).

- Each room houses 5 to 15 persons and does not have any curtains to ensure privacy. The rooms are provided with of bed, light and fans. No other separate furniture like chair, luggage space/ cupboards etc. are found during site visit. The beds were positioned close to each other without minimum space of 1meter.
- It was found that the density standards (number of residents per floor space) of each room were high against the usual space of approximately 40 square feet surface area.
- Other common facilities provided in labour camps are mattress, sanitation, drinking water, bathing space and security arrangements in the campsite. The number of toilets and shower/bathroom facilities provided to workers is about 15 persons/ unit. The shower/bathroom facilities are not provided with an supply of cold and hot running water. Adequate drainage facilities are lacking at bathing facilities and thereby overflowing of water is marked. Domestic wastewater from the toilets and bathing facilities lead to water stagnation and could act as breeding ground of mosquitoes.
- Though sanitary facilities are located within the same premises, but separate arrangements for sanitation and bathing facilities for men and women workers are not marked.
- There is a common canteen where food is prepared and provided to workers. The kitchens are provided with facilities to maintain personal hygiene including washbasins and RO water, tables and chairs for dining. The water coming from RO unit is not labelled as “Drinking Water” in a language understood by majority of the workers employed at construction site.
- The site staffs/ management has not developed and implemented waste management plan. It was informed by DBL that domestic waste from labour camp is disposed in open areas.
- At few places along the road where bridge construction work is going on small labour camps were established temporarily using tins were loosely mounted creates unsafe condition for workers. These labour camps were not provided with sanitation facilities, ventilation, electricity and provision of potable drinking water. No separate cooking places are provided here. The cooking place was very unhygienic and fuel wood was used for cooking.
- Adequate precautions are not taken to avoid the electrical hazards. The electric wires having many joints are found laid on the floor. Adequate measures like covering of the junction boxes/ panels are not taken to prevent physical hazard. The temporary electrical installations at construction site are not found to be provided with earth leakage circuit breakers. Few rooms were found to be loosely hanging electric wires which pose a major safety threat. Danger notices/ warning signs placed on electrical installations were not present in English, Hindi and local language, Telugu.
- It was noted that electrical wire was strewn on the ground without any marking and some of the wire was submerged in the water. Moreover, this cable was on the access path of the workers.
- It was noted that the all workers were not provided with adequate PPEs. As informed by DBL, though the PPEs were provided, but using them is not strictly enforced.
- Identity cards have not been issued by the contractors, detailing the name of the worker, designation, age and photograph.
- Firefighting and first aid facility was not available at labour accommodation
- Emergency contact numbers were not displayed prominently at the labour camp
- Pre-medical records and records of workers (as per section 223, Form XI) were not maintained onsite by the contractor.
- It was informed that an informal structure of grievance redressal mechanism is in place at site. It was confirmed by the workers, that in case of any issues, they directly approach the site supervisor. The grievance records were not available and maintained for review.

5. Analysis of Alternatives

5.1 Introduction

This chapter presents a comparative analysis of various alternatives considered to avoid, prevent or minimize impacts that would be inevitable if technically (based on design speed and geometrics) best-fit alignment is followed. A comparative analysis of alternatives will help to determine the best method of achieving Project objectives while minimising environmental and social impacts. Various alternatives selected for analysis usually includes the 'no project' or 'no action' alternative. The alternatives were considered for finalization of various options such as realignments, bypasses and different construction material options keeping in view objectives of the Project, traffic condition, obligatory points, geometric designs, congestions, socioeconomic viability, environmental and safety aspects. The discussion includes no project scenario; project with alternatives and project with mitigation measures. The objective of this chapter is to highlight some of the salient issues considered for exercising options.

5.2 Project Alternatives

5.2.1 No Project Scenario

The 'No project scenario' is analysed with respect to the development of the state as a requirement of reliable quality infrastructure for sustained growth of economy and consequent well-being of its citizens. Providing better connectivity within the State will ensure that, goods and people from areas accessed by the road can commute quicker and save time. Increase in trade and commerce activity is expected. The savings in the vehicle operating costs makes the Project viable.

The Project road between Anandapuram to Anakapalli is an existing National Highway 16 which connects Kolkata- Chennai NH-16 running through the Visakhapatnam city. The requirement of an extension of it to 6 lane was long felt due to the heavy traffic congested in the city limits, particularly during rush hour when the traffic comes to a crawl. Because of the better connectivity, the economic activity and employment potential for people in the region will increase. However, there would be an increase in the vehicular pollution - air and noise, in the vicinity of the road. Some agricultural land will have to be diverted for road widening, realignment and bypasses. Where the road is passing through villages and towns, some people will lose their properties close by the road to accommodate the proposed widening.

If the project is not implemented, there is every likelihood that the existing bad pavement of the corridor deteriorates further. In the absence of the proposed Project, the district will also find it extremely difficult to generate revenue. Increased air pollution, due to bad road condition, slow moving traffic and congestion will increase as the time goes by. Noise levels will rise due to deterioration of the pavement as well as increased honking. Without the improvement of the Project, the traffic would continue to pose a safety risk for the road users.

Therefore, 'Project with alternatives' scenario, with its minor adverse impacts is more acceptable than 'No project scenario' which would mean an aggravation of the existing problems. Potential benefits of the proposed road improvements are substantial and far-reaching both in terms of the geographical spread and time. Hence, it is recommended that, the implementation of the Project will be an advantage to Andhra Pradesh State in order to achieve all-round development of its economy and progress of people.

5.2.2 Project with Alternatives

Although the Project alternatives in terms of location (alignment) option is very limited as the project objective is to improve the existing roads except that some lengths of route require alternatives such as change of alignments from congested locations within towns or major human settlements to avoid impact on the public and community properties; traffic congestion; air pollution; noise levels and accidents; ribbon developments to safe guard social and commercial integrity of the region and to avoid resettlement and business re-establishment costs; to smoothen existing sharp curved (poor geometrics) alignments for facilitating traffic movement.

The alternatives considered with respect to alignment, routing, construction methods, materials used, landscaping, human values such as health and education, land use impact and keeping business and

commercial integrity for construction of road. Frequently two to three alternatives are chosen, and these alternatives are presented below.

Proposed Bypasses

Two bypasses are proposed at Pendurthi and Sabbavaram built up areas and a realignment at Anakapalli. There are two/ three alternatives were proposed for each bypass/ realignment and the best option is finalized based on the land requirement, loss of property and density of the habitation.

- **Pendurthi Bypass:** Pendurthi is a suburb and a *Mandal* in the district of Visakhapatnam and also a part of the Greater Visakhapatnam Municipal Corporation. The existing alignment passes through Pendurthi and is very congested with poor geometries. The settlements are densely made up of built-up area consisting of residential and commercial buildings. Congestion of local traffic is noticed within the village limits, hence making the bypass imperative.

Table 5-1: Comparison of Alternatives – Pendurthi Bypass

Description	Alternative 1	Alternative 2
Existing Chainage	Km 26.610 to 33.39	Km 26.610 to 33.39
Proposed Chainage	Km 699.900 to 706.5	Km 699.900 to 706.5
Length of proposed bypass	6.6 km	6.5 km
Length of Existing Road Bypassed	5.7 km	5.7 km
Depth of habitation	1.0 km	0.5 km
VUPs	1	3
PUPs	3	3
Interchange	1	1
ROBs	1	1
Number of Major Bridges	2	1
Land Acquisition	41 ha	44 ha
Traffic (Pendurthi Junction)	85222 PCUs	85222 PCUs
Selected Option	**Yes, as minimum land acquisition and costs**	**No**

- **Sabbavaram Bypass:** Sabbavaram is a *Mandal* head quarter in the district of Visakhapatnam located on the northwest side of Visakhapatnam. The village of Sabbavaram has a population of 12,200 with a total of 2,700 families residing in it. The existing alignment passing through Sabbavaram is very congested with very poor geometrics. Sabbavaram village is densely built-up, consisting of residential and commercial buildings abutting to existing carriageway. Congestion due to local traffic is observed within the village limits. Hence, a bypass option for Sabbavaram village is economical and feasible in comparison to widening of existing road to 6 lane configuration.

Table 5-2: Comparison of Alternatives – Sabbavaram Bypass

Description	Alternative 1	Alternative 2	Alternative 3
Existing Chainage	Km 38.1310 to 12.290	Km 38.1310 to 11.900	Km 38.1310 to 13.700
Proposed Chainage	Km 711.600 to 718.800	Km 711.500 to 718.900	Km 711.500 to 717.150
Length of proposed bypass	7.2 km	7.4 km	5.65 km
Length of Existing Road Bypassed	6.38 km	7.17 km	5.37 km
Depth of habitation	1.79 km	1.36 km	1.36 km
VUPs	3	3	2
PUPs	2	2	2
Number of Major Bridges	2	2	1
Connectivity to Port Road	Connection on bypass is not feasible	Connection on bypass is feasible	Connection on bypass is feasible
Land Acquisition	45 ha	48 ha	40 ha
Traffic	37,103 PCUs	37,103 PCUs	37,103 PCUs
Selected Option	**No**	**No**	**Yes, as minimum land acquisition and costs**

Anakapalli Realignment

Land use abutting to existing alignment is mainly agriculture. There are some encroachments noticed at few locations near Anakapalli town and near T Junction. Existing road has 2 lane ROB over existing railway line at Km 1.000. This section of road passes through outskirts of Anakapalli town, Sankaram and Rebaka villages. Three alternatives have been studied for proposed take off point/ realignment and the best option was selected. The double trumpet interchange is recommended at Anakapalli where the Project road meets NH – 16. The through traffic coming from Tuni/ Vijayawada to Anandapuram/ Pendurthi travels through the elevated portion. The traffic traveling from Tuni/ Vijayawada towards Visakhapatnam need to travel through the two loops before merging with the through traffic of east – west corridor. While, the traffic traveling towards Anakapalli needs through travel through a loop and then merges with the trough traffic of east – west corridor. This would reduce a lot of traffic congestion and hence reduce the noise and air pollution.

Table 5-3: Comparison of Alternatives – Ankapalli Realignment

Description	Alternative 1	Alternative 2	Alternative 3
Length of proposed realignment	1.85 km	3.21 km	3.14 km
Grade Separators	On NH 16, Double Trumpet type	On NH 16, Double Trumpet type at end	Cloverleaf at end location
Existing ROBs	-	4 lane ROB on NH 16	-
New ROBs	6 lane ROB	2 lane + 2 lane on NH 16	6 lane ROB
Traffic	72,607 PCUs	72,607 PCUs	72,607 PCUs
Selected Option	**Yes, as minimum land acquisition and costs**	**No**	**No**

5.2.3 Project with Mitigation Measures

Project with mitigation measures is most acceptable alternative in many cases. In this alternative, emphasis is given to minimise the impact due to project implementation on the environmental features. This alternative is most suitable where the option of 'Project with alternatives' is limited.

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6. Impact Assessment

6.1 Introduction

This chapter describes the environmental and social impacts identified by accessing the primary and secondary information gathered. Impacts have been identified based on review of available Project information, discussions with representatives of the Project, local community, as well as, sector-specific professionals and subject experts. Impacts anticipated during the construction and operation phase have been included and classified.

Additionally, this chapter evaluates the significance of each identified impact on the basis of the collective severity of its spread, duration, intensity and nature. Mitigation measures have been suggested for the identified impact evaluated as significant.

6.2 Assessment Criteria

Identified impacts have been appraised along the criteria of spread, duration, intensity and nature. As presented in Table 6-1, each appraisal criterion is further classified based on the level or type of its spread, duration, intensity or nature, while stating the defining limit of each level or type.

Table 6-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Local spread	Impact is restricted within the footprints of the Project boundary	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	Medium Spread	Impact is spread up to 2 km around the project area	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	High spread	Impact is spread beyond 2 km from footprint boundary of the Project	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Short Duration	When impact is likely to be restricted for a duration less than 2 years or till construction period	In case of biodiversity, the anticipated recovery time of impacted habitats or ecosystem services would be considered
	Medium Duration	When impact extends up to five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
	Long Duration	When impact extends beyond five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
Intensity: Defines the magnitude of impact	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	High intensity	when changes in the prevailing (baseline) environmental conditions exceeds 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

Table 6-2 presents the Impact Significance Matrix applied in order to assess the overall significance of the impacts appraised as per the Impact Assessment Criteria outlined in Table 6-1.

Table 6-2: Impact Significance Matrix

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Medium	Minor	Minor
	Medium	Low		
	Medium	Medium		
Medium	Short	Low		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
Local	Medium	High		
Local	Long	Medium		
Medium	Short	Medium		
Medium	Medium	Low		
Medium	Medium	Medium		
Medium	Long	Low		
Medium	Long	Medium		
High	Short	Low		
High	Short	Medium		
High	Medium	Low		
High	Medium	Medium		
High	Long	Low		
Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Medium		
High	Low	Low		
High	Low	High		

6.3 Impact Identification

Table 6-3 below presents the Activity-Impact Interaction matrix for pre-construction, construction, operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 6-3: Activity- Impact Interaction Matrix – Pre-Construction, Construction, Operation & Decommissioning Phase

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Pre-Construction and Construction Phase											
Land Procurement											
Site Clearance, Stripping of Topsoil, Site Levelling and Grading											
Sourcing, Transportation and storage of Construction Materials and equipment											
Quarrying Activity											
Storage and Handling of Raw Materials and Debris											
Establishment and Use of Labour Camp											
Drilling and Blasting											
Operation of DG sets											
Pavement works											
Use of Construction equipment											
Culvert and Bridge Construction											
Handling and Disposal of Wastes											
Operation Phase											
Vehicular Movement											
Maintenance of ancillary facilities											
Site Maintenance and Security											

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Handling and Disposal of Waste											
Material Handling and Storage											
Water Requirements for employees											

6.4 Anticipated Impact during the Pre- Construction, Construction and Operation Phase

Due to the activities of the proposed improvement there will be some potential impacts on the surrounding environment of varying magnitude. Most of the impacts are likely to occur during the construction phase and few impacts occur during the operation phase of the Project. The subsequent sections deal with the prediction of impacts due to the project on the natural, biological and social environment. Impacts have been assessed based on the information collected from the environmental surveys, study reports and additional secondary data collected as part of the study.

6.4.1 Impact on Physical Environment (Topography and Meteorology)

The impact on geology is mainly due to substantial change in road profile. Likely impact on the geological resources will occur from the extraction of materials (borrow of earth, granular subbase and aggregates for base courses and bridges).

There will be temporary change in the micrometeorology, particularly in temperature, of Project area due to tree cutting and increased paved surface. Temporary loss of shade from the roadside trees may cause minor discomfort to slow moving traffic and pedestrians. As the width of the clear zone will be increased, this will provide greater safety for road users. The new embankments slopes will be provided with turf and compensatory afforestation, which will increase the green cover in the project influence area.

The impact on Topology and Meteorology will have a local spread within the project vicinity, moderate intensity and will last for a long duration, which will result in an overall minor impact after mitigation.

Mitigation Measures

- The micro meteorological conditions are localised and limited to immediate vicinity of the road.
- Plantation of trees along roadside would improve the overall condition.
- Provision of wayside amenities would improve the local environment.

Significance of Impact

The overall impact on the meteorology of the region are not going to change significantly and, therefore, the impacts on the micro- meteorology due to the project are **low**.

Table 6-4: Impact Significance – Physical Environment

Aspect	Scenario	Spread	Duration	Intensity	Overall
Physical Environment	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

6.4.2 Impact on Soil

The Project has been constructed on open fallow land or agricultural patches. Loose topsoil will be peeled off and site levelling activities will be carried out for laying of pavement. Soil contamination may result due to accidental spillage and inappropriate storage of hazardous waste, construction debris, diesel or transformer oil etc. during construction phase. However, these activities and associated impacts are limited to be within the Project boundary and during construction phase only.

Construction Phase:

Alteration of agricultural land to non-agricultural land is a major impact on land, as some land needs to be acquired for the Project permanently. Upgradation of Project road requires acquisition of agricultural land abutting Project where the proposed RoW width exceeds the existing RoW.

Suspended particulate matter from quarries and crushers lead to decrease in productivity of the soil; degeneration of plant species and retards the plant growth.

Loss of Productive Soil: The project corridor requires marginal land acquisition at selected places. Some stretches of the project corridor constitutes productive agricultural land which may be affected. Some temporary loss of soil may also be envisaged during construction phase, if construction plant, offices, workers camps,

stockyards, borrow areas etc. located on fertile areas and if haul roads and traffic detours during construction etc. are routed through agricultural lands. Loss of agricultural land may result from the establishment of construction camp, labour camp, concrete batching plant, hot mix plants borrow areas, quarries near to project roads and access roads. Use of such land may cause minimal and temporary impact on productivity of the land.

Soil Erosion: Elevated sections of all project roads, particularly high embankments near bridge approaches will be vulnerable to erosion.

Compaction of Soil: Compaction of soil may occur, during site clearance due to movement of heavy machinery and vehicles and during setting up of construction camps and stockyards. During construction, there is a possibility of compaction due to the movement of vehicles and heavy machinery.

Contamination of Soil: Soil may get contaminated with spills from accidents or leaks of vehicles carrying hazardous chemicals; the probability is very low but potentially disastrous to the surrounding environment. The project houses ancillary facilities such as vehicle maintenance area, DG sets, storage of diesel etc, spillage of oil from these facilities in absence of containment and spill kit could cause severe contamination of land. The nature and duration of the impacts depends on the handling of the spills and this risk exists now and will not be significantly increased by the project.

Impact on Borrow Areas: Due to the extraction of the materials from the soil borrow areas and boulders/ aggregates/ granular base can result in some direct and indirect impacts on the local and regional environment. As part of the project design, sources of the materials for the use in the permanent works have been identified. Two quarries have been leased to extract construction material.

Operation Phase:

At this phase there is possibility of soil contamination by spills from accidents or leakage from vehicles carrying hazardous chemicals. The probability of incidents is low and such impacts will depend to a great extent on how such situations are handled on ground. DBL needs to prepare an emergency management plan to handle such situations.

Mitigation Measures

- Top humus rich soil from productive agricultural lands should be preserved during construction and reused later for plantation works and for turfing works of embankment slopes.
- Existing roads shall be used for hauling the construction materials and new haulage roads are routed on the barren lands.
- A construction camp layout plan shall be developed with designated area for storage of fuel, oil and lubricants with required slope directing it to oil interceptor before washings are let into the waste water chamber.
- All efforts shall be made to restore the sites of construction camps, labour camps, borrow areas, and access roads to these establishments shall be restored and rehabilitated to its original land use after construction works are over.
- It shall be planned in such a way that construction activities and diversion of traffic nearby settlements does not disturb the commercial activities of the towns.
- Road building materials will be procured from approved and licensed quarries only.
- Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss during high wind and runoff.
- Recommended slope ratio of 1 vertical to 2 horizontals shall be maintained to avoid soil erosion and landslides at embankment slopes and at borrow areas. IRC: 56-1974 shall be followed for treatment of embankment slopes for control of erosion.
- All construction debris shall be cleared immediately after the construction is over to prevent unconsolidated soil being eroded by either wind or runoff water.
- Allow only covered transportation of materials within Project site.
- Special care has to be taken while construction at erosion prone locations during monsoon season.

- Construction debris to be reused in paving on site approach road to prevent dust generation due to vehicular movement.
- Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
- Store chemical/hazardous material like diesel and used oil in isolated room and on impervious surface to prevent seepage into project site soil.
- Filling and transfer of oil to and from the container should be on impervious surface.
- All oil functioning stationary machineries should be carried out on impervious surface.
- Storage and disposal of hazardous waste in line with Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2016. Hazardous waste will be disposed to State Pollution Control Board authorised vendor only.

Significance of Impact

Considering the distribution of impact within the project boundary and short duration of construction phase with moderate intensity makes impact of moderate significance and can be controlled with the recommended mitigation measures to reduce the overall impact to minor.

Table 6-5: Impact Significance – Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

6.4.3 Impact on Water Environment

Construction Phase:

A few small river crossings and irrigation canals exist along the Project road. Construction activities may lead to degradation of water quality in terms of increased suspended solids as well as oil/ grease concentration. Adequate precautionary/ mitigation measures will be exercised to control these effects during construction.

- Water required for construction of road and for domestic uses of labour camps and workers drawn from existing community borewells and nearby irrigation canals may impact the local users.
- Sources of ground water such as borewells and hand pumps are getting affected by the widening of the project road.
- Unscientific disposal of the untreated wastewater generated in the construction camp and labour camps may contaminate the ground water.
- Disturbance to flows; alteration of drainage causing erosion.
- Any spillage of chemicals or disposal of waste in or near the seasonal streams can cause water pollution issues in nearby areas. In addition to this, improper disposal of sewage and wastewater from construction activities and construction debris can contaminate the ground water resources in the area.
- Some of the water supply units adjacent to Project road within proposed RoW will be impacted. Siltation of streams due to increased insurgence of debris flowing into the water bodies may be evident.

Operation Phase:

At operation phase there is very little chance of deterioration in water quality on streams. This may happen only in case of accidental discharges. As all safety measures will become operative during the operation phase there is rather low probability of such incidents.

Mitigation Measures

- Construction works of culverts and bridge (cross drainage structures) should be taken up during the lean flow periods in summer to minimize the impacts on drainage.

- The water should be sourced from authorized sources who have taken prior approval from the concerned authority.
- All the water resources and water supply connections such as borewells, taps, water cisterns, pipelines, etc. being impacted by the project shall be relocated in such a manner that it should not hamper the access to drinking water. Relocation of borewells shall be done with consent of concerned water supply authority or the owner.
- Ponds and tanks should be conserved by effective planning and design modifications. The locations should be such that it should be on barren land.
- Appropriate location should be sited for the construction camp, workers camp, etc. to prevent the wastewater from entering these water resources and prevent incidence of spreading of communicable diseases through water. Provision for treatment of wastewater shall be made.
- Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way to ground and surface water bodies.
- Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.
- When the excavation is undertaken in the wet area of the water body, the banks shall be protected, such that the slopes are not steeper than 1 vertical to 2 horizontals. Protection works such as geo-textures, silt traps shall be used to control the erosion at these points.
- Restoration plan to accommodate the loss of groundwater to be undertaken.
- Paved impervious surface and secondary containment to be used for chemical and fuel storage tanks to avoid spillage/ stain, if any, to find its way to surface and groundwater.
- Leak proof holding tanks to be provided for sanitary wastewater to protect contamination of shallow groundwater level.
- Water holding tanks/ septic tanks to be located away from the abstraction wells or any other underground holding tanks.
- Construction waste shall not be dumped into the rivers as it constricts the passage to the flow of water and ecosystem of the water body is disturbed.
- Cleaning of construction vehicles and construction equipment's shall be prohibited at rivers, canal and other water bodies.
- All efforts shall be maintained to use the hazardous tainted bituminous material in the construction of approach roads and disposed off on the landfill or dumping into clay lined bitumen disposal pits so that that leachate does not reach the ground water and pollute.
- Provision for oil interceptors shall be made at all the construction camps/workshop areas to separate the oil and grease waste generated from servicing of equipment's and vehicles used in the construction.

Significance of Impact

The impact on water resources will have high intensity with a medium spread for a short duration which will result in an overall major impact without mitigation. However, with proper implementation of suggested mitigation the impact will be reduced to moderate.

Table 6-6: Impact Significance – Water Resources

Aspect	Scenario	Spread	Duration	Intensity	Overall
Water resources	Without Mitigation	Medium	Short	High	Major
	With Mitigation	Medium	Short	Moderate	Moderate

6.4.4 Impact on Air Environment

The preconstruction and construction phase activities include site clearance, shifting of utilities, removal of trees present in the corridor of impact, transportation of man and material, construction of accommodations, construction of stock yards, installation of construction plants and construction of office buildings. Dust generation during such activities would be the predominant polluting activity during pre-construction phase and particularly

so if pre-construction tasks are performed during dry weather. Large quantities of dust become wind borne and are carried away depending on the wind velocity and wind direction. The fugitive dust released during the construction activities cause immediate effect on the construction workers as well as on the settlements adjacent to the alignment, especially those in the downwind direction.

Construction Phase:

During the construction phase the most predominant air pollutant would be particulate matter along with various other gaseous pollutants like oxides of nitrogen, carbon monoxide, sulphur dioxide and carbon-based emissions from the hot mix plants. The air pollution during the construction phase may be considerable locally, particularly near the working zones, construction plant sites, quarries and from construction machinery and construction vehicles. stone crushing units in the stone quarries, etc also add to the problem. Most of the generated pollutants from the above activities are limited to construction phase and confined to impact zone in downwind direction of the site hence no significant is envisaged.

Mitigation Measures

- Consent for Establishment (CFE) and Consent for Operation (CFO) shall be obtained for all construction establishments such as hot mix plants, batching plants and stone crushers from the SPCB. All Project activities are adhered to the contractual obligations under clearances and approvals.
- All vehicles and construction equipment's operating for the contractor and the consultant shall obtain "Pollution Under Control" (PUC) Certificates. Good maintenance of all vehicles and machines used in construction activities must be conformed to the applicable national standards.
- Vehicles deployed for borrow material, sand and aggregate haulage shall be covered with tarpaulins to be spillage proof.
- Location of all construction establishments such as hot mix plants, WMM plants, Crusher plants, Construction camps and offices be located at least 500 m away from the human habitations and preferably on the leeward side ensuring all legal requirements and standards.
- In order to curb the increased fugitive dust emissions in the area due to excavations, loading, unloading, vehicular movement and raw material transport, provisions shall be made for periodical sprinkling water on all the haul roads on a regular basis during the entire construction period.
- Intersections of the temporary road should be executed in such a way that there remains no bottleneck, to reduce traffic congestions. Maintaining a steady stream flow of traffic and by segregating slow and fast moving traffic is an advisable option.
- Pollution control devices such as cyclone separators /scrubbers shall be installed to control emissions from hot mix plants, crushing units and concrete batching plants. Height of the stacks shall be as per the statutory requirements.
- Construction labours shall be provided with nose masks and other personnel protective equipment's.
- Low sulphur diesel shall be used in the Diesel Generator (DG) sets and DGs are fitted with the chimney stack of required height.
- To ensure the efficacy of the mitigation measures suggested, all operational areas (work sites, haul roads, hot mix plants, quarries, borrow sites and disposal sites) under the road construction works are to be regularly monitored for air quality parameters so that suitable mitigation measures can be taken up if any of the parameters exceed the prescribed limit.

Operation Phase:

This phase is characterized by increased intensity of vehicular movement because of improved connectivity thereby increasing pollution load. The impacts of oxides of nitrogen, carbon monoxide, and respirable particulate matter will increase with the increasing number of vehicles using this road. Such impacts will be of long term and felt within a corridor width of 75m –100m on both sides from the edges of the road. Infrastructure development projects necessarily bring in its wake problems of emission .However future regulatory measures on stricter emission norms, improved auto-technology and introduction of improved fuel quality may substantially ameliorate air quality over the years.

Air Quality Modeling:

To assess the likely concentrations at the major locations along the corridor, prediction of pollutant concentrations has been carried out using CALINEPRO model (a dispersion model based on Gaussian Equation). Description of the input parameters for the prediction is detailed in Box 6-1.

CALINEPRO employs a mixing zone concept to characterize pollutant dispersion over the road. The model can be used to predict the pollutant concentrations for receptors located upto 2 to 5km from the roadway for the various pollutants with reasonable accuracy. The input parameters for the modeling have been considered are volume of traffic, width of road, meteorological conditions including wind, stability class, temperature and mixing height etc, and CPCB vehicular emission standards of the various locations along the project road.

Modeling Analysis

The predicted concentration for 2025, 2030, 2035 and 2040 have been considered for modeling. For emission of pollutant, Bharat Stage IV has been considered. Although from 1st April 2020 Bharat stage VI standards have been implemented but in reality it is not yet implemented.

The emission factor standards of Central Pollution Control Board for pollutant CO, NOx and PM are considered which is presented below.

Table 6-7: Emission from vehicles from the project, mg/km

Pollutant	Bharat Stage IV	Bharat Stage VI
CO	500 mg/ km	500 mg/ km
NOx	250 mg/ km	80 mg/ km
PM	25 mg/ km	4.5 mg/ km

Oxides of Nitrogen

For NOx the modelled values are compared with the NAAQS, which is 80 µg/m^3 for 24 hr. The stipulated standards as given in IFC Guidelines, for NOx is 200µg/m^3. For the purpose of modeling 1-hourly data have been taken into consideration.

Particulate Matter

The standards available for Particulate Matters are for annual and 24-hours. However, as the CALINEPRO software can run on either 1-hourly or 8-hourly data. For the purpose of modeling 8-hourly data have been taken into consideration.

Carbon Monoxide

For CO the modelled values are compared with the NAAQS. As per the NAAQS, the standard of 8-hours average concentration of is 2 mg/m^3. For the purpose of modeling 8-hourly data have been taken into consideration.

BOX 6-1: CALINE PRO MODEL

CALINE PRO, is a dispersion model based on Gaussian equation has been developed by the California Department of Transportation for the prediction of the concentrations of critical atmospheric pollutants (CO, NOx and PM) along the highways. This model employs a mixing zone concept to characterize pollutant dispersion over the highway and can be used to predict the pollutant concentrations for receptors up to 2 to 5 km of the corridor.

The various input parameters for the prediction of air impacts are discussed in the following sections:
(a) Site Geometry: Input parameters regarding site conditions like carriageway width, road height, mixing zone width, surface roughness and topographic conditions have been taken up from pavement condition and road inventory surveys conducted along the project corridor.
(b) Emission factors: Emission factors for various vehicle categories vary for different speeds. The emission factors adopted for the various vehicle speeds for the various pollutants are factor of the traffic composition and a composite emission factor has been derived for application in the model for the various sensitive receptors and links. The emission factors of running vehicles differ from the standards prescribed by the Central Pollution Control Board. The composite emission factor has been derived as a sum of the products of ratio of light, medium and heavy vehicles to the total volume and their corresponding emission factors.
(c) Meteorological Conditions: The various meteorological input parameters required for modeling as the wind speed, wind direction, mixing height, stability class have been collected from primary and secondary sources.
(d) Traffic volume: Traffic volume and composition along the corridor have been derived from the traffic volume counts conducted at site.
(e) Links : Links are homogenous sections of the project corridor with similar traffic, site geometric and meteorological characteristics. For calculating the emissions, worst-case scenario is assumed and concentrations are obtained for worst wind direction.
(f) Receptors: Receptors are specific locations within a link, which is likely to be impacted by vehicular emissions. For the purposes of assessing air impacts, sensitive receptors have been identified over an immediate influence area of 500 m on either side of the project corridor.

For the purpose of modeling, the 50.8 km Project stretch has been divided into 3 (three) sub-stretches. These are: Stretch 1 represents km 681.000 to km 699.800; stretch 2 is from km 699.800 to km 720.500 and stretch 3 is

from km 720.500 to km 731.780. The projected traffic in terms of Passenger Car Units (PCUs) have been considered for modelling is presented below.

Table 6-8: Stretch wise PCUs considered for modeling

Stretch	Kilometer	Major Settlements/ Receptors	PCU			
			2025	2030	2035	2040
Stretch 1	Km 681.000 – 699.800	Vellanki, Anandapuram, Gambheeram, Base Camp 1, Narayana Gajapathiraju Puram Gandigundam	1,16,391	1,54,782	2,04,064	2,68,137
Stretch 2	Km 699.800 – 720.500	Saripalle, Pendurthi, Rampuram; Pinagadi, Mogalipuram, Sabbavaram, Iruvada; Askapalli	54,956	72,768	95,653	1,25,384
Stretch 3	Km 720.500 – 731.780	Pallavanipalem, Base Camp 2, Dongalamarri, Batajangalapalem, Koduru, Rebaka, Golagam, Anakapalli	60,471	80,783	107,078	1,41,500

The predicted pollution levels along the Project corridor for 2025, 2030, 2035 and 2040 is presented in Table 6-9 and the isopleth maps for different pollutants is shown in Appendix H.

Table 6-9: Predicted Concentration of Pollutants

Location	2025			2030			2035			2040		
	NOx	PM	CO	NOx	PM	CO	NOx	PM	CO	NOx	PM	CO
	µg/m^3	µg/m^3	mg/m^3	µg/m^3	µg/m^3	mg/m^3	µg/m^3	µg/m^3	mg/m^3	µg/m^3	µg/m^3	mg/m^3
NAAQS	80 µg/m3 for 24 hr	100 µg/m3 for 24 hr	2 mg/m3 for 8 hr	80 µg/m3 for 24 hr	100 µg/m3 for 24 hr	2 mg/m3 for 8 hr	80 µg/m3 for 24 hr	100 µg/m3 for 24 hr	2 mg/m3 for 8 hr	80 µg/m3 for 24 hr	100 µg/m3 for 24 hr	2 mg/m3 for 8 hr
IFC Standards	200 µg/m3 for 1 hr	100 µg/m3 for 24 hr	-	200 µg/m3 for 1 hr	100 µg/m3 for 24 hr	-	200 µg/m3 for 1 hr	100 µg/m3 for 24 hr	-	200 µg/m3 for 1 hr	100 µg/m3 for 24 hr	-
Stretch 1 @ 30-60m from C/L	40.2	8.3	1.3	60.5	9.0	1.5	80.4	10.0	1.8	100.3	11.0	2.3
Stretch 1 @ 60-100 m from C/L	20.4	5.2	0.8	30.2	6.5	1.2	40.2	7.0	1.5	50.6	8.0	1.8
Stretch 2 @ 30-60m from C/L	30.5	4.3	0.9	40.8	5.6	1.2	50.8	6.5	1.4	70.6	7.8	1.8
Stretch 2 @ 60-100 m from C/L	18.6	2.6	0.5	28.7	3.8	0.8	35.6	4.4	1.0	40.2	5.8	1.3
Stretch 3 @ 30-60m from C/L	42.5	5.0	1.4	50.4	7.0	1.6	60.0	8.2	1.9	80.0	10.2	2.5
Stretch 3 @ 60-100m from C/L	22.5	3.0	0.8	30.2	5.2	1.2	40.0	6.3	1.6	40.0	7.1	1.8

Findings

It is seen from above the table that:

- The NOx concertation for the entire corridor falls within residential standard and the predicted values are not surpassed the ambient standards till 2035. However, there will be increase of concentration for 2040 within 50 m from the road centreline, owing to high traffic.
- The Particulate Matter values will remain within the standards all along the corridor throughout all years for residential standards.
- The CO concentrations are observed to be slightly higher than the residential standards in 2035 and 2040 for 8-hourly standards. However, the same will remain within permissible for 1-hourly standards.

- The modeling shows that there will not be any adverse increase of pollutants all along the corridor till 2035.

Significance of Impact

The impact on ambient air quality will have a local spread, high intensity and will last for a short duration primarily limited to construction related activities which will result in an overall moderate impact after mitigation.

Table 6-10: Impact Significance – Ambient Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Air Quality	Without Mitigation	Medium	Short	High	Major
	With Mitigation	Medium	Short	Medium	Moderate

6.4.5 Impact on Noise Environment

The typical on-site pre-construction and construction phase activities include man and material movements, clearing of encumbrances in the corridor of impact, and establishment of labour camps, onsite offices, stock yards and construction plants. Construction activities will last for a short duration and also shall be localized in nature.

Construction Phase:

During construction phase, the impacts of noise exposure on the community residing near to the work zones will be quite significant and intensity of the exposure to different receptors will also vary widely. But all such impacts again will be of temporary in nature as the construction site will go on changing with the progress of the works along different stretches. Due to modern construction activities, most of the activities are being carried out by machinery. For these operations the noise levels will be increased during the construction period. The machinery involved in the construction operation are; dozer, roller, grader, paver, tractors, tippers, generators, excavators etc.

During the operational phase of the road the residential areas on either side of the highway are likely to experience high day as well as night time noise levels. However, during operation phase, smooth traffic flow will minimize the noise level.

Noise barriers: The impacts due to current high noise levels may be critical at the various urban locations, due to the larger number of receptors and their continuous exposure to high noise levels from the traffic. Since safety of vehicles using the road is of paramount importance, a specific clear distance needs to be maintained from the pavement. Hence, the only viable option is to provide a shield around the receptor. The noise attenuation can be affected by the adoption of the following types of noise barriers:

- Physical barriers in the form of walls, screens etc.
- Structural modifications at receptor locations, in form of provision of double-glazing etc.
- Rearrangement of the sensitive locations, through changes in internal planning
- Earthen berms between the road and the receptor
- Vegetative barriers in the form of thick screen of vegetation etc.
- Selection of an appropriate barrier for a location is based on the following factors:
- Length and height of barrier for obtaining the required attenuation at the receptor location.
- Availability of land for location of barrier without obstruction to cross roads.
- Minimum disturbance to ventilation for the adjacent structures.
- Structural stability and cost of construction of the proposed barrier.
- Provisions have been made in the environmental budget for construction of masonry walls for all the sensitive receptors identified along the roads. Number and locations identified for the construction of noise barriers is given

Mitigation Measures

A part of abatement design includes understanding noise sources other than those from the Project highway. These sources include nearby arterial roads, industrial noise, noise emanating from residential/ commercial areas. Construction noise mitigation might involve use of temporary noise barriers or building sound insulation. While noise impacts during construction are temporary in nature, adequate mitigation measures should be implemented to ensure that it would not affect noise sensitive receptors adjacent to the alignment. The following mitigation measures are proposed for abetting construction noise.

- Provide NP walls that can block the construction equipment, i.e., retractable noise barriers, close to nearest receptors.
- Operate high noise emitting equipment during daytime or until early evening, as possible. If construction works using high impact noise equipment need to be extended or done during night-time, DBL should provide adequate noise control measures. Adequate measures would include partial enclosure of high impact noise equipment with retractable noise barriers. This would also apply for other areas along the Project route, such as adjacent or near schools, hospitals, and other noise sensitive receptors (if any).
- **Storage Areas**: During the planning and design stages of a project, storage areas may be able to be designated in locations removed from sensitive receptors. Where this is not possible, the storage of waste materials, earth, and other supplies may able to be positioned in a manner that will function as a noise barrier.
- **Haul Roads**: Haul roads can be designated in locations where the noise impacts caused by truck traffic will be reduced.
- **Detours:** Increased noise generated by temporarily rerouting traffic during construction is considered as part of construction noise. It is essential to consider efforts to reduce the impact from such changes during the design phases of the project.
- **Shields**: Employing shields that are physically attached to the particular piece of equipment is effective, particularly for stationary equipment and where considerable noise reduction is required. Provide DG sets and compressors with total enclosures to minimize high noise emissions needs to be considered.
- **Dampeners**: Equipment modifications, such as dampening of metal surfaces, is effective in reducing noise due to vibration. Another possibility is the redesign of a particular piece of equipment to achieve quieter noise levels.
- **Maintenance Programs:** Poor maintenance of equipment typically causes excessive noise levels. Faulty or damaged mufflers and loose engine parts such as screws, bolts, or metal plates contribute to increased noise levels. Removal of noise-reducing attachments and devices such as mufflers, silencers, covers, guards, vibration isolators, etc., will, to varying degrees, increase noise emission levels. Old equipment may be made quieter by simple modifications, such as adding new mufflers or sound absorbing materials. Loose and worn parts should be fixed as soon as possible.
- **Equipment Operation Training:** Careless or improper operation or inappropriate use of equipment can increase noise levels. Poor loading, unloading, excavation, and hauling techniques are examples of how lack of adequate guidance and training may lead to increased noise levels.
- Imposing speed limits at construction sites and access roads.
- Ensure that each of the heavy equipment is provided with effective noise mufflers to reduce noise.
- Conduct regular noise monitoring to check compliance with applicable noise regulations.
- Inclusion of incentives and/or disincentives in the contract specifications to encourage contractors to participate in the mitigation program and to make the contractors more accountable for impacts.
- Mandatory for contractors to participate in training programs related to project-specific noise requirements, specifications, and/or equipment operations. Such training may be provided by specialized agency or project management personnel, and/or equipment manufacturers or suppliers. The contractor may also receive onsite training related to noise-specific issues and noise-critical areas and sites adjacent to the project.
- It is recommended that DBL may formulate a grievance redressal mechanism and complaint resolution procedure for the local community so that any issues or concerns associated with noise impact are reported and ensure that appropriate and timely action is taken in case of receipt of such complaints. In case of complaints of higher noise levels and uncomforting received from the inhabitants of nearby settlements the provision of noise barriers near to the receptor need to be considered.
- All Construction plants and equipment used in construction shall strictly conform to the MoEF&CC/CPCB noise standards.
- Provide personal protective equipment to workers and labours working near high noise source.
- Sensitive locations should be identified, mitigation measures such as curb sheets, temporary noise barriers around machineries etc should be provided.

- At the construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, operation of DG sets, use of high noise generation equipment will be stopped during the night time between 10.00 PM and 6.00 AM**.**

Operation Phase:

Noise impacts during operation are permanent until the project lasts, adequate mitigation measures should be implemented to ensure it will not affect noise sensitive receptors adjacent to the alignment. The following are the proposed mitigation measures

Noise impacts during operation are permanent until the Project lasts. Adequate mitigation measures should be implemented to ensure that it would not affect noise sensitive receptors adjacent to the alignment. The following mitigation measures are proposed for the Project during operational phase.

- **Noise Barriers:** Noise barriers are solid obstructions built between the highway and the receptors (houses/ schools, shops or any other receiving units) along the highway. An effective noise barrier can reduce noise levels by 10 to 15 decibels, cutting the loudness of traffic noise almost by half. Barriers can be formed from earth mounds along the road (usually called earth berms) and vertical walls. Noise walls can be built out of wood, concrete, masonry, metal, and other materials. The material chosen should be rigid and of sufficient density to provide a transmission loss of 10 dBA greater than the expected reduction in the noise diffracted over the top of the barrier.
- **Steel sheet pile** walls often combine two functions: retaining wall and noise barrier, with the advantage that it requires a very small footprint along the roads. The efficiency of the noise barrier can be improved by installing the sheet piles with a small batter angle. Steel sheet piles reflect the sound waves, but due to their geometry, the result of the reflections is quite different compared to a pure smooth flat surface. In some cases, additional panels have been fixed on the sheets to absorb part of the sound. In case steel sheet piles act only as a sound barrier, then some of the piles can be shorter than the others and are designed in a similar way to a combined wall system.
- **Vegetation:** Vegetation, if it is high enough, wide enough, and dense enough that it cannot be seen through, can decrease highway traffic noise. The FHWA traffic noise analysis and abatement policy guidance notes of advocates that a 61-meter width of dense vegetation can reduce noise by 10 decibels, which cuts in half the loudness of traffic noise. However, it is usually impossible to plant enough vegetation along a road to achieve such reductions.

Figure 6-1: Vegetation and Noise Reduction

- **Traffic Management:** Controlling traffic can sometimes reduce noise problems. For example, trucks can be prohibited from certain streets and roads, or they can be permitted to use certain streets and roads only during daylight hours. Traffic lights can be changed to smooth out the flow of traffic and to eliminate the need for frequent stops and starts. Speed limits can be reduced; however, about a 33 kilometre-per-hour reduction in speed is necessary for a noticeable decrease in noise levels.
- **Building Insulation:** Insulating buildings can greatly reduce highway traffic noise, especially when windows are sealed, and cracks and other openings are filled. Sometimes noise-absorbing material can be placed in the walls of new buildings during construction. Noise insulation is normally limited to public use structures such as schools and hospitals.

Significance of Impact

The impact due to noise will have high intensity with a medium spread for a short duration which will result in an overall Major impact without mitigation. However, with proper implementation of suggested mitigation the impact will be reduced to moderate.

Table 6-11: Impact Significance – Ambient Noise Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Noise Quality	Without Mitigation	Medium	Short	High	Major
	With Mitigation	Medium	Short	Medium	Moderate

6.4.6 Impact on Solid and Hazardous Waste Management

Construction Phase:

The construction activities such as site clearance, excavation works, land levelling, placing of the asphalt coat, curing, placing of asphalt mix and compaction will generate different types of solid and hazardous wastes. The construction demobilization which will entail removal of machinery, and other temporary and permanent structures will also result in generation of waste. The following types of wastes will be generated due to construction of the Project:

- Domestic solid waste and sewage from labour accommodations;
- Used oil from generator, vehicles and other construction machinery;
- Diesel stored at the base camp's;
- Packaging waste such as gunny bags, plastics, etc.;
- Empty paint containers, metal scrap, etc.; and
- Construction debris.

The construction debris generated due to the demolition of structure on RoW, scarified material, excavation at some section of the Project road and construction activities will have the potential for spread to areas outside the Project boundary during construction phase. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. Improper disposal of scarified bitumen causes decreases of soil fertility and water pollution. This will happen only for a temporary period as the construction activities will be for limited duration.

Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It may also lead to discontent of local community and result in conflicts with the labour engaged at site. Improper disposal of packaging materials, boxes, plastics, ropes etc. can lead to littering in the construction site and surrounding areas. Hazardous wastes such as used oil from DG sets, lubricants, hydraulic oil etc. can cause contamination of soil and water bodies if adequate precautions for storage, management and handling are not undertaken. Use of chemicals such as paints, curing chemicals can lead to contamination of soil.

Mitigation Measures

- AAHPL shall ensure that the domestic waste generated daily from the labour accommodations are collected, stored and disposed off according to the Solid Waste Management Rules, 2015. Adequate waste disposal facilities should be arranged for segregation and collection of solid waste in different dustbins as per the Solid Waste Management (SWM) Rule 2015.
- Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the camp site. Disposal of sewage shall be made through a septic tank – soak pit arrangement.
- Waste/ used oil generated from generators and construction machinery and equipment should be stored on paved surface in a secure location at the base camps. Appropriate secondary containment capable of containing 110 percent of the content of the largest storage tank should be provided. The used oil and oil lined containers (characterized as hazardous wastes according to the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016), should be sold to SPCB approved authorized vendors. AAHPL to development a hazardous materials management plan as per Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

- As per the 'CFO' issued to the site office, the stone crushing unit shall not store hazardous waste for more than 180 days and the industry (Base camp comprising of RMC, WMM etc.) should not store hazardous waste for more than 90 days as per the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.
- Packaging material should also be collected at the storage area and sold to authorized scrap dealers. Recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. Any recyclable waste should be encouraged to be recycled at the site.
- Construction debris and excavated material to be stored in a confined area to prevent spread by wind or water. The construction debris of excavated areas to be used for backfilling embankments, filling pits, for foundation works, construction of crossroads, approach roads and landscaping.
- During the site clearance and disposal of debris, the contractor shall ensure that there are no dwellings affected by the dumping of debris and other solid waste and the traffic is not interrupted. Debris disposal sites shall be sited away from sensitive locations like settlements, water body, forest areas and any other sensitive locations. The debris dumpsites have to be suitably rehabilitated by planting local species of shrubs and other plants so that the landscape is coherent with the local environment.
- The Contractor shall ensure that the entire existing canal and drains within and adjacent to the site are kept safe and free from any debris.
- Care should always be taken to maintain the hydrological flow in the area and dumping sites do not contaminate the water sources such as rivers and ponds.
- The sewage generated from the construction workers camps shall be properly designed, treated and disposed off so that no water pollution takes place. Treated water shall be stored properly for subsequent use for gardening and non-domestic purposes. Domestic waste generated from the construction workers camps shall be stored properly and treated either by composting or by land filling.

Operation Phase:

There will not be any substantial generation of solid waste, other than insignificant domestic waste generated by maintenance and security workers. Domestic waste generated due to workers will be mainly food waste, food packaging, etc. Hazardous waste, like waste oil, paint, waste oil drums, oil rags etc. would be generated in maintenance of the highway.

Taking the distribution of impact as within site, duration short and intensity as low, the impact due to water abstraction will be "Low"

Mitigation measures

- Food waste and recyclables viz. paper, plastic, glass, scrap metal waste etc. should be properly segregated and stored in designated waste bins/containers and disposed of with help of local vendor in line with provisions of Solid Waste Management Rules, 2016periodically sold to local recyclers.
- Hazardous waste viz. waste oil, paint tins, oil rags etc. should be collected and stored in paved and enclosed area and subsequently sold to authorized recyclers/vendors. should be collected, stored and disposed of with help of state pollution control board authorized vendors as provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Significance of Impact

The impact due to waste disposal will have moderate intensity with a local spread for a short duration which will result in an overall minor impact without mitigation. However, with proper implementation of suggested mitigation measures the overall impact will be minor.

Table 6-12: Impact Significance – Solid and Hazardous waste Management

Aspect	Scenario	Spread	Duration	Intensity	Overall
Solid and Hazardous waste Management	Without Mitigation	Local	Moderate	High	Moderate
	With Mitigation	Local	Moderate	Moderate	Moderate

6.4.7 Impact on Ecological Resources and Biodiversity

Construction Phase:

Removal of Vegetation: There will be a significant, direct impact on cutting of the roadside trees during the pre-construction and construction phase. Most visible impact is the loss of shade, but also includes loss of tree products. Removal of roadside trees will also reduce comfort levels for slow moving traffic and pedestrians. The removal of trees will facilitate erosion and contribute to the loss of the micro-ecosystems developed on the roadside. Due to the proposed retrofitting of additional lane and service road, approximately 2,399 numbers of trees within the corridor of impact are likely to be affected, which will result in ecological degradation. The impact would be categorised as medium.

Levelling or Grading of Land: Topographical alterations caused by levelling or grading of land can alter natural drainage, which may lead to wetlands losing feeder flows or drylands getting water-logged. As a result, minor habitats of these types in the Study Area, along with any related ecosystem-services, may get degraded. Secondly, excavation and land-filling carried out towards levelling or grading can alter natural soil-profiles, change soil properties and disrupt sub-soil habitats. As a result, the current soil and hydrological regimes, along with any related ecosystem services, may get degraded.

Movement of Vehicles and Heavy Machinery: Movement of vehicles and operation of construction machinery would generate vehicular emissions and unnatural levels of dust, noise, light and vibrations, leading to pollution of natural resources, possible contamination of food webs and disturbance to species. Interruption of the natural night period by light is known to disrupt the natural biological cycles of many floristic and faunal species. Movement of vehicles and operation of construction machinery would also cause compaction of soil substrates, leading to injury or death of soil organisms, decrease in groundwater recharge and increase in surface run-off. As a result, the current soil and hydrological regimes, along with any related ecosystem services, would be degraded.

Spillage of Materials: Spillage of any toxic materials, either as part of routine operations, or accidentally, could lead to their leaching into the local environment, contaminating soil and water resources. As a result, the associated habitats and ecosystem services would be degraded.

Artificial Illumination: Use of artificial lighting during night-time construction can lead to unnatural illumination of the habitats in the vicinity, interrupting the natural period of darkness with respect to wild flora and fauna. As a result, the natural biological cycles of floristic and faunal species may get disrupted, impacting their natural life-cycle, reproductive success and long-term survival.

Laying of Road: Laying of the road would increase the existing fragmentation of near-natural to slightly modified habitats on opposite sides of the Project alignment. As a result, faunal access to habitats and habitat features, such as roosts, feeding grounds, nesting sites and nesting materials on the far side of the Project alignment would get reduced. The pre-existing fragmentation, caused by the prior presence of a road along the project alignment, would reduce the intensity of the impact, but contribute cumulatively to increase the scale of the impact.

This impact is particularly significant owing to the presence of a legally protected forest area, the Kambalakonda Wildlife Sanctuary, adjacent to a section of the Project alignment.

Installation of Electrical Cables: Installation of over-ground electrical cables disrupts aerial habitats, leading to death or injury to aerially moving organisms, such as birds and bats, through accidental collision and/or electrocution. Installation of underground cables can disturb the soil-profile and fragment sub-soil habitats. The pre-existing fragmentation, caused by the prior presence of a road along the project alignment, would reduce the intensity of the impact, but contribute to a cumulative increase in the scale of the impact.

Embankments: Raising of embankments can obstruct or hinder the current drainage or lateral flows. As a result, the current hydrological, sediment and nutrient regimes may get disrupted. Any pre-existing disruption, caused by the prior presence of a road along the project alignment, would reduce the intensity of the impact, but contribute to cumulative increase in the scale of the impact.

Bridges and Culverts: Bridges and culverts built to convey the road across any waterbodies intersecting the Project alignment can hinder the current ecological flows of the waterbodies. As a result, the current hydrological, sediment and nutrient regimes of the waterbodies may get disrupted. Any pre-existing disruption, caused by the prior presence of a road along the project alignment, would reduce the intensity of the impact, but contribute to cumulative increase in the scale of the impact.

Mitigation Measures

- During construction phase, temporary retractable noise barriers could be considered, while during operation phase afforestation could be considered beyond the ROW to increase the vegetation cover.
- Facilitate the conservation of the current land-use in the immediate vicinity of the Project alignment, to the maximum extent feasible. This is especially applicable to sections of the project alignment which are situated in proximity to any natural habitats or designated areas.
- Conserve the ground cover in any laydown areas to the extent possible or restore it by planting native species of trees, shrubs and herbs. Plant species native to the study area are listed in the 'Reported Forest Types' sub-section of the Biodiversity Baseline section of this report, which may preferentially be used for any compensatory plantation.
- Take special care to maintain the connectivity and integrity of any natural water-channels intersecting or downgradient of the Project alignment.
- Carry out slope stabilization along Project embankments to prevent siltation of water-bodies or water-logging of wildlife habitats or farmlands along the Project alignment. This is especially applicable to sections of the Project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.
- Restore the soil and natural vegetation of any construction-phase access roads which are not required in the operation and maintenance phase.
- Restrict construction activities requiring high levels of illumination to daylight hours, to the extent possible. This is especially applicable to sections of the Project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.
- Insulate any over-ground electrical transmission cables to prevent electrocution of organisms colliding with them or install bird deflector devices on them to render them relatively more visible to aerially moving organisms.
- Integrate mechanical speed-control structures, (rumble strips) in proximity to the Kambalakonda Wildlife Sanctuary.
- DBL may consider to provide a retaining wall to prevent wild fauna straying from the sanctuary to highway at forest location from km 689.200 to km 689.500 subject to approval of NHAI and forest department.
- In-case of accidents, the forest officials of the Kambalakonda Wildlife Sanctuary may be consulted for practical advice for effectively mitigating risk of wildlife injury and/or mortality.

Operation Phase:

Plantation: There will be beneficial impact during this stage. Strip plantations will be raised along the road and this will cover a much larger area and more numbers. During operation phase trees and shrubs will be planted along the Project corridor and aesthetic view of the corridor will be improved. Transplanting of the younger plants and compensatory afforestation will compensate these losses. While DBL will ensure median plantations are done and maintained at all times, NHAI will be primary responsible for maintenance of avenue plantation. The project proposed to plant 21,900 trees along the RoW and other locations.

Vehicular Traffic: Vehicular traffic along the Project alignment would increase risk of injury and/or mortality to terrestrial or aerially moving fauna traversing across the Project alignment. The pre-existing risk of faunal injury and/or mortality, caused by the prior presence of a road along the project alignment, may reduce the intensity of the impact, but would contribute cumulatively to the scale of the impact.

Artificial Illumination: Vehicular lights, as well as, artificial illumination of the Project alignment or other installations during the night-time, can cause unnatural illumination in the area during the night, thereby interrupting the natural period of darkness with respect to wild flora and fauna. As a result, the natural biological cycles of floristic and faunal species may get disrupted, thereby impacting their natural life-cycle, reproductive success and long-term survival. The pre-existing artificial illumination during night-time, caused by the prior presence of a road along the project alignment, may reduce the intensity of the impact, but would contribute cumulatively to the scale of the impact.

Mitigation Measures

- Ensure that electrical components of the Project are insulated, to the extent possible, to prevent electrocution of wild fauna through accidental contact with them.
- Restrict maintenance-related activities to the daytime, to the extent possible.
- Avoid use of artificial lighting in and around the Project alignment, to the extent possible.
- Opt for low intensity artificial illumination, where unavoidable.
- Ensure that maintenance activities that require high levels of illumination are restricted to daylight hours to prevent disruption of the natural night period by artificial lighting.
- Install signages, suitably including vernacular language(s) and non-verbal symbols, to alert road-users regarding the possible presence of wild species on the Project alignment.
- Prohibit avoidable vehicular honking by road-users in the section of the Project alignment situated in proximity to the Kambalakonda Wildlife Sanctuary.
- Plant relatively tall-growing native vegetation along the Project alignment to act as a visual screen and noise absorbent for the benefit of wildlife habitats in the vicinity. This is especially applicable to sections of the project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.

Significance of Impact

The impact on ecology will have medium intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation. However, with proper health and safety measures the intensity of impact can be reduced to low resulting in an overall minor impact.

Table 6-13: Impact Significance – Ecology

Aspect	Scenario	Spread	Duration	Intensity	Overall
Degradation of Habitats	Without Mitigation	Local	Long	High	Moderate
	With Mitigation	Local	Long	Low	Minor
Fragmentation of Habitats	Without Mitigation	Local	Long	High	Moderate
	With Mitigation	Local	Long	Low	Minor
Loss of Ecosystem Services	Without Mitigation	Local	Long	High	Moderate
	With Mitigation	Local	Long	Low	Minor

6.4.8 Visual and Aesthetic Impacts

Construction Phase:

During construction, the initial visual impacts will be associated with the removal of encroachments from corridor of impact and structures from the acquired land, removal of cultural properties, clearing of trees and vegetation for the construction activities. These activities create significant differences in the local aesthetics of which some are negative and some are positive. Some activities pose positive impacts such as creation of clearer views along roads or from roadside houses and other buildings that were previously blocked by encroachments. Changes in the aesthetics during the construction phase are generally temporary negative impacts.

Operation Phase:

There are numbers of temples and shrines within the proposed corridor of impact and the widening activity will result in the negative impacts in terms of religious sentiments. A total of 518 structures have been impacted from the land acquisition process out of which 438 have been demolished or relocated and 80 are awaiting relocation or demolition. As part of Project, all such properties will be relocated in discussion with the community and district administration.

Various mitigation measures proposed in the Project to address are (i) enhancement of bus shelters, (ii) plantation of trees on both sides and median plantation, (iii) provision of road facilities and furniture for local people and road users.

Significance of Impact

The impact on aesthetics and visual aspects will have low intensity with a local spread for a long duration which will result in an overall minor impact without mitigation. The residual minor impact, even after control of intensity and spread, will remain minor owing to the duration of project.

Table 6-14: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual and Aesthetics	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

6.4.9 Impacts on Socio-Cultural Environment

Construction Phase:

The socio-cultural impacts are mostly confined to resettlement of Project Affected Persons (PAPs), acquisition of structures, influx of construction workers and related economic impacts. The adverse impacts may resulting from (i) resettlement of affected people, (ii) relocation of community structures, (iii) acquisition of land and structures, (iv) influx of construction workers etc.

The mitigation measures taken for these include adequate compensation to PAPs, relation of cultural and community resources, and accommodation of labour work force within specific areas in campsites so that there would be minimum disturbances to local people.

Operation Phase:

The widening of the Project will in general have beneficial impact on socio- economic front both locally and regionally through improved connectivity of the area with markets located in the State and adjoining area. The overall local and regional impacts on the socio-economics will be positive because of infrastructure development. Such strengthened infrastructure is expected to contribute to economic growth of the State and socio-economic well-being of the people.

Significance of Impact

The impact on socio-cultural environment will have medium intensity with a local spread for a long duration which will result in an overall moderate impact without mitigation. However, with proper measures the intensity of impact can be reduced to low resulting in an overall minor impact.

Table 6-15: Impact Significance – Stakeholder Engagement

Aspect	Scenario	Spread	Duration	Intensity	Overall
Socio-Cultural Engagement	Without Mitigation	Local	Long	Medium	Moderate
	With Mitigation	Local	Long	Low	Minor

6.4.10 Impacts on Occupational Health and Safety and Public Health

Construction Phase:

During the road construction operations there will be some discomfort, even after providing proper safety measures, to the pedestrians, community residing near the construction zone, slow moving traffic and motorized road uses passing through the construction zones. The levels of discomfort can be reduced with proper planning of construction works and providing required construction zone safety measures, special attention must be given while working in work zones close to settlements.

The improved roads on the other hand will increase accessibility to local and regional health centres and other community support facilities. The Project will be implemented with due considerations for safety of pedestrians, school children and domestic animals.

Occupational Health and Safety (OHS) of workers is important during construction phases where local and migrant workers are involved. During road paving, workers are subject to physical, chemical and noise hazards due to nature of work activities such as vegetation clearing, placing of the asphalt coat, curing, placing of asphalt mix and compaction.

Workers are exposed to physical hazards from operating machineries and moving vehicles, along with being subjected to elevated working places. Accidents may occur due to workers functioning without proper personal protective equipment. It was observed at the site that the usage of personal protective equipment's was not up to the mark, this could lead to health and safety hazard. Fire hazard due to absence of fire protective equipment at site of storage of oils, diesel and any other form of chemicals storage may impose safety concerns

Almost all workers will be exposed to weather elements, noise and working in limited area to minimize traffic obstruction. These are likely to be potential impacts on worker's health and safety due to exposure to risk through the project development activities. Various other occupational health and safety risks are frequently present, in particular during the construction phase are:

- Mobile vehicles and heavy equipment accidents;
- Heat stress when working in humid and high temperatures;
- Manual handling and musculoskeletal disorders;
- Hand are vibration impacts from concrete breakers, grinders, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns;
- Temporary or permanent hearing loss from noise generated machinery used for excavation or piling work;
- Dermatitis that can rise from contact with small substances such as wet cement and asphalt;
- Tripping due to uneven surfaces and obstacles;
- Falling during working at height;
- Fire due to hot works, smoking and failure in electrical installations; and
- Electrical shocks etc.

Mitigation Measures

- AAHPL should ensure implementation and monitoring of the EHS policies and procedures as specified in the Environmental Plan and EHS manual.
- AAHPL should communicate the purpose and objective of the Environmental Plan/EHS Policy to the staff on-Site and across all stakeholders for improving E&S performance.
- AAHPL to prepare Occupational Health Safety Plan incorporating safety reporting procedure with responsibility being assigned to designated team, procedure for handling safety-related grievances and have a responsibility matrix for addressing grievances raised.
- Contractor shall implement road safety plan and attend to issues of health and safety of construction workers; maintaining and cleaning up campsites and safeguard the environment in the vicinity of project area.
- Provide adequate PPE for the workforce and improve compliance of the onsite workers to the same include EHS management related terms and conditions as part of contract with the sub-contractors.
- All the workers at construction site and all associated facilities of the plants shall be compulsorily equipped with personal protective equipment's like gumboots, helmet, ear plugs, air mask and goggles.
- AAHPL shall ensure that all workers have undergone training in safety practices and use of personal protective equipment and refresher training is provided periodically.
- Workers engaged in overhead works will ensure that workplace is barricaded for unauthorized access. Proper training on hoisting/ lifting equipment, maintenance of lifting equipment, strict implementation of equipment lifting procedures, and proper use of ladders.
- Workers should be supplied with protective clothing when working with mixture of asphalt and solvents. Workers should be protected from exposure to chemical hazards during construction associated with dust from paving activities, exhaust from heavy equipment emissions and use of paint and diesel.
- Handling and storage of hazardous chemicals and solvents should be guided by materials safety data sheet.
- Provision of first aid facilities for all the construction workers at construction camps and all workplaces first aid equipment and nursing staff must be provided

- Periodical health check-up of the workers is to be arranged by the contactors to ensure good health. For those workers working in hot mix plants and with bitumen pavers, health check-ups for monitoring benzene content in their blood, especially before and after the construction is ensured.
- Adequate sanitary, drainage, toilets with septic tanks, refuse collection and disposal facilities shall be provided for the construction workers. The provision of a potable water supply, cooking fuel and toilet facilities shall be made as per the stipulated guidelines of the Indian labour Act.
- Development and implementation of transportation management plan to ensure work zone safety. The plan should clearly establish work zones to separate workers on foot from traffic and equipment, by rerouting traffic to alternative roads or shoulders and closure of lanes and diversion.
- AAHPL will practice work rotation system among the workers to reduce health impacts related to prolonged exposure to noise.

Operation Phase:

During operation phase there will be both positive and negative impacts on the public health. The positive impacts include increased speed of accessibility to local and regional health centres and other community support facilities. The adverse impacts on public health may result from health impacts due to vehicular pollution and safety provision.

Various mitigation measures provided in Project is given below.

(i) Design improvement at crossings and where traffic is mixing,
(ii) Segregation of slow traffic in congested areas by providing service roads,
(iii) Provision of proper signage and proper lighting arrangement to avoid accidents,
(iv) Traffic management plans will be prepared operation phase,
(v) Workers should be provided with personal protective equipments during construction and operation phase.

During the operation phase, the risks for workers will be quite limited due to nature of operation activities. The activities will be limited to guarding and on call and/or onsite technical support (maintenance and cleaning). There will be potential impacts on personnel's health and safety during operation phase due to exposure to risks such as:

- Slipping and tripping;
- Falling during working at height;
- Exposure to hazards such as electric shock and thermal burn hazards;
- Exposure to chemicals, hazardous and flammable materials; and
- Maintenance activities are expected to be carried out in hot weather conditions; thus, workers are exposed to dehydration, heat exhaustion and heat stroke.
- Risk of theft at the Toll Plaza, could subject employees to undergo mental stress and in extreme case injuries/death.

Mitigation Measures

- AAHPL should prepare and implement Occupational Health and Safety Plan (OHSP) with clearly identifies roles and responsibilities of the personnel involved within the Project. The OHSP to include but not limited to the following: site specific safety plan, electrical safety, fire safety, heat stress, personnel protective equipment, emergency response plan, reporting and investigation and others.
- Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments;
- Implement Lock out/ Tag Out (LOTO) system;
- Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented when working at height.
- PPEs e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components;

- fire extinguishers and sand buckets at all strategic locations should be placed, and the location should be known to all.
- Any accident reporting, and monitoring record shall be maintained.
- Extra safety precautions should be taken at the Toll booth. The design of the Toll booths should be done in such a way that the safety of the employee is ensured.

Significance of Impact

The occupational health and safety impacts will have high intensity with a local spread for a short duration which will result in an overall moderate impact without mitigation. However, with proper implementation of suggested mitigation, the intensity can be reduced to minor.

Table 6-16: Impact Significance – Impact to Occupational Health and Safety of Workers

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact to Occupational Health and Safety of Workers	Without Mitigation	Local	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

6.5 Climate Change Impacts and Risks

ADB screening tool has been designed to consider climate induced risks and natural hazards of geophysical origin. This screening tool helps to expand the ADB's risk assessment capacity within its policy framework and project life cycle operations. ADB has developed this risk screening tool to rapidly assess impacts and associated risk at the project preparation stage. The checklist presents a set of questions, answers to questions in the risk screening tool, when totalled generate a risk value of High, Medium or Low.

Table 6-17: Climate and Disaster Risk Screening

General Project Identification		
Date	:	April 2020
Country and Project Title	:	India: ESIA study for Road Project - Anandapuram-Pendurthi-Anakapalli Section of NH-16

Risk Assessment Category	Risk Value	Total	Remarks
Pre-determined impacts and risk factors			
Which physical environment best describes the project area	Using Appendix V, add the score for the physical environment which best describes the project location. 1+1	1	The region falls under humid and sub-humid plains, foothills and hill country. The region experiences more than 500 mm precipitation/yr. The project would be established on Barren scrub land, with a few agricultural patches on either side of the RoW. The area falls in Zone II: Low Damage Risk Zone of getting affected due to earthquakes.
Categories sectoral risk of project (See Appendix W: Risk by sector)	Add risk value from 0-3	2	Transport and Communications
List individual hazards that may impact project	Add risk value of 1 for each natural hazard (up to a maximum of 4). If hazards unknown use 3 as a risk value 1+1+1	2	The area falls in Zone II: Low Damage Risk Zone hence low risk of getting affected due to earthquakes. The area experiences heavy rainfall and hence flash floods are a common phenomenon. However, as informed the impact is very low as there is no loss of life of property
Estimate the number of people in the project area "exposed" to risk after the project is completed.	For <100 score = 0, 100-1000 score = 1, 1000-10,000 score 2; >10,000 score = 3 Less than 100	3	The only impact on population would be during operation phase due to exposure to noise pollution.
Stakeholder engagement and risk knowledge			

Risk Assessment Category	Risk Value	Total	Remarks
Pre-determined impacts and risk factors			
Do the project proponents have the institutional capacity to successfully incorporate, manage and deliver risk management measures to the project	Yes/No (If good capacity then adds 0; if poor capacity adds 1 risk value: if very poor capacity add 2 risk values)	1	The major risk related to project would be a natural disaster -earthquake and hence AAHPL team onsite should make coordinated efforts with district disaster risk management authority to take control of the situation, when in time of need.
Will potential hazard impacts on communities, gender, indigenous people or the social dimension of risk be considered in the concept paper.	Yes/No (If No, add 1 risk value). If Unsure, add 1 risk value	1	Impacts on gender and community has been considered from the hazard perspective (flood, earthquake and landslide). There is no gender specific impact.
Are there any demographic or socio-economic variables (i.e. population increase, settlement patterns, bio-physical/environmental conditions) that may increase exposure to hazard impacts	Yes/No (If yes, add 1 risk value). If Unsure, add 1 risk value	1	There may be some rural sprawl of population in the next ten years from now, which might be impacted by noise of along the highway.
Is it likely that Executing Agency stakeholder(s) has some practical knowledge of risk reduction measures for the project?	Yes/No (if No, add 1 risk value). If Unsure, add 1 risk value	1	Yes, AAHPL team has capacity of risk management at the stage of project development.
Will the project reduce, leave unaltered, or increase the risk to project beneficiaries?	Reduce risk, score = 0, Leave risk unaltered, score = 1, Increase risk, score = 2.	1	AAHPL will have no control on reducing the natural disasters, hence the risk related to natural disasters will remain altered.
Will the project reduce, leave unaltered, or increase the risk to the localized environment/project dependent ecosystem?	Reduce risk, score = 0, Leave risk unaltered, score = 1, Increase risk, score = 2.	1	
Do country/institutional policies or environmental laws significantly promote risk management measures?	Yes/No (If No, add 1 risk value). If Unsure, add 1 risk value	1	Yes, the country institutional policies and environment laws significantly promote risk management measures.
Does the Project require a risk expert to introduce risk reduction measures in project design, implementation, or operations and maintenance?	Score = 0 for No. Score either 1 or 2 for Yes (based on your assessment of the level of risk).	1	The area falls in Zone II: Low Damage Risk Zone of getting affected due to earthquakes, frequent flash floods that does not necessarily impact the population in the region. Hence risk reduction measures or disaster management are being referred to by AAHPL.
Total Risk Value (Range 0 to 25)	High Risk: between 17-25 Moderate Risk: between 8-16 Low Risk: between 0-7	16	Moderate Risk

Low Risk (0-7): This range indicates the Project proposal has considered risk management measures to minimize hazard impacts and associated risks, and that the Project may therefore have a potentially higher threshold against current and anticipated risks.

Moderate Risk (8-16): Project exposure to Risk is **likely**. It is **recommended** that risk reduction measures be incorporated into project design and activities.

High Risk (17-25): Project exposure and vulnerability to potential Risks is **very likely**. It is **highly recommended** that risk reduction measures be incorporated into project design and activities, and that a further review of the Project **proposal be undertaken.**

In accordance with the Climate and Disaster Risk Screening tool the Project is computed to be "**Moderate Risk**" in terms of climate induced risks and natural hazards on the project. It is recommended that risk reduction measures be incorporated into Project design and activities.

Climate change is projected to increase the frequency and intensity of some extreme weather events. Specifically, heat waves will likely be more severe, sea level rise could amplify storm surges in coastal areas, and precipitation will likely be more intense. These changes could increase the risk of delays, disruptions, damage, and failure across the project cycle. Most road infrastructure being built now is expected to last for about 30 years or longer. Therefore, it is important to understand how future climate might affect these investments in the coming decades.

- Higher temperatures can cause pavement to soften and expand. This can create rutting and potholes, particularly in high-traffic areas and can place stress on bridge joints. Heat waves can also limit construction activities, particularly in areas with high humidity.
- Climate change is projected to concentrate rainfall into more intense storms. Heavy rains may result in flooding, which could disrupt traffic, delay construction activities, and weaken or wash out the soil and culverts that support roads, tunnels, and bridges.
- Exposure to flooding also shortens the life expectancy of highways and roads. The stress of water cause damage, requiring more frequent maintenance, repairs, and rebuilding. Road infrastructure in coastal areas is particularly sensitive to more frequent and permanent flooding from sea level rise and storm surges.
- Major highways in coastal areas serve as critical evacuation routes. Evacuation routes must be protected from flooding and damage so they may be used for emergencies.
- Landslides and washouts could also occur more frequently, as saturated soils are exposed to more rainwater.

Mitigation Measures

- White or clear surface pavement materials, and permeable pavements can effectively undermine the urban heat island phenomenon; (e.g., white stones, permeable concrete blocks, paving grids for grass parking lots, green walls)
- Permeable paving in areas with low traffic volumes and/or not heavy traffic loads;
- Modular interlocking block pavements that contribute to reducing runoff;
- A sound disaster management plan needs to be adopted to counter the risk of natural hazards.
- Efforts shall be made to minimize the number of trees being cut during design by realigning the Project and maximise tree plantation by making green tunnels. Efforts shall be taken up on available land locations and within RoW as an enhancement measures to reduce tree cutting and impacts of air and dust pollution and act as a natural filter to traffic emissions.

7. Environment and Social Management Plan

7.1 Introduction

The purpose of an Environmental and Social Management Plan (ESMP) is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the operation and closure of the proposed Project. An ESMP is an important component of an ESIA as it provides an important tool that can be used to measure and check, in a continuous mode, the efficacy of the mitigation measures and project commitments incorporated in the ESIA to minimize or eliminate identified negative impacts. The ESMP also aligns the schedule for implementation of management plans.

The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives;
- Monitor the project proponent's compliance with all the mitigation measures and commitments in the ESIA report;
- Monitor the project proponent's compliance with legal standards and limits for waste discharge and emissions;
- Provide early warning signals on potential environmental changes, so that appropriate actions can be taken to prevent or minimize environmental and social impacts;
- Put in place a sound and cost-effective contingency plan that can be activated for prompt response to any accidental occurrence;
- Encourage and achieve the highest environmental and socio-economic performance and response from individual employees and contractors throughout the duration of the project; and
- Routinely check all measures/devices put in place for effective monitoring of project functions and activities.

The ESMP delineates the monitoring and management measures to avoid and/or minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures. The ESMP shall ensure a continuous communication process between project proponent, project developer, workers (including sub-contractors), local community and other stakeholders.

In this section, an ESMP is presented to be used throughout the life span of the proposed project. This ESMP will facilitate environmental and social management of the proposed project and procedures are provided to help prevent, avoid or minimize negative environmental impacts that may occur during project operations and decommissioning phase.

7.2 Organization Structure

The organizational structure of the Concessionaire team (AAHPL) and the DBL is headed by the General Manager (GM). Further, the Concessionaire team is head by the Project Manager as execution of work is concerned. A dedicated Project EHS/ Safety officer have been appointed at the site level and the same is supported by a team of ten (10) employees for EHS implementation at the Project level. The organizational structure for EHS applicable to the Project is provided below.

The Human Resources (HR) for the Project is managed by a team of five people, comprising of one assistant manager and four senior executives. However, they are responsible only for welfare of DBL employees appointed for the Project. Engagement and workforce management responsibility of contractor workforce is carried out by directly by the respective project teams such as engineering, survey, construction etc. engaging the same workforce.

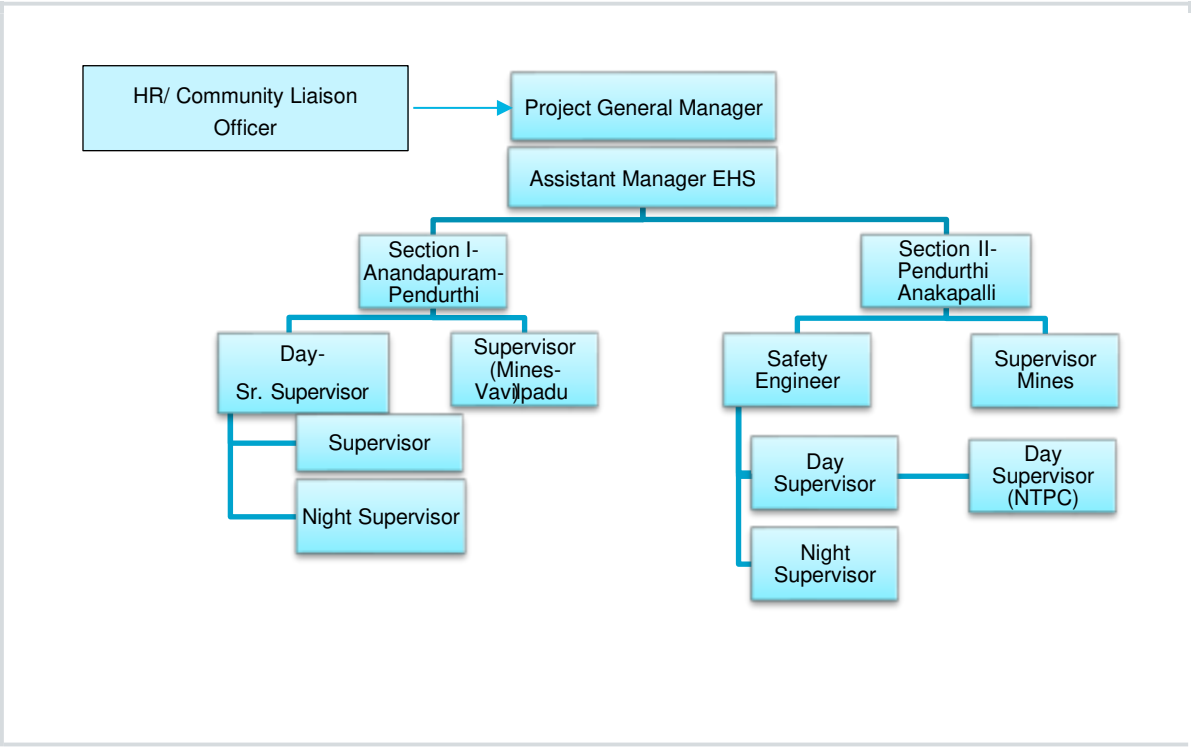


Figure 7-1: Organisational Chart for EHS at the Project Level

7.2.1 Roles and Responsibilities

This section describes the roles and responsibilities of the key persons responsible for management of the Project activities:

Head-EHS (from Corporate)

- Overseeing overall activities related to Environment, Health, Safety and Social (EHSS) screening, audit and impact assessment of assets either internally or through external agencies as the case may be;
- Overseeing the implementation of the systems, protocols and checklists of the ESMS at the corporate level and where necessary, transferring information and expertise to EHS Project;
- Interaction with other teams such as Project team, land, procurement, HR etc. for handling and resolution of EHSS issues and risks;
- Ensuring implementation of training and capacity building exercises at the corporate levels and project level;
- Documentation and control of ESMS related documents; and
- Development of processes with respect to EHSS. Also includes internal updating of existing systems pertaining to EHSS wherever feasibly and technically possible.

Assistant Manager EHS

The Assistant Manager EHS (at project level) is responsible for overall management of the Project and ESMP implementation on site during construction and operation phase of the project. The following tasks will fall within his/ her responsibilities:

- Monitor site activities on weekly basis for compliance;
- Keeping a check on operation and maintenance services required during operation phase.

Apart from the project related aspects, Site In-charge will also have additional responsibilities of community liaison such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Keep record of the CSR activities being undertaken for the project, if any;
- Keep the Regional Project Manager informed on the progress of CSR activities undertaken at project site;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and inform them about the Grievance Redressal Mechanism and ensure effective implementation.

Supervisor/ Safety Engineer

Roles and responsibilities of Supervisor/ EHS Engineer include the following:

- Implementation of on-ground tools, checklists and processes;
- Overseeing overall EHSS compliance at the ground level;
- Responsible for all interactions with contractors pertaining to EHSS in coordination with Assistant Manager EHS;
- Carrying out compliance audits and safety checks during operation phase with assistance from Assistant Manager EHS;
- Generate and reporting back of site-level audit reports and key performance indicators to the corporate level; and
- Vigilance and enforcement agency for investigation of EHSS non-compliance, investigation of incidents and accidents and imposition of fines and penalty measures.

Community Liaison Officer (CLO)/ HR

The CLO would be expected to undertake the following roles:

- Manager, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP and monitor the implementation;
- Co-ordinate and evaluate the effectiveness of all program elements;
- Manage the implementation of community health program, including coordination with HSE team on OHS measures associated with management of impact to community health;
- Coordinating the HSE team on implementation of the Project vehicle safety measures associated with management of impact to community safety;
- Coordinating with Human Resource (HR) team person to ensure implementation of labour related measures required in this ESMP;
- Consultation with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMP; and

Managing social monitoring and reporting the results to the Project Manager.

7.3 Training

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMS.

The EHS Engineer along with recommendations from EHS Projects and EHS Head (at corporate) will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMS and existing capacity of site and project personnel (including the contractors and sub-contractors) to

undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMS checklists and procedural guidance;
- Occupational health and safety;
- Fire safety and prevention;
- Emergency response preparedness;
- Operational training;
- HR induction training;
- PPE training;
- Driver safety; and
- Implementation of Environmental and Social Management/ Action plan.

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/ worker joins the company and/ or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

An environmental and social management training programme will be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme will ensure that all concerned members of the team understand the following aspects:

- Purpose of action plan for the project activities;
- Requirements of the specific Action Plans;
- Understanding of the sensitive environmental and social features within and surrounding the project areas; and
- Aware of the potential risks from the project activities.

In case of contractors or turnkey contractors having sufficiently well-developed standards on EHS management, the training can be sub-let to the same for their respective employees and DBL will monitor the completion and sufficiency status of these programs. In case of subcontractors, the training and capacity building will be done by the EHS manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers.

7.4 Inspection Monitoring and Audit

The on-site team should implement the ESMP as per mitigation measures provided for identified environmental and social impacts. This ESMP will have to be monitored on a regular basis, half-yearly and all outcomes would need to be audited in accordance with existing EHS commitments.

The monitoring process will cover all stakeholders including contractors, suppliers and the local community impacted by the Project activities and associated facilities. Inspection and monitoring of the environmental and social impacts of operation phase activities will increase the effectiveness of suggested mitigations. Through the process of inspection, audit, and monitoring DBL shall ensure that all the contractors comply with the requirements of conditions for all applicable permits including suggested action plans. The inspections and audits shall be done by DBL's trained team and external agencies/ experts. The entire process of inspections and audits will be documented. The inspection and audit findings will be implemented by the contractors in their respective areas.

Sub-contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting will be done in the form of environmental, health, safety and social check list, incident record register and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

7.5 Documents and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured. The following records shall be maintained at site:

- Documented Environment Management System;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Resource consumption records;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register, and issues attended/ closed reports.

7.6 Environment and Social Management Plan

7.6.1 ESMP During Pre-Construction and Construction Phase

The environmental and social management plan proposed during pre-construction and construction phase mainly focuses on the aspects related to land acquisition and resettlement, permit compliances, procurement of materials and landscaping.

Major environmental, social and biological aspects considered during the construction phase are:

- Land use
- Visuals and aesthetics of the area
- Water resources (ground and surface water) and their quality
- Ambient Air and Noise quality
- Soil quality
- Noise levels
- Solid and hazardous waste generation
- Ecology and biodiversity
- Public health and safety

The ESMP proposed for the pre-construction and construction phase is given in the Table 7-1.

7.6.2 ESMP During Operation and Decommissioning Phase

The environmental and social management plan proposed during the operation phase has been prepared considering the impacts this Project may have on the surround environment and human beings' due operational activities. The major aspects covered during the operation phase are ambient temperature, solid and hazardous waste generation, wastewater management, ecology and biodiversity.

During decommissioning phase, all the environmental, social and biologicals aspects that were considered for the construction phase have been taken into consideration. The major aspects covered in the ESMP proposed during decommissioning phase are land use, air quality, water quality, soil quality, noise levels and solid and hazardous waste generation.

Detailed ESMP proposed during the operation and decommissioning phase is given in Table 7-2.

Table 7-1: Environment and Social Management Plan (ESMP) During Pre-Construction and Construction Phase

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
PRE-CONSTRUCTION ACTIVITIES BY PROJECT AUTHORITY AND CONCESSIONAIRE							
1.	Land procurement	• Impact on landowners	Major	• Identification of landowners who have become landless owing to project-specific land procurement; • Providing the owners who have become landless preference in matters of employment; and • Persuading the landowners who have become landless to procure cultivable land within close vicinity of the project using the compensation money received. • The acquisition of land and private properties will be carried out in accordance with the RAP and entitlement framework of the Project • NHAI has to ascertain that acquisition of land in the post design phase are addressed and integrated into the EMP and relevant contract documents.	Moderate	List of landowners becoming landless needs to be prepared so that the number of landless persons employed can be traced.	P – NHAI/ AAHPL S – NHAI
2.	Permit Compliance	• Non-compliance to various social, Environmental, health and safety Permits required and pertaining to the proposed highway project, there could be legal Implications to AAHPL.	Major	• Site has to obtain various Environmental Permits such as no-objection certificate (NOC) for abstraction of ground water under Environment protection Act Environment Protection Act -1986, compliances to Factory License under Factories Act, 1948, CFO obtained, Interstate Migrant Workmen Act 1979, and other permits as applicable.	Minor	AAHPL should ensure Periodic EHS audits to verify permit requirements and associated compliances	P – NHAI/ AAHPL S – NHAI
3.	Encroachment clearance	• Advance notice to PAPs	Moderate	• Advance notice, as per RAP shall be given to the encroachers and squatters present in the Corridor of Impact, who need to be relocated. All R&R activities will be undertaken. Entitlements as per NHAI entitlement framework will be completed before construction starts.	Minor	NHAI to complete the formalities after payment	P – NHAI S – NHAI
4.	Tree Cutting	• A total of 2399 trees have been either cut or in the process of being cut as per the Tree felling Permission received by NHAI from the Government of Andhra Pradesh Forest	Moderate	• As part of this there is a proposed plan of planting of approximately 21,900 trees along the project stretch. Single row of plantation on both sides is suggested through-out the length of 50.780Kms • The Independent Engineer/ NHAI and AAHPL should carry out joint field verification to ascertain any possibilities of saving trees, environmental and community resources.	Minor	AAHPL should ensure regular maintenance and watering of the trees planted. AAHPL should monitor the survival rate and all efforts shall be made for survival of planted trees	P – NHAI/ AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
		Department in letter No.811120171s4, dated.04/01/2018 for the project.		• Stacking, transport and storage of the wood should be done as per the relevant norms. • Trees impacted by the project shall be compensated by planting of endemic tree species which are highly tolerable to vehicular emissions and dust will be taken up as per IRC: SP 21.			
CONSTRUCTION ACTIVITIES BY CONCESSIONAIRE							
5.	ESMP Implementation	• Inadequate implementation of ESMP by Contractor	Moderate	• Site Specific Environment management system and procedures should be prepared before construction work commences; • Social, Environment, Health and Safety Organization Chart shall be prepared at Corporate level and Site-specific level; • Proper procedure shall be developed for training of personnel & contractor, ESMP monitoring and reporting (externally & internally); • ESMP shall be part of the tender and bid documents so that contractor can include cost related to ESMP	Minor	AAHPL and its contractor should ensure periodic audits to verify the implementation and effectiveness of the management systems	P – NHAI/ AAHPL S – NHAI
6.	Procurement of Machineries and Construction Equipment (such as Diesel Generators, Batching Plant, Concrete mixing plant etc.)	• Inadequate implication of ESMP by Contractor	Moderate	• The contractor shall follow all stipulated conditions for pollution control as suggested in ESMP and as per the regulatory requirements • No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority • Equipment's conforming to the latest noise and emission control measures shall be used. • PUC certificates for all vehicles and machinery shall be made available for verification whenever required.	Minor	Development of ESMS and procedures before construction work	P – AAHPL S – NHAI
7.	Landscaping	• Disturbance to original lay out of the land	Moderate	• Road landscaping design shall be conducted at the same time with the main works design. Meeting the regional planning requirement, the route of roads shall maintain the natural landscape and harmonize with the surrounding environment as much as possible. • To reduce damage to the existing ecological environment, landscaping works shall be carried out simultaneously in Project design. • Selection, design and layout of construction camp, storage yards, fuel storage shall be done in such a way that it does not impact the local community and surrounding environment.	Minor	Landscaping plan shall be developed before starting of construction works	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
8.	Landscape Aesthetics and Visual	• Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Moderate	• Ensure the construction site is left in an orderly state at the end of each workday • Construction machinery, equipment, and vehicles not in use should be removed in a timely manner to the extent possible • Proper handling of waste streams should be ensured. • Construction debris needs to be stored in an orderly manner, so that it does not create menace to anyone.	Minor	Daily Housekeeping	P –AAHPL S – NHAI
9.	Disposal of Debris from dismantling structures and road surface	• Siltation of water bodies • Particulate matter creating menace to the settlements In the immediate vicinity. • Debris generated due to the dismantling of the existing road will be suitably used in the proposed construction:	Moderate	• AAHPL should suitably dispose of unutilized debris materials either through filling up of borrow areas located or will be given to the locals for their private use. • The scarified bitumen surface will be used in the construction of the shoulders. • At locations identified for disposal of residual bituminous wastes, dumping will be carried out over a 60 mm thick layer of rammed clay so as to eliminate the possibility of leaching of wastes into the ground water. • AAHPL should ensure that the surface area of such a dumping pits is covered with a layer of soil and plantation will be done. • The pre-designed disposal locations will be identified as part of Comprehensive Solid Waste Management Plan to be prepared by AAHPL in consultation with NHAI. • Debris generated from pile driving or other construction activities shall be disposed such that it does not flow into the surface water bodies or form mud puddles in the area. No debris will be staged on the road or culvert/bridges locations.	Minor	AAHPL should ensure the implementation of Solid waste management as per the Solid Waste Management Rules, 2015 along with Construction and Demolition Waste Management Rules 2016.	P – AAHPL S – NHAI
10.	Base camp, Crushers, hot-mix plants and Batching Plants Location	• Fugitives of air and noise pollution from these plants could be detrimental to the nearby habitation. • Close proximity of these plants to water body could lead to runoff and hence contamination.	Major	• All construction plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 500 m away from the nearest dwelling preferably in the downwind direction. • The Concessionaire shall submit a detailed lay-out plan for all such sites and approval of Independent Engineer/ NHAI shall be necessary prior to the establishment. • Arrangements to control dust pollution through provision of wind screens, water sprinklers, and dust extraction systems will have to be provided at all such sites. • Specifications for crushers, hot mix plants and batching plants will comply with the requirements of the relevant emission control legislations. Consent for the Establishment and Operation from APPCB shall be obtained before establishment	Moderate	• AAHPL should ensure compliance and maintenance of conditions mentioned in the consent. • Periodic audits should be conducted to ensure the measures are being followed. • Every effort should be made to ensure that the wastewater is channelized and	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				and operation respectively and a copy should be submitted to the NHAI. • Location for stockyards for construction materials will be identified at least 800 m from water courses. • The sewage and solid waste for the camp will be designed, built and operated by the Concessionaire. AAHPL should ensure the sewage does not find its way to contaminate ground or surface water.		does not contaminate ground, surface water or soil.	
11.	Other Construction Vehicles, Equipment and Machinery	• Fugitives of air and noise pollution • Leakage of oil/grease/lubricants contaminating water and soil environment.	Moderate	• All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 1988 shall be strictly adhered to. • AAHPL shall maintain a record of PUC for all vehicles and machinery used during the contract period which shall be produced to NHAI for verification whenever required.	Minor	• AAHPL should ensure periodic maintenance of vehicles so as to improve its efficiency and reduce pollution.	P – AAHPL S – NHAI
12.	Quarry Areas	• Fugitives of air and noise pollution • Loosening of topsoil.	Moderate	• AAHPL will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials, quality and other logistic arrangements. The Contractor shall obtain materials from quarries only after consent of the Department of Mines and Geology and District Administration • AAHPL will not start excavating earth from select quarry area until the formal agreement is signed between landowner and Concessionaire and a copy is submitted to the NHAI. • Planning of haul roads for accessing quarry areas will be undertaken during this stage. The haul roads shall be routed to avoid agricultural areas as far as possible and will use the existing village roads wherever available. • Curbing sheets, Water sprinklers etc should be adopted to reduce the fugitives being spread across and causing harm to the stakeholders. • Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. • Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the MoRTH besides the law of the land as applicable.	Minor	• Finalizing quarry area and all logistic arrangements as well as compliance to environmental requirements, as applicable, will be the sole responsibility of the AAHPL. • AAHPL should ensure efforts to reduce air and noise fugitives.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives. The contractor shall at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. • The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whomsoever concerned or affected or likely to be concerned or affected by blasting operations. • Blasting shall be carried out during fixed hours (preferably during mid-day). The timing should be made known to all the people within 1000m (200m for pre-splitting) from the blasting site in all directions.			
13.	Ground water resources	• Possibility of contaminated runoff from the site entering ground. • Domestic water runoff from the portable toilets into the ground water can lead to degradation of water quality. • The project area being categorised as falling in "Safe Category", However, the project would induce some pressure on ground water resources.	Major	• The water to be sourced from inhouse borewells. • AAHPL will need to comply with the requirements of the State Ground Water Department for the extraction and seek their approval for doing so and submit copies of the permission to NHAI. Water abstraction should be carried out only after all permissions have been obtained. All the conditions in the NOC should be followed. • Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into ground water. • Conserve water at all project locations and ancillary facilities and if possible, recycle and reuse water utilising every opportunity. • Restoration plan to accommodate the loss of ground water should be prepared and implemented. • Leak-proof holding tanks for sanitary wastewater to protect the shallow ground water level. • Wastewater holding tanks/septic tanks to be located at more than 800 m away from bore wells or any other underground water holding tanks. • Paved impervious surface and secondary containment to be used for fuel storage tanks. • AAHPL will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Wastewater from vehicle parking, fuel	Moderate	• Maximum efforts to reuse and recycle water to reduce water consumption, conserve water and practice rainwater harvesting. • Labourers should be made aware of the importance of water to the area and training provided for ways water could be conserved. • Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into ground water.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				storage areas, workshops, wash down and refuelling areas will not be discharging into on land or into surface water bodies. • In all, fuel storage and refuelling areas, if located on agricultural land or areas supporting vegetation, the topsoil will be stripped, stockpiled and returned after cessation of such storage.			
14.	Surface Water resources	• Domestic water runoff from the portable toilets into the surface water can lead to degradation of surface water quality. • Leakage of oil/grease/lubricants finding its way into the surface water. • Siltation due to construction activities,	Major	• Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into surface water. • Drip pans provided to vehicles with leaks to prevent surface water contamination • Wastewater holding tanks / septic tank to be located at more than 500 m away from surface water resources. • Sufficient culverts and bridges to be incorporated in the design of the highway to avoid changing the path of the water stream. • AAHPL should not excavate beds of any stream/canals/ any other water body for borrowing earth for embankment construction. • AAHPL will ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water course. • Silt fencing will be provided to prevent sediments from the construction site entering into the nearby watercourses. • AAHPL will take all precautionary measures to prevent entering of wastewater into streams, water bodies or the irrigation system during construction. • AAHPL should avoid construction works to bath or urinate close to the streams or water bodies. • AAHPL will ensure that all construction vehicle parking locations, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located at least 800 m away from rivers and irrigation canal/ponds. • All spills and collected petroleum wastes will be disposed off in accordance with Petroleum Rules and PCB guidelines. • While working across or close to any perennial water bodies, AAHPL will not obstruct/ prevent the flow of water. • Construction over and close to the non-perennial streams shall be undertaken in the dry season. If construction work is expected to disrupt users of community water bodies, notice shall be served well in advance to the affected community.	Moderate	• AAHPL to ensure machinery and vehicles thoroughly checked for the presence of leaks if any; • Leakage of vehicles to be checked; • Storage of oil on site to be checked • Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into surface water.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• Oils and other hazardous materials should be stored in covered, bunded areas			
15.	Local Topography	• Alteration in natural drainage pattern • Disruption of ephemeral streams feeding ephemeral, seasonal or perennial wetlands or waterbodies	Moderate	• AAHPL will ensure that no construction materials like earth, stone, or appendage disposed off in a manner that block the flow of water of any water course and cross drainage channels. • AAHPL will take all necessary measures to prevent any blockage to the water flow. In addition to the design requirements, AAHPL will take all required measures to prevent temporary or permanent flooding of the site or any adjacent area. Limit the alteration of contour level and cause minimum alteration of the natural drainage pattern. • Provide storm water management to collect surface runoff from the project site during the monsoon period • If channels/drains get blocked due to negligence, it will be ensured that they are cleaned especially during monsoon season.	Minor	• The drainage patterns of the area will be maintained taking in consideration the slope of the site. • Storm water drainage will be planned around the site.	P – AAHPL S – NHAI
16.	Air Quality	• Fugitive Dust due to movement of project vehicles, site clearance, batching plant, WMM, Hot mix plant etc. and • Emission from Diesel Generators. • Fugitives from Camp site and Quarry area.	Major	• AAHPL shall take necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, and clearing of land. These would include short term measures e.g. sprinkling of water to long term measures e.g. turfing and landscaping. • AAHPL will take every precaution to reduce the level of dust from construction plants, construction sites involving earthwork by sprinkling of water, encapsulation of dust source. • Practice water sprinkling wherever required on unpaved area and for batching plant and crushers along with quarry area. • AAHPL shall place construction material in a manner that will minimize dust generation. • Curbing sheets need to be provided around heavy fugitive activities such as base camp area and quarry area, so as to arrest the fugitive within the site. • Vehicles speed to be restricted to 20-30 km/ hr on unpaved road. • Raw material to be covered with tarpaulin sheet during transportation and in storage area. • All the project vehicles must have valid PUC certificate • Ensure regular maintenance of project vehicles during construction	Moderate	• AAHPL to ensure all vehicles used for transportation must have a PUC certificate. • Conditions provided in consent should be concurred to.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• Turn off the DG sets & machineries which are not in use • DG sets preferably placed away from settlement area. • Exhaust emissions of construction equipment to be adhered to emission norms as set out by MoEF&CC/ CPCB. • AAHPL will procure the construction plants and machinery which will conform to the pollution control norms specified by the MoEF&CC/CPCB/APPCB. • The concentration of suspended particulate matter at a distance of 40m from a construction plant located in a cluster of industries should be less than 500 µg. The environmental monitoring is to be conducted as per the monitoring plan. • Alternatively, only crushers licensed by the Andhra Pradesh Government shall be used. Required certificates and consents shall be submitted to the NHAI.			
17.	Soil Quality	• Contamination of soil due to leakage of oil, diesel and other hazardous waste. • Stripping, stocking and loss of topsoil • Soil Erosion due to loosening of soil	Moderate	• Provide appropriate storage of topsoil in an isolated and covered area to prevent its loss in high wind and runoff. • Allow only covered transportation of topsoil within project site. • Use topsoil at the time of plantation • Drip pans provided to vehicles with leaks to prevent contamination of soil. • In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste. • Store hazardous material (like fuel storage tanks, used oil etc.) in isolated room with impervious surface and secondary containment to be used. • Filling and transfer of oil to and from the container shall be on impervious surface. • Waste disposal grounds that are in use by the local people shall be identified and permission from local administration for use of the same needs to be obtained for disposing domestic wastes. • Hazardous wastes, when accumulated, be disposed to facilities registered with the Central Pollution Control Board. • Spill Kits shall be provided at site to counter any spill incident. • Cleared or disturbed areas would be rehabilitated as soon as possible to prevent erosion. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times.	Minor	• AAHPL should ensure workforce shall be sensitized to handling and storage of hazardous substances viz. fuel oil, machine oil/ fluid etc. • The workers engaged in handling hazardous substances shall be briefed about the possible hazards and the need to prevent contamination. • Periodic EHS audits should be conducted to monitor the use of hazardous materials and its inventory maintained	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• Spilled material to be tracked and accounted for. • The hazardous materials stored at the construction site like acetylene cylinders, petroleum, spirit, diesel, lubricating oil, paints etc., stored as per the statutory provisions of Manufactures, Storage and Import of Hazardous Chemicals Rules. 1989 under the Environment (Protection) Act, 1986 • Afforestation done in the area after the completion of construction, in order to reduce the risk of soil erosion. • The topsoil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the temporarily acquired area and/or Right of Way will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Independent Engineer. The following precautionary measures will be taken to preserve them till they are used: – Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. – Stockpiles will not be surcharged, or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation. – It will be ensured by AAHPL that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles. • Such stockpiled topsoil will be utilized for - – Covering all disturbed areas including borrow areas, only in a case where there are to be rehabilitation – Dressing of slopes of road embankment – Agricultural fields of farmers and acquired temporary land. • AAHPL will construct slope protection works as per design to control soil erosion and sedimentation through use of dykes, sedimentation chambers, basins, fibber mats, mulches, grasses, slope, drains and other devices. • AAHPL will ensure the following aspects: – After construction of road embankment, the side slopes will be covered with grass and shrub as per design specifications.			

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				– Turfing works will be taken up as soon as possible provided the season is favourable for the establishment of grass. Other measures of slope stabilization will include mulching netting and seeding of batters and drains immediately on completion of earthworks. – Along sections abutting water bodies, pitching as per design specification will protect slopes.			
18.	Noise Quality	• Disturbance to habitants • Vehicular noise from heavy vehicles utilized to deliver construction materials and solar plant parts • Noise from DG sets • Construction noise from using mobile equipment, and concrete mixing • Noise from ancillary equipment's such as crusher plant, WMM, Hot mix and batching plant etc.	Major	• Regular maintenance of construction machinery and equipment shall be carried out to ensure noise emissions are reduced. • Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures. • All vehicles and equipment used in construction will be fitted with exhaust silencers. • Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. • Keep stationary source of noise such as DG sets (during construction phase) at farthest point from the settlements. Diesel generator sets, if used; will adhere to noise standards of MoEF&CC. • All Construction plants and equipment used in construction shall strictly conform to the MoEF&CC/CPCB noise standards. • Provide personal protective equipment to workers working near high noise source. • Sensitive locations should be identified, mitigation measures such as curb sheets, temporary noise barriers around machineries etc should be provided. • At the construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, operation of DG sets, use of high noise generation equipment will be stopped during the night time between 10.00 pm and 6.00 am. • Working hours of the construction activities will be restricted around educational institutes/ health centres (silence zones) up to a distance of 100 m from the sensitive receptors i.e., school, health centres and hospitals.	Moderate	• AAHPL to ensure that noise emissions of construction equipment adhere to emission norms as set out by MoEF&CC/ CPCB • Ensured that heavy vehicles and equipment are not operated during the night-time.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
19.	Solid and Hazardous waste management	Contamination of Land and water resources	Moderate	• Solid waste needs to be segregated into degradable, Bio-degradable, Plastic, Bio-Medical, hazardous and E-waste into different dustbins, as per the Waste Management Rule 2016. • Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". • Adequate training needs to be provided to the employees on the type and segregation of waste. • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Used oil should be stored at designated locations in enclosed structures over impermeable surface. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for. • Hazardous wastes shall be stored in leak-proof containers in bunded area and will be disposed only to authorised facilities registered with the APPCB/ Central Pollution Board.	Minor	Periodic EHS audits should be conducted by AAPL to monitor the same	P – AAHPL S – NHAI
20.	Occupational Health and Safety	• Material handling and storage • Possible injuries associated with working with heavy machineries • Other occupational hazards • Accidents during stripping, drilling, chipping and piling • Physical injuries when workers involved in loading/unloading activities and don't adhere to proper ergonomics discipline. • Trip and fall hazards • Other occupational hazards	Moderate	• All material will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor. • Loading and unloading operation of equipment should be done under the supervision of a trained professional • All work at height to be undertaken during daytime with sufficient sunlight • Proper PPEs should be provided to workers handling welding, electricity and related components. Welder's protective eye-shields to workers who are engaged in welding works • Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks • An accident reporting, and monitoring record should be maintained • Display of phone numbers of the city/local fire services, etc. at site should be done • The labour engaged for working at height should be trained for temporary fall protection devices.	Minor	• labour engaged for working at height should be trained • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
		• Diseases due to unhygienic condition		• Protective footwear, protective goggles and nose masks to the workers employed in asphalt works, concrete works, crusher etc. • Earplugs to workers exposed to loud noise, and workers working in crushing or compaction • AAHPL should comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. • AAHPL should comply with all the precautions as required for ensuring the safety of the workmen as per the International Labour Organization (ILO). • AAHPL should make sure that during the construction work all relevant provisions of Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. • AAHPL should also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. • AAHPL should provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. • AAHPL should mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance. • AAHPL will take all required precautions to prevent danger from electrical equipment and ensure that- – No material will be so stacked or placed as to cause danger or inconvenience to any person or the public. – All necessary fencing and lights will be provided to prevent entry of public in construction zones. – Bare wires should not pass on the ground – Loose joints should not allow on the ground – All the switch boxes and joints should be placed in weather protected box • AAHPL will take all reasonable precautions to prevent danger to the workers and public from fire, flood etc. resulting due to construction activities. • AAHPL will make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. Construction Safety Plan prepared by the		the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.	

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				Concessionaire will identify necessary actions in the event of an emergency. • A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone • Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital • Equipment and trained nursing staff at construction camp.			
21.	Community Health and Safety	• Risk of Accidents and other mishaps due to construction work. • Accessibility disruption of stakeholders.		• AAHPL will provide safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project road, providing temporary connecting road. • AAHPL will also ensure that the existing accesses will not be undertaken without providing adequate provisions. • AAHPL will take care that the crossroads are constructed in such a sequence that construction work on the adjacent crossroads are taken up one after one so that traffic movement in any given area not get affected much.		• AAHPL should take all steps possible to ensure that least discomfort is caused to the community living adjacent to the construction work. • All AAHPL employees should be trained to work with peace and harmony with the community.	P – AAHPL S – NHAI
22.	Biodiversity and Ecosystem Services	• Loss, degradation and fragmentation of habitat area • loss of access to critical food resources for habitat-specialist species • Increase in risk of injury or death due to roadkill • Loss of or loss of access to priority provisioning (pasture/fodder) ecosystem services, especially with respect to the local pastoral community	Moderate	• Restriction of movement of vehicles and operation of heavy machinery to pre-designated routes • All works will be carried out such that the damage or disruption to flora other than those identified for cutting is minimized • Avoidance of artificial illumination during night-time • Avoidance or damping of construction noise and vibrations to the maximum extent possible • Adopt efficient system for containment and disposal of waste or spillage so that it does not contaminate the resources (Water). • Prohibition of harvesting of water, fuelwood or wild foods (including fauna) by construction labour • AAHPL should take reasonable precaution to prevent its workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. • If any wild animal is found near the construction site at any point of time, the AAHPL will immediately upon discovery thereof	Minor	• Trainings for site managers, construction contractors and construction labourers to sensitize towards biodiversity and ecosystem services conservation	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				acquaint the Independent Engineer/ NHAI and carry out the instructions for dealing with the same. • The Independent Engineer will report to the nearby forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials. • Integrate mechanical speed-control structures, (rumble strips) in proximity to the Kambalakonda Wildlife Sanctuary. • In-case of accidents, the forest officials of the Kambalakonda Wildlife Sanctuary may be consulted for practical advice for effectively mitigating risk of wildlife injury and/or mortality. • During construction phase, temporary retractable noise barriers could be considered, while during operation phase afforestation could be considered beyond the ROW to increase the vegetation cover.			
23.	Engagement of Local and Migrant Labour	• Labour requirement • Conflicts between labour and contractor • Labour Accommodation and its management, • Sanitation	Moderate	• AAHPL preferably will use unskilled construction workers and security guards drawn from local communities to give the maximum benefit to the local community. • AAHPL should include clause or provisions related with non-engagement of forced and child labour, gender equity, non-discrimination on employment and opportunity and freedom to express their view in contractor's agreement and HR policy • AAHPL through its contractors should ensure that labour is being adequately paid by contractors. Also ensure that wages are being paid as per the requirement of minimum wages act • AAHPL should conduct internal audits as when required to monitor the performance of contractor. • AAHPL through the contractor inform the labour about emergency preparedness plan and communication system to be followed during emergency • AAHPL through contractor should ensure that labour receive training on health and safety issues involved in the proposed project. • AAHPL should follow all relevant provisions of the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. • The location, layout and basic facility provision of each labour camp will be submitted to Independent Engineer and NHAI prior to their construction.	Minor	• Periodic EHS audits should be conducted to monitor the same • Grievance Redressal mechanism should be followed and monitored	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• The Construction will commence only upon the written approval of Independent Engineer/ NHAI. • The Concessionaire will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner. • AAHPL will construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. • AAHPL will also provide potable water facilities within the precincts of every workplace in an accessible place, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. • AAHPL will also guarantee the following: – Supply of sufficient quantity of potable water (as per IS) in every workplace/labour camp site at suitable and easily accessible places and regular maintenance of such facilities. – If any water storage tank is provided that will be kept such that the bottom of the tank at least 1meter above the surrounding ground level. – If water is drawn from any existing well, which is within 30meters proximity of any toilet, drain or other source of pollution, the well will be disinfected before water is used for drinking. – All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. – A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. – Testing of water will be done every month as per parameters prescribed in IS 10500-1991. • Compliance report will be made available for checking by NHAI. • Separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women • Sewage system for the camp should be designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place			

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
			Moderate	• Adequate water supply is to be provided in all toilets and urinals	Minor		
24.	Planning for Traffic Diversions and Detours	• Risk of mishaps due to lack of detour information/signages		• Detailed Traffic Control Plans will be prepared by AAHPL with approval of Independent Engineer, seven days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, traffic safety arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, safety measures for night-time traffic and precaution for transportation of hazardous materials and arrangement of flagmen. • AAHPL will ensure that the diversion/detour is always maintained in running condition, particularly during the monsoon to avoid disruption to traffic flow. • The temporary traffic detours will be kept free of dust by sprinkling of water three times a day and as required under specific conditions (depending on weather conditions, construction in the settlement areas and volume of traffic). • AAHPL will provide, erect and maintain all traffic safety measures during construction such barricades, including signs, markings, flags, lights and flagmen as proposed in the Traffic Control Plan. • AAHPL that all signs, barricades, pavement markings are provided as per the MoRTH specifications. • Traffic Calming measures will be provided to minimise the possibility of accident.		AAHPL should ensure that adequate signages in languages understood by the local people and in English has been put up.	P – AAHPL S – NHAI
25.	Clean-up Operations, Restoration and Rehabilitation	• Restoration and rehabilitation of the site.		• AAHPL will prepare site restoration plans, which will be approved by the Independent Engineer/ NHAI. The clean-up and restoration operations are to be implemented by AAHPL prior to demobilization. • AAHPL will clear all temporary structures; dispose all garbage, and POL (Petroleum, Oil and Lubricants) wastes as per Comprehensive Waste Management Plan. • All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by AAHPL and approved by the Independent Engineer/ NHAI in a layer of thickness of 75 mm-l50 mm. • All construction zones and facilities including culverts, road-side areas, camps, Hot Mix plant sites, Crushers, batching plant sites and any other area used/ affected due to the project operations		• AAHPL should ensure that all the measures are taken to restore the Base camps and other ancillary facilities as well as the construction site to a pristine condition.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				will be left clean and tidy, at the Concessionaire's expense, to the entire satisfaction to the Independent Engineer/ NHAI.			
26.	Clearance of Encroachment/ squatters	• Economic Implications	Moderate	• Advance notice, as per RAP shall be given to the encroachers and squatters present in the Corridor of Impact, who need to be relocated. All R&R activities will be undertaken. Entitlements as per NHAI entitlement framework will be completed before construction starts.	Minor	• AAHPL should ensure periodic warnings to the encroachers. Periodic audits should be conducted to avoid new encroachers.	P – AAHPL S – NHAI
27.	Archaeological Property	• Chance finds of any archaeological property.	Minor	• AAHPL will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Independent Engineer of such discovery and carry out the instructions for dealing with the same, waiting which all work shall be stopped. • The Independent Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Concessionaire to recommence the work in the site • All fossils, coins, articles of value of antiquity, structures and other remains or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. • AAHPL to develop a chance finding procedure for the project in consistency with regulatory requirement and best practices.	Insignificant	-	P – AAHPL S – NHAI

Table 7-2: Environment and Social Management Plan (ESMP) During Operation and Decommissioning Phase

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
OPERATION ACTIVITIES BY CONCESSIONAIRE							
1.	Operation Performance	• Effectiveness of mitigation measures	Moderate	• AAHPL needs to adhere to mentoring plan to indicate the effectiveness of the mitigation measures adopted in EMP	Minor	• AAHPL will monitor the operational performance of the various mitigation/ enhancement measures carried out as a part of the project. • The indicators selected for monitoring include the survival rate of trees; utility of enhancement provision made under the project; effectiveness of noise barriers etc.	P – AAHPL S – NHAI
2.	Maintenance of Drainage	• Blockage of drainage	Moderate	• AAHPL will ensure that all drains (side drains, median drain and all cross drainages) are periodically cleared especially before monsoon season to facilitate the quick passage of rainwater and avoid flooding. • AAHPL should ensure that no hazardous waste enters its drains and ultimately reaches water body.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI
3.	Noise Levels	• Noise generation due to vehicular tyre friction on the paved highway.	Moderate	• Wind barrier should be designed in accordance with the international acoustic design standards • Implement the recommended complaint resolution procedure (Grievance Redress Mechanism) to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved; • Building natural barriers like plants/usage of appropriate noise barriers around potentially affected structures, if complaints on the same are received. • The public will be advised to construct the noise barriers such as walls, double glazed windows and tree plantation between the roads and their property • Periodic Monitoring should be conducted to access the effectiveness of mitigation measure.	Minor	• Periodic EHS audits should be conducted to monitor the same • Grievance Redress Mechanism should be put in place and issues need to be resolved at the earliest.	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
4.	Hazardous Waste Management	• Contamination of land and soil	Moderate	• Hazardous wastes generated such as used transformer oil, will be stored & disposed of to state pollution control board authorized vendor as per provisions of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its amendments. • Hazardous waste to be disposed with help of SPCB authorised vendor.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI
5.	Solid Waste Management	• Contamination of land	Moderate	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". The waste generated should be disposed as per The Municipal Solid Wastes (Management and Handling) 2016. • Domestic waste will be composted and recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI
6.	Water Resources and Quality	• Through storm water management, existing natural drain will be aligned in such a way that that flows of storm water is maintained outside project area.	Moderate	• Storage of oil shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks. • Rainwater harvesting plan to be optimum with periodic monitoring for quality. • Proper storm water drainage lines to collect surface runoff (during monsoon) from the project site should be constructed. • Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into surface waters	Minor	Periodic EHS audits to be conducted to monitor the same	P – AAHPL S – NHAI
7.	Wastewater Management	• Degradation of ground and surface water quality	Moderate	• Ensure that constructed septic tanks during operation are well contained and impermeable to prevent leakage of wastewater into soil. • Ensure that septic tanks are emptied and collected by contractor at appropriate intervals to avoid overflowing	Minor	Periodic EHS audits to be conducted to monitor the same	P – AAHPL S – NHAI
8.	Occupational Health and Safety of Workers	• Fire due to short-circuit • Possible injuries associated with working at height	Moderate	• Provide and ensure wearing of personal protective equipment's viz., gloves, helmets, ear plug, safety belt etc. • Ensure effective work permit system following the laws of the state and central level for critical activities such as electrical work and working at height • Prepare emergency communication system and emergency preparedness plan	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
		• Diseases due to unhygienic condition		• Ensure proper sanitation facilities.			
9.	Pollution Monitoring	• Monitoring of Air, Water, Soil and noise should not exceed the CPCB limits.	Moderate	• The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil quality in the selected locations as suggested in pollution monitoring plan through the SPCB or its approved monitoring agency.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI
10.	Soil Erosion	• soil erosion, embankments and other places expected to be affected	Moderate	• Visual monitoring and inspection of soil erosion, embankments and other places expected to be affected, will be carried out. • If any significant erosion is observed, then strengthening of embankments should be carried out to reduce erosion.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI
11.	Encroachment	• Encroachment on ROW	Moderate	• Necessary hoardings will be erected indicating the availability of ROW and legal charges for encroachment of RoW.	Minor	Periodic EHS audits should be conducted to monitor the same	P – NHAI S – NHAI/ AAHPL
12.	Ecology	• Risk of Roadkill • Survival rate of Planted trees	Moderate	• The traffic – animal conflicts during the operation stage shall be resolved by implementing speed calming mitigation measures such as road humps, rumble strips, speed limits, sign boards etc. Adequate signages should be deployed to indicate Kambalakonda Wildlife Sanctuary location, and the workers need to be made aware of its sensitivity. • Adequate signages should be placed along the road indicating ecological hotspots, to create awareness amongst the riders to follow the safety measures. • Commuters and road using community will be sensitised on the road safety issues to reduce the accidents involving traffic – animal through informatory sign boards. • Prohibit avoidable vehicular honking by road-users in the section of the Project alignment situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value. • Plant relatively tall-growing native vegetation along the Project alignment to act as a visual screen and noise absorbent for the benefit of wildlife habitats in the vicinity. This is especially applicable to sections of the project alignment that are situated in proximity to the Kambalakonda Wildlife Sanctuary, a legally protected area designated for its biodiversity value.	Minor	Periodic EHS audits should be conducted to monitor the same	P – AAHPL S – NHAI

Sl. No.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements	Responsibility P – Planning & Execution S – Supervision/ Monitoring
				• Efforts shall be made for survival of planted trees. • AAHPL may consider to provide rumble strips in the KWS area after consultation with NHAI and IE.			
13.	Removal of Dead Animals	• Chances of accident	Moderate	• Dead animals lying on the road should be removed and buried away from the nearby residences. • In-case of wild animals the forest officers will be consulted.	Minor	Periodic monitor	P – AAHPL S – NHAI
14.	Public awareness on Noise levels, Public Health and Safety	• Chances of accident	Moderate	• The public awareness on road safety, noise abetment measures, construct the noise barriers such as walls and tree plantation. • Workers should be provided with personal protective equipments during operation phase.	Minor	Periodic monitor	P – AAHPL/NHAI S – NHAI
DECOMMISSIONING ACTIVITIES BY CONCESSIONAIRE							
15.	Clean-up Operations, Restoration and Rehabilitation	• Chances of accident and closure of project activity	Moderate	• Concessionaire will prepare site restoration plans, which will be approved by the Independent Engineer/ NHAI. The clean-up and restoration operations are to be implemented by the Concessionaire prior to demobilization. The Concessionaire will clear all temporary structures; dispose all garbage, night soils and POL (Petroleum, Oil and Lubricants) wastes as per Comprehensive Waste Management Plan. • All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by the Concessionaire and approved by the Independent Engineer/ NHAI in a layer of thickness of 75 mm-l50 mm. • All construction zones and facilities including culverts, road-side areas, camps, Hot Mix plant sites, Crushers, batching plant sites and any other area used/ affected due to the project operations will be left clean and tidy, at the Concessionaire's expense, to the entire satisfaction to the Independent Engineer/ NHAI.	Minor	Demobilisation activities by concessionaire	P – AAHPL S – NHAI

7.7 Environment Monitoring Programme

7.7.1 Environmental Monitoring Programme

Regular monitoring of environmental aspects during the Project operations phase is important to assess the status of environment with respect to baseline conditions. The monitored data can serve as an indicator for any change in environmental quality due to the project activities, and further to take adequate mitigation measures to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in following table.

Table 7-3 Environmental Monitoring Plan

Attribute	Project Stage	Parameter	Standards	Frequency	Responsibility	Location
Air	Construction	PM10, PM2.5, SOx, NOx, CO, O3, Lead, Ammonia, Benzene, Benzopyrene (BaP), Arsenic, Nickel	Air (prevention and Control of Pollution) Rules, CPCB, 1994	Every Three Months	Site EHS Manager	Ravindra Bharat School (Vellanki village), Anandapuram village, Pendhurthi village (bypass), Maturu quarry, Batajangalapalem village, Vavilipadu quarry, Basecamp 1 and 2
	Operation			Every Three Months		Ravindra Bharat School (Vellanki village), Anandapuram village, Gambhiram Toll Plaza, Pendhurthi village, Batajangalapalem village
Noise	Construction	Noise levels on dB (A) scale	MoEF&CC Noise Rules, 2000	Every Three Months	Site EHS Manager	Ravindra Bharat School (Vellanki village), Anandapuram Village, KKR Gautham School, Forest Area, NSRIT School, Gandigundam Village, Mudapaka Village, Pendhurthi Village, Rampuram Village, Pinagadi village, Asakapalli Village, Base Camp 1, Base Camp 2, Maturu quarry, Vavilipadu Quarry, Anakapalli Village.
	Operation			Every Six months		Ravindra Bharat School (Vellanki village), Anandapuram Village, KKR Gautham School, Forest Area, NSRIT School, Gandigundam Village, Mudapaka Village, Pendhurthi Village, Rampuram Village, Pinagadi village, Asakapalli Village, Base Anakapalli Village.
Water	Construction	Physio-chemical parameters monitored for Surface and Ground water	Indian Standards for Inland Surface Waters (IS: 2296, 1982) and for Drinking Water (IS : 10500 - 1991)	Every Six Months	Site EHS Manager	GW: Base Camp 1, Base Camp 2
	Operation			Every Six Months		GW Anandapuram Village, Pendurthi Village. SW: Chintanippula Agraharam, Mudapaka lake, Rajayyapeta Lake, Pendurthi Village Pond, water body.
Soil	Construction	Physio-chemical parameters	Threshold for each contaminant set by IRIS database of USEPA until national standards are promulgated	Every Three Months	Site EHS Manager	Base camp 1, Base camp 2, Sub base camp 1 and 2, both quarry areas.
	Operation			Every Six Months		All the maintenance area, Oil/Lubricant storage area, Hazardous waste storage area.
Tree plantation	Operation stage	Visual Inspection and monitoring of the survival rate.	-	Quarterly	Site EHS Manager	Areas where plantation is being done
Prevention of Roadside Squatters	Operation stage	Visual Inspection and following up on warning letters provided to the encroachers.	-	Regularly throughout the year	Site EHS Manager	Regularly throughout the year

7.7.2 Social and Health and Safety Monitoring Plan

Working conditions on site with respect to health and safety of the workers and concerns from the communities are required to be monitored regularly to ensure the positive impacts of the mitigation and management measures taken for the anticipated impacts.

Table 7-4 Social and Health and Safety Monitoring Plan

Attribute	Monitoring Parameter	Monitoring Frequency	Responsibility
Health and Safety Risks	• Sanitation status of onsite camps • Potable drinking water with respect to BIS drinking water standards 10500:2012; • Usage of adequate PPEs; • Health and Safety training to workers • Fire Safety measures on site • Incident/ accident records • Permit to work records • LOTO records • OHSMP of the project • Labour audit	Monthly	Site Manager

7.8 Budgetary Provisions for ESMP Implementation

The ESMP implementation will not be successful without a proper designated team and financial support for the same. The proposed team for ESMP implementation is as given below. Adequate budgetary provision will be made by the AAHPL for execution of environmental management plan.

The environmental budget for the various environmental management measures proposed in the EMP is presented in Table 7-5. There are several other environmental mitigation measures that have been addressed as part of good engineering practices, the costs for which have been accounted for in the engineering costs (Project cost). The design team has confirmed that the mitigation costs indicated in engineering cost are part of standard contract works. The budget for environmental management has been estimated to be INR **4,40,28,600 (628,980 USD)**

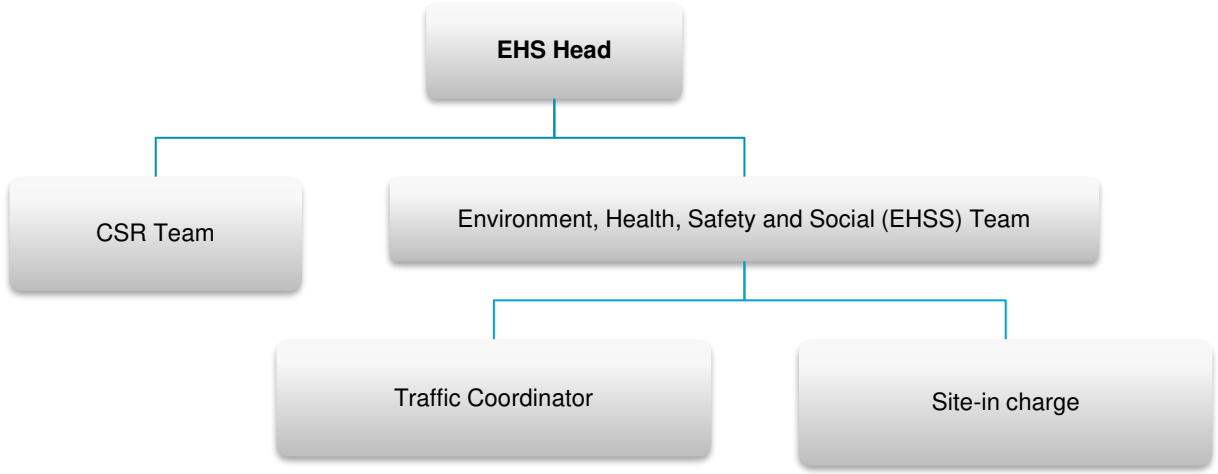


Table 7-5 ESMP Budget

Sl. No.	COMPONENT	STAGE	ITEM	UNIT	UNIT COST (INR)	QUANTITY	Total Cost (INR)
(A) MITIGATION							
1	Air	Construction	Dust Management with sprinkling of water, covers for vehicles transporting construction material	km	-	-	Included in Engineering Costs
2	Water	Construction	Relocation of Hand Pumps	No.	-	-	Included in R&R Cost
3			Oil Interceptors at Vehicle parking areas	No. (civil construction is not included)	1,50,000	2	3,00,000
4	Noise	Construction	Noise Barrier at 3 locations_ Year 2020	Sqm	14,000	1350	1,89,00,000
	Noise	Construction	Wall Barrier at 2 location_ Year 2020	Sqm	9,680	900	87,12,000
	Noise	Construction	Wall Barrier at 1 location_ Year 2030	Sqm	9,680	450	43,56,000
	Noise	Construction	Wall Barrier at 1 location_ Year 2040	sqm	9,860	450	43,56,000
5	Soil	Construction	Turfing / Pitching	Sqm	-	-	Included in Engineering Costs
		Operation	Redevelopment of Borrow areas	Sqm	-	-	Included in Engineering Costs
6A	Flora	Construction	Plantation including compensatory afforestation	No.	500	21,900	Cost accounted by NHAI
7	Flora	Operation	Planting of Median Shrubs	666 shrubs/ km	-	33,300	Included in Engineering Costs
8	Biodiversity	Operation	Provision of retaining wall at forest location km 689.200 to km 689.500 (if required)	-	-	-	The cost to be worked out separately by DBL after discussion with NHAI
						(A) Mitigation cost	**3,66,24,000**
(B) MONITORING							
9	Air Quality	Construction	Monitoring along the road as per Envt Monitoring Plan	No. of Samples	10,000	At 8 locations, every quarter in a year till construction period (June 2021) (Total 8x4x1 = 32 samples)	320,000
10		Operation	Monitoring along the road as per Envt Monitoring Plan	No. of Samples	10,000	At 5 locations, every quarter in a year for a period of 3 years (July 2024) (Total 5x4x3 = 60 samples)	600,000

Sl. No.	COMPONENT	STAGE	ITEM	UNIT	UNIT COST (INR)	QUANTITY	Total Cost (INR)
11	Water Quality	Construction	Drinking water quality monitoring at labour camps/ works site	No. of Samples	10,000	At 2 basecamp locations, twice in a year till construction period (June 2021) (Total 2x2x1 = 4 samples)	40,000
12		Operation	Monitoring along the road as per Envt Monitoring Plan	No. of Samples	10,000	At 6 locations, twice in a year for 3 years (Total 6x2x3 = 36 Samples)	360,000
13	Noise	Construction	Monitoring along the road	No. of Samples	2,000	At 16 locations, every quarter in a year till construction period (June 2021) (Total 16x4x1 = 64 samples)	128,000
14		Operation	Monitoring along the road at locations where monitoring was done during constructions	No, of Samples	2,000	At 12 locations, every quarter in a year for a period of 3 years (July 2024) (Total 16x4x3 = 192 samples)	384,000
15	Soil	Construction	Monitoring along the road	No of Samples	7,500	At 6 locations, every quarter in a year till construction period (June 2021) (Total 6x4x1 = 24 samples)	180,000
16		Operation	Monitoring along the Road	No. of Samples	7,500	At 1 location, four seasons in a year for 3 years (Total 1x4x3 = 12 samples)	90,000
						(B)- Monitoring Costs	**21,02,000**
(C) TRAINING AND CAPACITY BUILDING and AUDIT							
17	Training to Environmental Officer	Construction	Training to Environmental Officer for EMP implementation	LS	150,000	External training to cover ESMP Implementation and capacity building	150,000
18		Operation	Training to Environmental Officer for EMP implementation	LS	150,000		150,000
19	Reporting	Construction	PPE inventory, skill matrix as per job safety assessment including HIRA/Hazop	LS	6,00,000	Inhouse/ external agency to prepare HIRA/ HAZOP	6,00,000
20	Audit	Construction	Labour audit during construction Phase	Semi annually	2,00,000	Labour audit during construction Phase	4,00,000
						(C)- Capacity Building	**13,00,000**
Summary of Cost							
						(A) Mitigation cost	3,66,24,000
						(B)- Monitoring Costs	21,02,000
						(C)- Capacity Building	13,00,000
						Total	4,00,26,000
						Contingency @ 10%	40,02,600
						Total Cost	**4,40,28,600 (INR)** **628,980 (USD)**

8. Stakeholder Engagement Plan and Grievance Redressal

8.1 Stakeholder Engagement

Stakeholders are persons or groups who are directly or indirectly affected by a Project as well as those who may have interests in a Project and/or ability to influence its outcome either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interest, the academic community and other businesses24. Stakeholder engagement process can be described as a process which engages stakeholders with an aim to achieve certain outcomes. The process enables communication between the community members and the Project proponent. Increased communication between them would lead to a favourable condition and would thereby increase the viability of a project.

The purpose of the Stakeholder Engagement Plan (SEP) is to ensure that the direct and indirect impacted stakeholders of the Project are regularly apprised of the Project activities. The plan has been developed in order to draw out an outline wherein the communication process associated with the activities of the project cycle is to be undertaken.

Stakeholder Engagement and public consultation is embedded in ADB's safeguard policies on environment, involuntary resettlement and indigenous people. It is pertinent to note that the host country's regulations also cover public participation, consultation disclosure and grievance resolution process in its EIA notification and Land acquisition laws.

8.1.1 Stakeholder Engagement

To ensure the systematic implementation and execution of the stakeholder engagement process certain resources and framework is required to be in place. Certain defined roles and responsibilities of designated personnel can assist in smooth implementation of the stakeholder engagement process. The following personnel can be involved:

- **Corporate Social Responsibility (CSR) Head at the Corporate level:** The CSR head shall be responsible for the overall budgeting and monitoring of the stakeholder engagement activities undertaken at the site level. Impact assessment reports of the implemented stakeholder engagement activities should be reviewed by the CSR head and shall determine the feasibility of the implementation of the activities.

- **Site-in-charge at the Site level:** The Site-in-charge shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Site-in-charge shall develop resources and plan for the consultation activities to be conducted. Documentation of all processes such as identification and engagement activities with stakeholders is imperative and shall be done by the Site-in-charge.

8.1.2 Stakeholder Engagement Process

In order to engage the stakeholders, an approach is required to ensure that there is optimum implementation of the SEP. The approach would require the following steps depicted in ***Error! Reference source not found.***.

Figure 8-1 Stakeholder Engagement Process

[24] IFC's Stakeholder Engagement- A Good Practice Handbook for Companies doing Business in Emerging Markets

Stakeholder Identification

Identification of all affected communities and stakeholder groups according to the degree of their vulnerability to the impacts of the Project should be undertaken. They can be classified into “Direct” and “Indirect Stakeholders” according to their degree of influence of the project and vice versa.

Stakeholder Analysis

Stakeholder analysis takes into consideration a more comprehensive view of the stakeholder’s groups interest, how they would be affected and to what extent and the influence they could have on the Project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy.

The key stakeholders identified in the above section have been categorised into four major groups: inform, monitor, consult and engage deeply. The stakeholder analysis takes into consideration a more comprehensive view of the stakeholders’ groups interest, how they would be affected and to what extent and the influence that they could have on the project. These aspects would cumulatively provide the basis for constructing the stakeholder engagement strategy.

Analysis and categorisation of key stakeholders has been provided in Table 8-1.

Table 8-1 Stakeholder Analysis

Categorisation	Key Stakeholders Identified	Influence level	Interest Level
Inform	National Highway Authority of India (NHAI)	High	High
	Andhra Pradesh Pollution Control Board (APPCB)	High	High
	Central Ground Water Board	High	High
	Labour Department, Government of Andhra Pradesh	High	High
	Village Panchayats	High	High
	Regional Police Stations	High	High
Monitor	Contractors and its workers	High	High
	Subcontractors and its workers	High	High
	Vendors	High	High
Consult	Direct employees	High	High
	Contractors and its workers	High	High
	Subcontractors and its workers	High	High
	Vendors	High	High
Engage	• Community members of villages along the alignment	Low	Medium
	• Women Community Members	High	Medium
	• Employees	Medium	High

8.1.3 Stakeholder Engagement Programme

Table 8-2 presents the stakeholder engagement schedule, frequency of engagement, the areas of interest and influence. It also presents the appropriate methods of communication that can be utilised to engage with different stakeholders and the proposed plan of activities.

Table 8-2: Communicative Methods for Targeted Stakeholders

Targeted Stakeholder	Areas of Influence/Interest	Project Phase	Objective	Communicative Methods	Proposed Plan of Activities	Engagement Tools	Frequency
National Highway Authority of India (NHAI)	Concessionaire Agreement	All	Compliance to Concessionaire Agreement	• Submission of compliance reports	• Compliance to Concessionaire Agreement	• Face to Face Meetings	• As per requirements
Andhra Pradesh Pollution Control Board (APPCB)	Regulatory Compliance	All	Compliance to regulatory requirements.	• Information Meetings • Application/permit Renewal visits	• Compliance with regulatory requirements	• Face to Face Meetings	• As per regulatory requirements and when required
Central Ground Water Board	Regulatory Compliance	All	Compliance to regulatory requirements.	• Information Meetings • Application/permit Renewal visits	• Compliance with regulatory requirements	• Face to Face Meetings •	• As per regulatory requirements and when required
Labour Department, Government of Andhra Pradesh	Regulatory Compliance	All	Compliance to regulatory requirements.	• Information Meetings • Application/permit Renewal visits	• Compliance with regulatory requirements	• Face to face Meetings •	• As per regulatory requirements and when required
Village Panchayats	Regulatory Compliance and Local Impacts and opportunities	All	Compliance to regulatory requirements.	• Information Meetings • Application/permit Renewal visits	• Compliance with regulatory requirements	• Face to face Meetings •	• As per regulatory requirements and when required
Contractors and Vendors		All	To appraise about labour working condition and compliance of EHS related aspects	• Meetings	• Monthly Meetings (for the purpose of information dissemination, including information regarding labour laws, local employment opportunities, safety measures and discussions of grievances)	• Interactive Sessions	• Continual Engagement
Community Members (Impacted villages along the alignment)	Local Impacts and Opportunities	All	Managing and ensuring participation in CSR activities As part of GRM	• Focus group Discussions • Public Consultations • Participatory Workshops	• To enhance skills and diversify livelihood options of the community • Training sessions on skill development • To contribute and provide assistance for improvement of the project area. • To share/ exchange and develop ideas on better environmental management of the area.	• Skill Development Programmes • Livelihood Enhancement and Diversification programmes	• Frequent Engagement
Women Community Members (Impacted villages along the alignment)	Local Impacts and Opportunities	All	Ensuring participation in CSR activities	• Focus Group discussion • Participatory Workshops	• To enhance skills and diversify livelihood options of the community • Training sessions on skill development •	• Livelihood Enhancement and Diversification programmes	• Frequent Engagement
Employees of AAHPL	Internal	All	Regular Engagement	• Internal Meetings	• Updates on policies of CSDC and necessary information on CSDC activities. • To create teambuilding spirit.	• Audio-Visual Aids Interaction	• At least half yearly

8.2 Monitoring and Reporting

8.2.1 Monitoring

Internal: Internal audits of the stakeholder engagement activities implemented at the Project level should be undertaken. The frequency of the internal audits and review of the applicability, execution and feedback/ response to the implemented stakeholder engagement activities should be decided upon at the corporate level (preferably six monthly). EHS Head at the corporate level shall review the stakeholder engagement activities and provide feedback on its implementation. Site-in-charge shall be responsible for the internal monitoring of the stakeholder engagement activities that have been undertaken.

External: External Audits of the stakeholder engagement activities implemented at the Project level should be undertaken at least once every year by a third party appointed by the corporate in consultation with the site. The external agency should have prior experience of undertaking external audits of stakeholder activities and encompass team members possessing requisite educational qualification.

8.2.2 Reporting

Documentation and record keeping of the stakeholder engagement activities undertaken is recommended. Documentation of the following should be undertaken:

- Stakeholders Identified for the Project;
- Minutes of meetings of the stakeholder meetings;
- Details of communication methods used for stakeholders and feedback received;
- Documentation of stakeholder engagement activities undertaken at Project Level; and
- Quarterly reporting to corporate level of implemented activities.

8.2.3 Management Functions

As indicated earlier, the Site-in-charge shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Site-in-charge shall develop resources and plan for the consultation activities to be conducted.

The Site-in-charge will be responsible for SEP and will report to the Project Manager. The key responsibilities of the Site-in-charge will include but not limited to: -

- Management of community liaison at site;
- Development of Community Development Plan/ CSR Plan based on the views of key stakeholder groups regarding the Project and its impacts as well as the mitigation measures proposed in the ESIA study Report;
- Implementation of community engagement strategy and overseeing all community liaison-related matters;
- Establishing a monitoring and evaluation plan and other tools for stakeholder engagement including grievance register.

8.2.4 Information Disclosure

The disclosure of information, with relevant stakeholders, will not only minimize the risk of disputes and Project delay but also facilitates smooth implementation of project. Information disclosure will also be done throughout Project cycle. Based on the public outreach program, DBL to organise and maintain all relevant documents which needs to be disclosed to target stakeholders. The information disclosure included the followings:

- Project objective and scope,
- Potential impacts and mitigation measures,
- Grievance redressal mechanism, and
- Project compliance documents.

8.3 Grievance Redressal Mechanism

A grievance is indignation or resentment stemming from a feeling of having been wronged. In case of projects involving land acquisition and involuntary resettlement, the grievance procedure and appeal mechanism are an important aspect related to Resettlement and Rehabilitation (R&R) of the affected families, environmental and social performance. A Grievance Redress Mechanism (GRM) is needed to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the Project, particularly on compensation and community inconvenience. DBL is required to establish a Project specific GRM to provide an accessible platform for receiving and facilitating resolution of complaints from affected persons on Project implementation.

The GRMs is apply to both the work force, the community, contract workers and labours engaged for this project. This procedure focuses on Grievance Redressal Mechanisms to meet requirements, prevent and address community concerns, reduce risk, and assist processes that create positive social change. A well-functioning grievance mechanism should address the following:

- Provides a predictable, transparent, and credible process to all stakeholders, resulting in outcomes that are seen as fair, effective, and lasting;
- Builds trust as an integral component of broader community relations activities and between employees;
- Enables more systematic identification of emerging issues and trends, facilitating corrective action and community engagement.

Managing community grievances is equally important, especially in the present arrangement of land purchase where there is a likelihood of people not being satisfied. There could be grievances due to the manner in which construction activities are carried out or labour movement in local area etc. AAHPL needs to mitigate such issues either by getting directly involved or by ensuring that mitigation is done by its contractors.

Scope

Grievance Redressal mechanism is a locally based, formalized way to accept, assess, and resolve community complaints concerning the Project performance, its contractors, or employees. The present procedure is applicable to the life cycle of the Project (including construction and operations phase). In effort to develop an effective two-way communication a GRM will be developed by AAHPL. The broad outline of the mechanism is as follows.

- Grievance can be obtained either oral or in the written format (a sample format is given below)
- Grievance can be collected in the Suggestion Box placed for stakeholders at designated places at the Project site
- Number of suggestion box and place of availability will be communicated to all stakeholders and documented for evidences.
- Developers will address the concern immediately and action taken with mitigation plan with time target.
- In case of any potential E&S concern/ impacts will be informed to EHS in-charge at site. Other grievances will be directed to Project Manager at site.
- A register needs to be developed to record all grievances.

Receive and Register a Complaint

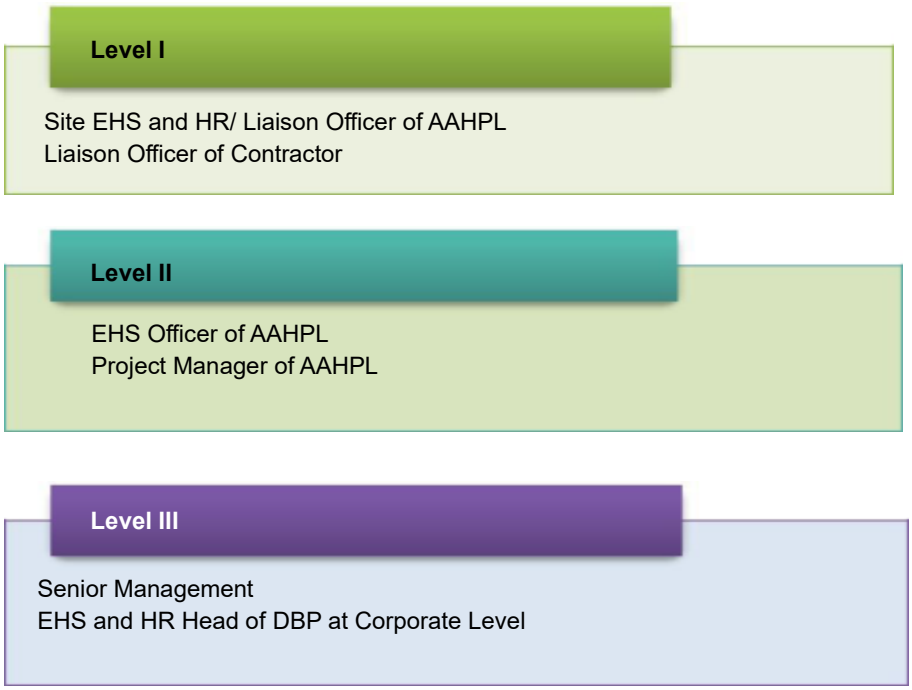
- Any labour/ stakeholder/ person with any concerns pertaining to onsite work, issues with community or among co-workers, management etc. may register their complaint in writing to the nominated persons at site (Level-I);
- Secured grievance boxes shall be placed at site and project offices to receive complaints;
- If the complainant wishes to remain anonymous, he/she can write down the grievances and drop in the available complaint boxes;
- Once a complaint has been received it shall be recorded in the complaints log register or system.

Assessment and Addressal of Complaint

- The Site EHS and HR/ Liaison Officer of AAHPL will open the complaint boxes as and when a complaint is received (or every fifteen (15) days, whichever is earlier) and try to resolve the grievances on their own (Level I)

- During the assessment of complaints, the team will gather information about the key issues and concerns and helps determine whether and how the complaint might be resolved;
- The issues will be registered by HR Officer who will take 2 days to screen and assess the grievance. If the complaint seems to require intervention then it will be considered for further action, otherwise it will be rejected and the same will be communicated to the concerned complainant by Liaison Officer;
- The grievance will be assessed to determine if the issues raised by the complaint fall within the mandate of the grievance mechanism or not;
- If the grievance fails to be addressed at Level-I within stipulated time or to the satisfaction of complainant, the grievance will be referred to the Project Manager of AAHPL (Level – II).
- EHS officer will explore all the available options for solving problems through internal decision-making processes. The solution for the grievance will be devised within next 7 working days by the EHS officer and HR stationed at Project site. In case no action is taken even after intervention of above two levels, the Level-III of GRC shall take the final decision pertaining to the complaint;
- Of required, the Project Manager of AAHPL may intimate NHAI to step to resolve the grievances;
- The minutes of the Grievance Committee meetings at the site level will be recorded and circulated to corporate staff and unresolved issues will be escalated to the next Level of committee;
- At Level-III, Corporate HR Head along with EHS Head will try to address the grievance. If necessary meetings will be conducted with the complainant and evidence will be examined. The grievance will be closed within 5 working days of referral;
- The complainant will have the opportunity to be present (if required) and discuss the grievance at all the levels. If the grievance remains unresolved even after going through all the levels of GRC, the complainant will have the option to approach the appropriate court of laws for redress;
- Redressal of all the compliances/ issues will be documented as per form (refer below).

The GRC process is shown below.



Action

- Prepare a communication record;
- Document minutes of all meetings and documents released to external agencies;
- Inform the workers about the grievance mechanism at the time of recruitment and make it easily accessible to them;
- Implement Grievance Redressal Mechanism for employees;
- Display of GRM at notice board at the project site offices and to be included in worker documentation.

Record Keeping/ Outcome

- Register for grievances received;
- Register of communication;
- Remedial action taken.

Format for Grievance Recording

Name of the Person: _____

Employee/Worker/ Community member (specify):_____

Work Area/ Place: _____ **Date of receive: _____**

Description of Grievance:_____

_____

_____

_____

_____

_____

_____

_____

GRC Action Items to be checked

GRC Action Points	Yes (Y), No (No)
Have you made aware of presence of Grievance Redressal mechanism?	
Display of GRM at notice board at the project site offices	
GRM to be included in worker documentation	
Are you aware of the levels of Grievance Redressal Committee (level I, level II and level III)?	
Have you provided with the option to approach the appropriate court of laws for redress?	
Have workers informed about the grievance mechanism at the time of recruitment and make it easily accessible to them?	

Signature: _____

Date of resolve of grievance: _____

Format for Grievance Register

Sl. No.	Grievance Received from Employee/ Worker/ Community	Short Description of Grievance	Corrective Action Taken	Level of GRC (Level I, II, III)

Maintained by: _____ **Signature: _____**

9. Conclusion

The Project road, six laning of the Anandapuram- Anakapalli section of existing National Highway 16 in the State of Andhra Pradesh is proposed to be up-graded with bypasses and realignments at some locations for improving the road geometrics to meet the Project objective. The Project road does not attract the EIA Notification, 2006 by MoEF&CC. AAHPL is implementing the Project under the Bharatmala Pariyojana and developed as per the Build-Operate- Transfer and Hybrid Annuity Mode (BOT-HAM). Concession Agreement for the Project has been signed between AAHPL and NHAI in April 2018.

The Initial Environmental and social Due Diligence was conducted to identify significant potential environmental impacts associated with the construction and operational phases of the Project road. Apart from positive impacts, the road could have some adverse direct and indirect environmental impacts. Direct environmental impacts are usually due to construction activities, while indirect environmental impacts are usually related to the operation of improved road.

The Project road is a 50.8 km stretch of highway starting from the Anandapuram village and concluding at Anakapalli village, both falling within Vishakhapatnam district. Presently, the road is in the construction phase with approximately 50% of work is completed till date.

An Environmental and Social Impact Assessment (ESIA) is carried out and most of the adverse impacts of road Project during construction period are temporary in nature. Most of these impacts can be minimized through specific engineering solutions, construction methodology incorporated in the Project design and by implementing mitigation measures as suggested in ESMP. The overall impact on environmental attributes by the proposed Project is unlikely to cause any significant adverse environmental impacts and no further detailed study is required. The ESMP may be updated if deemed necessary as per the site requirement in future.

Construction of the Project will involve use of various types of construction equipment that are mobile and with high intermittent noise emissions. Operation of the highway will also lead to noise emission from movement of traffic. The Federal Highway Administration's Traffic Noise Model (FHWA TNM) was used in this study to simulate predicted noise levels. Appropriate mitigation measures at sensitive locations for have been proposed.

Any major change in the Project will require updating the environmental assessment document as per the requirement. The updated assessment will have to be submitted to concerned Government authorities and ADB for concurrence before the actual construction commence.

Applying the criteria stipulated by the ADB Safeguard Policies on environmental categorization, the proposed Project is assigned as '**Category B**' on the basis of the available data, review of documents and site visit, and present conditions of the road (50% being completed). The primary data available till date indicates that the environmental risks and impacts of the proposed Project activities are expected to be few in number, generally site-specific, most of them reversible, and readily addressed through mitigation measures as suggested in this report.

List of Appendix

Appendix A List of Plants Reported in the Study Area

SN	*Scientific Name*	Common Name	Habit	Family	IUCN Category[25]
Woody Species					
1	*Acacia leucophloea*	Tella tumma	Tree	Leguminosae	LC
2	*Acacia chundra*	Sundra	Tree	Leguminosae	-
3	*Ailanthus excelsa*	Peddamanu	Tree	Simaroubaceae	-
4	*Alangium salviifolium*	Vooduga	Tree	Cornaceae	LC
5	*Albizia amara*	Nallaregu, cheekireni	Tree	Leguminosae	LC
6	*Alseodaphne semecarpifolia*	Naramamidi	Tree	Lauraceae	-
7	*Anacardium occidentale*	Jeedimamidi	Tree	Anacardiaceae	-
8	*Antidesma acidum*	Pullagummadi	Tree	Phyllanthaceae	LC
9	*Atalantia monophylla*	Advinimma, Karunimma	Tree	Rutaceae	-
10	*Azadirachta indica*	Vepa	Tree	Meliaceae	LC
11	*Barringtonia acutangula*	Kadmi	Tree	Meliaceae	LC
12	*Bauhinia racemosa*	Ari	Tree	Leguminosae	-
13	*Bauhinia divaricata*	Godari	Tree	Leguminosae	LC
14	*Bauhinia variegata*	Bodaddam	Tree	Leguminosae	LC
15	*Borassus flabellifer*	Tati, Tadi (Aracacum)	Tree	Arecaceae	-
16	*Bridelia tomentosa*	Balli	Tree	Phyllanthaceae	LC
17	*Psydrax dicoccos*	Nakkina, Nalla balusu	Tree	Rubiaceae	VU
18	*Cassia fistula*	Rela	Tree	Leguminosae	LC
19	*Toona ciliata*	Galimanu	Tree	Meliaceae	LC
20	*Chloroxylon swietenia*	Billa, Billudu	Tree	Rutaceae	VU
21	*Cipadessa baccifera*	Rana billa (Ranabheri)	Tree	Meliaceae	LC
22	*Cordia myxa*	Lriki, Nakeri, Bhootan kusum	Tree	Boraginaceae	-
23	*Crateva religiosa*	Tellavulimidi	Tree	Capparaceae	LC
24	*Dalbergia lanceolaria subsp. paniculata*	Pachari, Sayaboddi	Tree	Leguminosae	-
25	*Dalbergia spinosa*	Chillangi	Tree	Leguminosae	-
26	*Dichrostachys cinerea*	Velthuru	Tree	Leguminosae	LC
27	*Diospyros chloroxylon*	Vullinda (Tokarika)	Tree	Ebenaceae	-
28	*Diospyros vera*	Alli	Tree	Ebenaceae	-
29	*Diospyros sylvatica*	Tella gatha	Tree	Ebenaceae	-
30	*Diospyros montana*	Yerragatha	Tree	Ebenaceae	-
31	*Diospyros villosiuscula*	Nironddi	Tree	Ebenaceae	-
32	*Cassine glauca*	Neridi	Tree	Celastraceae	-
33	*Phyllanthus emblica*	Rach usirika	Tree	Phyllanthaceae	-
34	*Erythroxylum monogynum*	Adavigorinta	Tree	Erythroxylaceae	-
35	*Euphorbia tirucalli*	Jemudu	Tree	Euphorbiaceae	LC
36	*Ficus benghalensis*	Marri	Tree	Moraceae	-
37	*Ficus hispida*	Boddamarri	Tree	Moraceae	LC
38	*Ficus retusa*	Yerra juvvi	Tree	Moraceae	-
39	*Ficus religiosa*	Ravi	Tree	Moraceae	-

[25] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where –LC – Least Concern and NA – Not assessed*

SN	*Scientific Name*	Common Name	Habit	Family	IUCN Category[25]
40	*Ficus mollis*	Juvvi	Tree	Moraceae	-
41	*Ficus amplissima*	Pitta juvvi	Tree	Moraceae	-
42	*Garcinia spicata*	Pidatha	Tree	Clusiaceae	-
43	*Gmelina asiatica*	Karugummadi	Tree	Lamiaceae	LC
44	*Grewia laevigata*	Potrika	Tree	Malvaceae	LC
45	*Grewia flavescens*	Nalli	Tree	Malvaceae	-
46	*Grewia asiatica*	Bankarara	Tree	Malvaceae	LC
47	*Grewia tiliifolia*	Thada	Tree	Malvaceae	-
48	*Grewia hirsuta*	Chrijana	Tree	Malvaceae	-
49	*Gymnosporia spinosa*	Chinni, Danti	Tree	Celastraceae	-
50	*Helicteres isora*	Gubathada	Tree	Malvaceae	-
51	*Holarrhena pubescens*	Pala	Tree	Apocynaceae	LC
52	*Hymenodictyon orixense*	Dudippa	Tree	Rubiaceae	-
53	*Ixora coccinea*	Korivi, Korimpala	Tree	Rubiaceae	-
54	*Lantana camara*	Sitammavari poda	Tree	Verbenaceae	-
55	*Lannea coromandelica*	Gumpena	Tree	Anacardiaceae	-
56	*Mangifera indica*	Mamidi	Tree	Anacardiaceae	DD
57	*Memecylon scutellatum*	Alli	Tree	Melastomaceae	-
58	*Manilkara hexandra*	Pala	Tree	Sapotaceae	-
59	*Morinda coreia*	Togaru	Tree	Rubiaceae	-
60	*Murraya koenigii*	Karivepaku	Tree	Rutaceae	-
61	*Ochna jabotapita*	Tammi	Tree	Ochnaceae	-
62	*Phoenix sylvestris*	Ita	Tree	Arecaceae	-
63	*Polyalthia cerasoides*	Chilakadudduga	Tree	Annonaceae	-
64	*Pterospermum suberifolium*	Lolugu	Tree	Malvaceae	-
65	*Pterolobium punctatum*	Korintha, Kodimudusu	Tree	Leguminosae	-
66	*Sapindus emarginatus*	Kunkudu, Ritta	Tree	Sapindaceae	-
67	*Semecarpus anacardium*	Nalla Jeedi	Tree	Anacardiaceae	-
68	*Spondias pinnata*	Adavi mamidi	Tree	Anacardiaceae	-
69	*Streblus asper*	Barinika	Tree	Moraceae	LC
70	*Terminalia bellirica*	Thadi, Thani	Tree	Combretaceae	-
71	*Terminalia chebula*	Karaka	Tree	Combretaceae	-
72	*Wrightia tinctoria*	Ankudu	Tree	Apocynaceae	-
73	*Ziziphus xylopyrus*	Gotti	Tree	Rhamnaceae	-
74	*Abutilon indicum*	Tutturabenda	Shrub	Malvaceae	-
75	Acacia pennata	Mulla korintha	Shrub	Leguminosae	LC
76	*Acanthus ilicifolius*	Alchi	Shrub	Acanthaceae	LC
77	*Asparagus racemosus*	Pilli teegelu	Shrub	Asparagaceae	-
78	*Canthium coromandelicum*	Balusu	Shrub	Rubiaceae	-
79	*Capparis sepiaria*	Nalluppi	Shrub	Capparaceae	-
80	Carissa carandas	Kalivi	Shrub	Apocynaceae	-
81	*Carissa spinarum*	Pedda vaka	Shrub	Apocynaceae	-
82	*Casearia tomentosa*	Chilakadudduga	Shrub	Salicaceae	-
83	*Senna auriculata*	Thangedu	Shrub	Leguminosae	-
84	*Senna timoriensis*	Pagadi, tangedu	Shrub	Leguminosae	LC

SN	*Scientific Name*	Common Name	Habit	Family	IUCN Category[25]
85	*Senna tora*	Kasivinda, Kasinda	Shrub	Leguminosae	-
86	*Celastrus aculeatus*	Danti	Shrub	Celastraceae	-
87	*Clerodendrum infortunatum*	Pisinika, backeda	Shrub	Lamiaceae	-
88	*Dichrostachys cinerea*	Veluthuru	Shrub	Leguminosae	LC
89	*Dodonaea viscosa*	Pulledu	Shrub	Sapindaceae	LC
90	*Euphorbia nivulia*	Brahmajemudu	Shrub	Euphorbiaceae	-
91	*Euphorbia trigona*	Kattimandu	Shrub	Euphorbiaceae	-
92	*Flacourtia indica*	Kanregu, Pedda kanregu	Shrub	Salicaceae	LC
93	*Hemidesmus indicus*	Sugandhapala	Shrub	Apocynaceae	-
94	*Glycosmis pentaphylla*	Golugu	Shrub	Rutaceae	LC
95	*Hugonia mystax*	Pentapeeda kakibeera	Shrub	Linaceae	-
96	*Pavetta indica*	Papidi	Shrub	Rubiaceae	-
97	*Catunaregam spinosa*	Manga	Shrub	Ribiaceae	-
98	*Benkara fasciculata*	Pedda manga	Shrub	Rubiaceae	-
99	*Eugenia roxburghii*	Arivita	Shrub	Myrtaceae	-
100	*Memecylon edule*	Alli	Shrub	Melastomataceae	-
101	*Mimosa pudica*	Attipatti	Shrub	Leguminosae	LC
102	*Murraya paniculata*	Golimi	Shrub	Rutaceae	-
103	*Pterolobium punctatum*	Korintha	Shrub	Caesalpinoideae	-
104	*Acilepis divergens*	Kampurodda	Shrub	Compositae	-
105	*Ziziphus oenopolia*	Pariki	Shrub	Rhamnaceae	LC
106	*Capparis zeylanica*	Konda thivva, Adonda	Climber	Capparidaceae	-
107	*Ventilago denticulata*	Surugudu	Climber	Rhamnaceae	-
108	*Caesalpinia bonduc*	Gacha	Climber	Leguminosae	LC
109	*Abrus precatorius*	Gurivinda	Climber	Leguminosae	-
110	*Acacia intsia*	Korintha	Climber	Leguminosae	-
111	*Leptadenia reticulata*	Mukkutummudu theega	Climber	Asclepiadaceae	-
112	*Derris scandens*	Nallateega	Climber	Leguminosae	LC
113	*Ichnocarpus frutescens*	Pala theega	Climber	Apocynaceae	-
114	*Tinospora sinensis*	Tippa teega	Climber	Menispermaceae	-
115	*Mimosa rubicaulis*	Undra kampa	Climber	Leguminosae	-
116	*Dendrocalamus strictus*	Sadhanam veduru	Bamboo	Poaceae	-
117	*Bambusa bambos*	Mulla veduru	Bamboo	Poaceae	-
Non-woody Species					
118	*Evolulus alsinoides*	Vishnukrantham	Herb	Convolvulaceae	-
119	*Cuscuta reflexa*	Seetammasavaram, pasi tivva	Herb	Convolvulaceae	-
120	*Achyranthes aspera*	Uttareni	Herb	Amaranthaceae	-
121	*Gloriosa superba*	Adavinabhi	Climber	Colchicaceae	LC
122	*Clitoria ternatea*	Sankupushpam	Climber	Leguminosae	-
123	*Smilax zeylanica*	Kumari teega	Climber	Smilaceae	-
124	*Cissus quadrangularis*	Nalleru	Climber	Vitaceae	-
125	*Hemidesmus indicus*	Sugundhapala	Climber	Apocynaceae	-
126	*Mucuna pruriens*	Yenugu dulagonda	Climber	Leguminosae	-

SN	*Scientific Name*	Common Name	Habit	Family	IUCN Category[25]
127	*Aristida setacea*	Chippera gaddi, Paraka gaddi	Herb	Poaceae	-
128	*Chrysopogon fulvus*	Gurram thoka gaddi	Herb	Poaceae	-
129	*Cymbopogon martini*	Kanchini, Kasi gaddi	Herb	Poaceae	-
130	*Ischaemum afrum*	Kurdara gaddi	Herb	Poaceae	-
131	*Schima nervosum*	Nendra gaddi	Herb	Poaceae	-
132	*Eulaliopsis binata*	Sabari gaddi	Herb	Poaceae	-
133	*Heteropogon contortus*	Yedagaddi pandiballalu	Herb	Poaceae	-

Source: Wildlife Management Plan for the Kambalakonda Wildlife Sanctuary

Appendix B List of Mammals Reported in the Study Area

SN	*Scientific Name*	Common Name	IUCN Category[26]	WPA Schedule[27]
1	*Macaca mulatta*	Rhesus Monkey	LC	II
2	*Megaderma lyra*	Greater False Vampire	LC	-
3	*Miniopterus schreibersii*	Schreiber's Bent-winged Bat	NT	-
4	*Murina cyclotis*	Round-eared Tube-nosed Bat	LC	-
5	*Myotis montivagus*	Burmese Whiskered Myotis	LC	-
6	*Pteropus giganteus*	Indian Flying Fox	LC	V
7	*Rousettus leschenaultii*	Leschenault's Rousette	LC	-
8	*Semnopithecus entellus*	Northern Plains Gray Langur	LC	II
9	*Eonycteris spelaea*	Dawn Bat	LC	-
10	*Lutrogale perspicillata*	Smooth-coated Otter	VU	II
11	*Aonyx cinereus*	Asian Small-clawed Otter	VU	II
12	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC	-
13	*Rhinolophus pusillus*	Least Horseshoe Bat	LC	-
14	*Rhinolophus rouxii*	Chinese Horseshoe Bat	LC	-
15	*Rhinopoma hardwickii*	Lesser Mouse-tailed Bat	LC	-
16	*Scotophilus heathii*	Greater Asiatic Yellow House Bat	LC	-
17	*Hipposideros speoris*	Schneider's Roundleaf Bat	LC	-
18	*Taphozous longimanus*	Long-winged Tomb Bat	LC	-
19	*Cynopterus sphinx*	Greater Shortnosed Fruit Bat	LC	V
20	*Pipistrellus tenuis*	Least Pipistrelle	LC	-
21	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-
22	*Axis axis*	Chital	LC	III
23	*Muntiacus vaginalis*	Northern Red Muntjac	LC	III
24	*Anathana ellioti*	Madras Treeshrew	LC	-
25	*Suncus murinus*	House Shrew	LC	-
26	*Mus platythrix*	Brown Spiny Mouse	LC	V
27	*Tatera indica*	Indian Gerbil	LC	-
28	*Sus scrofa*	Wild Boar	LC	III
29	*Lepus nigricollis*	Indian Hare	LC	IV
30	*Herpestes edwardsii*	Indian Grey Mongoose	LC	II
31	*Herpestes smithii*	Ruddy Mongoose	LC	II
32	*Mellivora capensis*	Honey Badger	LC	I
33	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	II
34	*Viverricula indica*	Small Indian Civet	LC	III

[26] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where – VU- Vulnerable, NT – Near Threatened and LC – Least Concern.*
[27] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

SN	*Scientific Name*	Common Name	IUCN Category[26]	WPA Schedule[27]
35	*Canis aureus*	Golden Jackal	LC	II
36	*Tetracerus quadricornis*	Four-horned Antelope	VU	I
37	*Felis chaus*	Jungle Cat	LC	II
38	*Prionailurus bengalensis*	Leopard Cat	LC	I
39	*Prionailurus rubiginosus*	Rusty-spotted Cat	NT	I
40	*Moschiola indica*	Indian Chevrotain	LC	I
41	*Cuon alpinus*	Dhole	EN	II
42	*Vulpes bengalensis*	Bengal Fox	LC	III
43	*Rusa unicolor*	Sambar	VU	III
44	*Bandicota bengalensis*	Lesser Bandicoot Rat	LC	V
45	*Bandicota indica*	Greater Bandicoot Rat	LC	V
46	*Boselaphus tragocamelus*	Nilgai	LC	III
47	*Funambulus palmarum*	Common Palm Squirrel	LC	-
48	*Funambulus pennantii*	Five-striped Palm Squirrel	LC	IV
49	*Hystrix indica*	Indian Crested Porcupine	LC	IV
50	*Mus booduga*	Common Indian Field Mouse	LC	V
51	*Mus musculus*	House Mouse	LC	V
52	*Mus terricolor*	Earth-colored Mouse	LC	V
53	*Rattus rattus*	House Rat	LC	V
54	*Canis lupus*	Grey Wolf	LC	I
55	*Manis crassicaudata*	Indian Pangolin	EN	I
56	*Panthera pardus*	Leopard	VU	I

Sources: Vivek Menon (2014), Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, pp 1-522; Y. P. Sinha (1980). The Bats of ---: Taxonomy and Zoogeography. Records of Zoological Survey of India, 76, pp 7-63; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix C List of Birds Reported in the Study Area

C.1 Resident Birds

SN	Scientific Name	English Name	IUCN Category[28]	WPA Schedule[29]
1	*Elanus caeruleus*	Black-winged Kite	LC	I
2	*Pernis ptilorhynchus*	Oriental Honey Buzzard	LC	I
3	*Neophron percnopterus*	Egyptian Vulture	EN	IV
4	*Spilornis cheela*	Crested Serpent Eagle	LC	I
5	*Gyps bengalensis*	White-rumped Vulture	CR	I
6	*Gyps indicus*	Indian Vulture	CR	I
7	*Aquila nipalensis*	Steppe Eagle	EN	I
8	*Circus aeruginosus*	Western Marsh Harrier	LC	I
9	*Accipiter badius*	Shikra	LC	I
10	*Haliaeetus leucogaster*	White-bellied Sea Eagle	LC	I
11	*Haliastur indus*	Brahminy Kite	LC	I
12	*Milvus migrans*	Black Kite	LC	I
13	*Butastur teesa*	White-eyed Buzzard	LC	I
14	*Acrocephalus dumetorum*	Blyth's Reed Warbler	LC	IV
15	*Acrocephalus stentoreus*	Clamorous Reed Warbler	LC	IV
16	*Aegithina tiphia*	Common Iora	LC	IV
17	*Eremopterix griseus*	Ashy-crowned Sparrow Lark	LC	IV
18	*Mirafra affinis*	Jerdon's Bushlark	LC	IV
19	*Alauda gulgula*	Oriental Skylark	LC	IV
20	*Alcedo atthis*	Common Kingfisher	LC	IV
21	*Ceryle rudis*	Pied Kingfisher	LC	IV
22	*Pelargopsis capensis*	Stork-billed Kingfisher	LC	IV
23	*Halcyon smyrnensis*	White-throated Kingfisher	LC	IV
24	*Spatula querquedula*	Garganey	LC	IV
25	*Sarkidiornis melanotos*	Comb Duck	LC	IV
26	*Apus affinis*	Indian House Swift	LC	IV
27	*Ixobrychus cinnamomeus*	Cinnamon Bittern	LC	IV
28	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	IV
29	*Butorides striata*	Striated Heron	LC	IV
30	*Ardeola grayii*	Indian Pond Heron	LC	IV
31	*Ardea cinerea*	Grey Heron	LC	IV
32	*Ardea purpurea*	Purple Heron	LC	IV
33	*Ardea alba*	Great Egret	LC	IV
34	*Egretta garzetta*	Little Egret	LC	IV
35	*Artamus fuscus*	Ashy Woodswallow	LC	IV
36	*Pericrocotus cinnamomeus*	Small Minivet	LC	IV

[28] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered; EN – Endangered; NT – Near Threatened; VU – Vulnerable and LC – Least Concern.*
[29] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

SN	Scientific Name	English Name	IUCN Category[28]	WPA Schedule[29]
37	*Pericrocotus flammeus*	Scarlet Minivet	LC	IV
38	*Coracina javensis*	Large Cuckooshrike	LC	IV
39	*Caprimulgus asiaticus*	Indian Nightjar	LC	IV
40	*Charadrius dubius*	Little Ringed Plover	LC	IV
41	*Charadrius mongolus*	Lesser Sand Plover	LC	IV
42	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	IV
43	*Vanellus indicus*	Red-wattled Lapwing	LC	IV
44	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	IV
45	*Anastomus oscitans*	Asian Openbill	LC	IV
46	*Ciconia ciconia*	European White Stork	LC	I
47	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT	IV
48	*Cisticola juncidis*	Zitting Cisticola	LC	IV
49	*Prinia hodgsonii*	Grey-breasted Prinia	LC	IV
50	*Prinia sylvatica*	Jungle Prinia	LC	IV
51	*Prinia inornata*	Plain Prinia	LC	IV
52	*Orthotomus sutorius*	Common Tailorbird	LC	IV
53	*Columba livia*	Rock Pigeon	LC	IV
54	*Streptopelia decaocto*	Eurasian Collared Dove	LC	IV
55	*Streptopelia chinensis*	Spotted Dove	LC	IV
56	*Streptopelia senegalensis*	Laughing Dove	LC	IV
57	*Chalcophaps indica*	Asian Emerald Dove	LC	IV
58	*Coracias benghalensis*	Indian Roller	LC	IV
59	*Dendrocitta vagabunda*	Rufous Treepie	LC	IV
60	*Corvus splendens*	House Crow	LC	Schedule-V
61	*Corvus macrorhynchos*	Large-billed Crow	LC	IV
62	*Centropus sinensis*	Greater Coucal	LC	IV
63	*Phaenicophaeus viridirostris*	Blue-faced Malkoha	LC	IV
64	*Eudynamys scolopaceus*	Asian Koel	LC	IV
65	*Cacomantis passerinus*	Grey-bellied Cuckoo	LC	IV
66	*Hierococcyx varius*	Common Hawk Cuckoo	LC	IV
67	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	IV
68	*Dicrurus macrocercus*	Black Drongo	LC	IV
69	*Dicrurus caerulescens*	White-bellied Drongo	LC	IV
70	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	LC	IV
71	*Euodice malabarica*	Indian Silverbill	LC	IV
72	*Carpodacus erythrinus*	Common Rosefinch	LC	IV
73	*Cursorius coromandelicus*	Indian Courser	LC	IV
74	*Glareola lactea*	Little Pratincole	LC	IV
75	*Antigone antigone*	Sarus Crane	VU	IV

SN	Scientific Name	English Name	IUCN Category[28]	WPA Schedule[29]
76	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	IV
77	*Metopidius indicus*	Bronze-winged Jacana	LC	IV
78	*Lanius cristatus*	Brown Shrike	LC	IV
79	*Lanius vittatus*	Bay-backed Shrike	LC	IV
80	*Sterna aurantia*	River Tern	NT	IV
81	*Turdoides striata*	Jungle Babbler	LC	IV
82	*Psilopogon zeylanicus*	Brown-headed Barbet	LC	IV
83	*Psilopogon haemacephalus*	Coppersmith Barbet	LC	IV
84	*Merops orientalis*	Green Bee-eater	LC	IV
85	*Hypothymis azurea*	Black-naped Monarch	LC	IV
86	*Anthus rufulus*	Paddyfield Pipit	LC	IV
87	*Motacilla citreola*	Citrine Wagtail	LC	IV
88	*Motacilla maderaspatensis*	White-browed Wagtail	LC	IV
89	*Saxicoloides fulicatus*	Indian Robin	LC	IV
90	*Copsychus saularis*	Oriental Magpie Robin	LC	IV
91	*Kittacincla malabarica*	White-rumped Shama	LC	IV
92	*Luscinia svecica*	Bluethroat	LC	IV
93	*Calliope calliope*	Siberian Rubythroat	LC	IV
94	*Phoenicurus ochruros*	Black Redstart	LC	IV
95	*Monticola solitarius*	Blue Rock Thrush	LC	IV
96	*Saxicola caprata*	Pied Bushchat	LC	IV
97	*Leptocoma zeylonica*	Purple-rumped Sunbird	LC	IV
98	*Cinnyris asiaticus*	Purple Sunbird	LC	IV
99	*Oriolus xanthornus*	Black-hooded Oriole	LC	IV
100	*Sypheotides indicus*	Lesser Florican	EN	I
101	*Pandion haliaetus*	Osprey	LC	I
102	*Passer domesticus*	House Sparrow	LC	IV
103	*Gymnoris xanthocollis*	Yellow-throated Sparrow	LC	IV
104	*Pelecanus philippensis*	Spot-billed Pelican	NT	IV
105	*Microcarbo niger*	Little Cormorant	LC	IV
106	*Pavo cristatus*	Indian Peafowl	LC	I
107	*Coturnix coturnix*	Common Quail	LC	IV
108	*Coturnix coromandelica*	Rain Quail	LC	IV
109	*Perdicula asiatica*	Jungle Bush Quail	LC	IV
110	*Francolinus pondicerianus*	Grey Francolin	LC	IV
111	*Gallus gallus*	Red Junglefowl	LC	IV
112	*Phoenicopterus roseus*	Greater Flamingo	LC	IV
113	*Phylloscopus trochiloides*	Greenish Leaf Warbler	LC	IV
114	*Jynx torquilla*	Eurasian Wryneck	LC	IV

SN	Scientific Name	English Name	IUCN Category[28]	WPA Schedule[29]
115	*Dinopium benghalense*	Lesser Golden-backed Woodpecker	LC	IV
116	*Dendrocopos nanus*	Brown-capped Pygmy Woodpecker	LC	IV
117	*Leiopicus mahrattensis*	Yellow-fronted Pied Woodpecker	LC	IV
118	*Ploceus philippinus*	Baya Weaver	LC	IV
119	*Tachybaptus ruficollis*	Little Grebe	LC	IV
120	*Podiceps cristatus*	Great Crested Grebe	LC	IV
121	*Psittacula krameri*	Rose-ringed Parakeet	LC	IV
122	*Pycnonotus jocosus*	Red-whiskered Bulbul	LC	IV
123	*Pycnonotus cafer*	Red-vented Bulbul	LC	IV
124	*Pycnonotus luteolus*	White-browed Bulbul	LC	IV
125	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	IV
126	*Porphyrio porphyrio*	Purple Swamphen	LC	IV
127	*Gallinula chloropus*	Common Moorhen	LC	IV
128	*Fulica atra*	Common Coot	LC	IV
129	*Himantopus himantopus*	Black-winged Stilt	LC	IV
130	*Rhipidura aureola*	White-browed Fantail	LC	IV
131	*Rostratula benghalensis*	Greater Painted-snipe	LC	IV
132	*Limosa limosa*	Black-tailed Godwit	NT	IV
133	*Calidris pugnax*	Ruff	LC	IV
134	*Athene brama*	Spotted Owlet	LC	IV
135	*Otus scops*	Eurasian Scops Owl	LC	IV
136	*Otus sunia*	Oriental Scops Owl	LC	IV
137	*Otus bakkamoena*	Indian Scops Owl	LC	IV
138	*Asio flammeus*	Short-eared Owl	LC	IV
139	*Bubo bubo*	Eurasian Eagle Owl	LC	IV
140	*Ketupa zeylonensis*	Brown Fish Owl	LC	IV
141	*Gracupica contra*	Asian Pied Starling	LC	IV
142	*Sturnia pagodarum*	Brahminy Starling	LC	IV
143	*Acridotheres tristis*	Common Myna	LC	IV
144	*Dumetia hyperythra*	Tawny-bellied Babbler	LC	IV
145	*Geokichla citrina*	Orange-headed Thrush	LC	IV
146	*Turnix tanki*	Yellow-legged Buttonquail	LC	IV
147	*Turnix suscitator*	Barred Buttonquail	LC	IV
148	*Tyto alba*	Common Barn Owl	LC	IV
149	*Upupa epops*	Common Hoopoe	LC	IV
150	*Tephrodornis pondicerianus*	Common Woodshrike	LC	IV
151	*Zosterops palpebrosus*	Oriental White-eye	LC	IV

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

C.2 Migratory birds

SN	Scientific Name	English Name	IUCN Category[30]	WPA Schedule[31]	Migratory Status
1	*Lalage melanoptera*	Black-headed Cuckooshrike	LC	IV	Summer migrant
2	*Merops philippinus*	Blue-tailed Bee-eater	LC	IV	Summer migrant
3	*Circus macrourus*	Pallid Harrier	NT	I	Winter
4	*Circus melanoleucos*	Pied Harrier	LC	I	Winter
5	*Iduna caligata*	Booted Warbler	LC	IV	Winter
6	*Dendrocygna javanica*	Lesser Whistling Duck	LC	IV	Winter
7	*Tadorna ferruginea*	Ruddy Shelduck	LC	IV	Winter
8	*Anhinga melanogaster*	Oriental Darter	NT	IV	Winter
9	*Bubulcus ibis*	Cattle Egret	LC	IV	Winter
10	*Ardea intermedia*	Intermediate Egret	LC	IV	Winter
11	*Lalage melaschistos*	Black-winged Cuckooshrike	LC	IV	Winter
12	*Pluvialis squatarola*	Grey Plover	LC	IV	Winter
13	*Mycteria leucocephala*	Painted Stork	NT	IV	Winter
14	*Falco tinnunculus*	Common Kestrel	LC	IV	Winter
15	*Falco peregrinus*	Peregrine Falcon	LC	I	Winter
16	*Cecropis daurica*	Red-rumped Swallow	LC	IV	Winter
17	*Hirundo rustica*	Barn Swallow	LC	IV	Winter
18	*Lanius schach*	Long-tailed Shrike	LC	IV	Winter
19	*Chroicocephalus brunnicephalus*	Brown-headed Gull	LC	IV	Winter
20	*Chroicocephalus ridibundus*	Black-headed Gull	LC	IV	Winter
21	*Ichthyaetus ichthyaetus*	Pallas's Gull	LC	IV	Winter
22	*Chlidonias hybrida*	Whiskered Tern	LC	IV	Winter
23	*Anthus godlewskii*	Blyth's Pipit	LC	IV	Winter
24	*Motacilla flava*	Western Yellow Wagtail	LC	IV	Winter
25	*Motacilla cinerea*	Grey Wagtail	LC	IV	Winter
26	*Motacilla alba*	White Wagtail	LC	IV	Winter
27	*Muscicapa dauurica*	Asian Brown Flycatcher	LC	IV	Winter
28	*Cyornis tickelliae*	Tickell's Blue Flycatcher	LC	IV	Winter
29	*Eumyias thalassinus*	Verditer Flycatcher	LC	IV	Winter
30	*Oriolus kundoo*	Indian Golden Oriole	LC	IV	Winter
31	*Phalacrocorax carbo*	Great Cormorant	LC	IV	Winter
32	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	IV	Winter
33	*Phylloscopus humei*	Hume's Leaf Warbler	LC	IV	Winter
34	*Numenius phaeopus*	Whimbrel	LC	IV	Winter
35	*Calidris temminckii*	Temminck's Stint	LC	IV	Winter

[30] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where – CR – Critically Endangered; EN – Endangered; NT – Near Threatened; VU – Vulnerable and LC – Least Concern.*
[31] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

SN	Scientific Name	English Name	IUCN Category[30]	WPA Schedule[31]	Migratory Status
36	*Calidris alba*	Sanderling	LC	IV	Winter
37	*Calidris minuta*	Little Stint	LC	IV	Winter
38	*Gallinago stenura*	Pintail Snipe	LC	IV	Winter
39	*Gallinago gallinago*	Common Snipe	LC	IV	Winter
40	*Actitis hypoleucos*	Common Sandpiper	LC	IV	Winter
41	*Tringa ochropus*	Green Sandpiper	LC	IV	Winter
42	*Tringa erythropus*	Spotted Redshank	LC	IV	Winter
43	*Tringa nebularia*	Common Greenshank	LC	IV	Winter
44	*Tringa totanus*	Common Redshank	LC	IV	Winter
45	*Tringa glareola*	Wood Sandpiper	LC	IV	Winter
46	*Sturnia malabarica*	Chestnut-tailed Starling	LC	IV	Winter
47	*Pseudibis papillosa*	Indian Black Ibis	LC	IV	Winter
48	*Clamator jacobinus*	Pied Cuckoo	LC	IV	Passage
49	*Terpsiphone paradisi*	Indian Paradise-flycatcher	LC	IV	Passage

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

C.3 Congregatory Species of the Study Area

Scientific Name	English Name	IUCN Category[32]	WPA Schedule[33]
Charadrius dubius	Little Ringed Plover	LC	IV
Charadrius mongolus	Lesser Sand Plover	LC	IV
Fulica atra	Common Coot	LC	IV
Himantopus himantopus	Black-winged Stilt	LC	IV
Dendrocygna javanica	Lesser Whistling Duck	LC	IV
Tadorna ferruginea	Ruddy Shelduck	LC	IV
Mycteria leucocephala	Painted Stork	NT	IV
Chroicocephalus brunnicephalus	Brown-headed Gull	LC	IV
Chroicocephalus ridibundus	Black-headed Gull	LC	IV
Ichthyaetus ichthyaetus	Pallas's Gull	LC	IV
Chlidonias hybrida	Whiskered Tern	LC	IV
Calidris temminckii	Temminck's Stint	LC	IV
Calidris alba	Sanderling	LC	IV
Calidris minuta	Little Stint	LC	IV
Actitis hypoleucos	Common Sandpiper	LC	IV
Tringa ochropus	Green Sandpiper	LC	IV
Tringa erythropus	Spotted Redshank	LC	IV
Tringa nebularia	Common Greenshank	LC	IV
Tringa totanus	Common Redshank	LC	IV
Tringa glareola	Wood Sandpiper	LC	IV
Pseudibis papillosa	Indian Black Ibis	LC	IV

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1-528; Salim Ali (2012) reprinted. The Book of Indian Birds. Oxford University Press, pp 1-326; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2.

[32] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where LC –Least Concern.*
[33] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Appendix D List of Reptiles reported from the Study Area

SN	Scientific Name	Common Name	IUCN Category[34]	WPA Schedule[35]
1	*Hemidactylus frenatus*	Common House Gecko	LC	-
2	*Ophiophagus hannah*	King Cobra	VU	II
3	*Geochelone elegans*	Indian Star Tortoise	VU	IV
4	*Crocodylus palustris*	Mugger	VU	II
5	*Pseudocerastes persicus*	Persian Horned Viper	LC	IV
6	*Hemidactylus subtriedrus*	Jerdon's Gecko	DD	-
7	*Hemidactylus brookii*	Brooke's House Gecko	LC	-
8	*Trimeresurus gramineus*	Common Bamboo Viper	LC	IV
9	*Sitana ponticeriana*	Fan Throated Lizard	LC	-
10	*Eutropis carinata*	Keeled Indian Mabuya	LC	-
11	*Varanus bengalensis*	Bengal Monitor Lizard	LC	II
12	*Oligodon taeniolatus*	Streaked Kukri Snake	LC	IV
13	*Varanus salvator*	Common Water Monitor	LC	I
14	*Hemidactylus treutleri*	Treutler's Gecko	LC	-
15	*Eutropis trivittata*	Three-banded Mabuya	LC	-
16	*Lycodon travancoricus*	Travancore Wolf Snake	LC	IV
17	*Barkudia melanosticta*	Russell's Legless Skink	DD	-
18	*Grypotyphlops acutus*	Beaked Worm Snake	LC	IV
19	*Hemidactylus maculatus*	Spotted Leaf-toed Gecko	LC	-
20	*Eutropis allapallensis*	Schmidt's Mabuya	LC	-
21	*Eublepharis hardwickii*	Eastern Indian Leopard Gecko	LC	-
22	*Chamaeleo zeylanicus*	Asian Chameleon	LC	II

Sources: The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

[34] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where –LC – Least Concern and NA – Not assessed.*
[35] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Appendix E List of Amphibians Reported in the Study Area

SN	Scientific Name	Common Name	IUCN Category[36]	WPA Schedule[37]
1	*Duttaphrynus melanostictus*	Asian Common Toad	LC	-
2	*Fejervarya limnocharis*	Asian Grass Frog	LC	IV
3	*Hoplobatrachus tigerinus*	Indian Bullfrog	LC	IV
4	*Euphlyctis hexadactylus*	Green Pond Frog	LC	IV
5	*Hoplobatrachus crassus*	South Indian bullfrog	LC	IV
6	*Microhyla ornata*	Ant Frog	LC	IV
7	*Duttaphrynus stomaticus*	Indian Marbled Toad	LC	-
8	*Hydrophylax malabaricus*	Fungoid Frog	LC	IV
9	*Uperodon systoma*	Marbled Balloon Frog	LC	IV
10	*Sphaerotheca breviceps*	Indian Burrowing Frog	LC	IV
11	*Euphlyctis cyanophlyctis*	Indian Skittering Frog	LC	IV
12	*Uperodon taprobanicus*	Sri Lankan Bullfrog	LC	IV
13	*Polypedates maculatus*	Indian Tree Frog	LC	IV
14	*Uperodon globulosus*	Indian Balloon Frog	LC	IV
15	*Sphaerotheca dobsonii*	Dobson's Burrowing Frog	LC	IV
16	*Sphaerotheca rolandae*	Roland's Burrowing Frog	LC	IV

Sources: The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

[36] *Status assigned by the International Union for Conservation of Nature and Natural Resources, where –LC – Least Concern and NA – Not assessed.*
[37] *Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Appendix F Details of Notification under section 3A, 3D, 3G of NH Act, 1956 for the Project

Details of 3A, 3D and 3G																
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
1	Iruvada	215	12-02-2018	6314	0	6314	1060	09-03-2018	5950		5950	44/2018	24-10-2018	5950		5950
2	Asakapalli	215	12-02-2018	7704	4530	12234	1060	09-03-2018	7704	4530	12234	52/2018	06-12-2018	7704	4530	12234
		3239	19-10-2016	45501	15983	61484	580	22-02-2017	13181	8822	22003					
		1106	07-04-2017	5268	81	5349	887	20-03-2017	40		40					
		1893	13-06-2017	1538	5099	6637	1940	20-06-2017	6482	81	6563					
		1295	26-04-2017				2583	11-08-2017	6597	121	6718					
		2389	28-07-2017				2699	21-08-2017	688	5099	5787					
3	Asakapalli						3373	18-10-2017	7121	1335	8456	19/2018	24-04-2018	29352	15498	44850
		3232	19-10-2016	12247	1619	13866	573	22-02-2017	7932	1255	9187					
	Gangasaini	581	22-02-2017	2548	5028	7576	1739	31-05-2017	2548	5028	7576					
4	Agraharam	1150	11-04-2017				1986	23-06-2017	324		324	03/2018	15-02-2018	10804	6283	17087
		3232	19-10-2016	125416	27434	152850	573	22-02-2017	34397	9429	43826					
		581	22-02-2017	9844	5777	15621	1739	31-05-2017	16723	10552	27275					
		1893	13-06-2017	81	81	162	1986	23-06-2017	19125	3724	22849					
		1150	11-04-2017				2583	11-08-2017		1700	1700					
		1294	26-04-2017				2699	21-08-2017	81	81	162					
5	Gandigundam	2388	28-07-2017				3372	18-10-2017	4026	891	4917	12/2018	05-03-2018	63971	16420	80391
6	Gandigundam	215	12-02-2018	14203	4856	19059	1060	09-03-2018	14203	4856	19059	42/2018	27-08-2018	14203	4856	19059
		3239	19-10-2016	168759	25027	193786	716	03-03-2017	14938	5746	20684					
		1106	07-04-2017	25611	7546	33157	887	20-03-2017								
		1295	26-04-2017				1739	31-05-2017	25584	243	25827					
		1893	13-06-2017	23146	15539	38685	1940	20-06-2017	12693	546	13239					
		2389	28-07-2017				1986	23-06-2017								
							2583	11-08-2017	13141		13141					
7	Iruvada						2699	21-08-2017	23146	15539	38685	27/2018	19-05-2018	105350	23126	128476

Details of 3A, 3D and 3G															
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
							3372	18-10-2017								
							3374	18-10-2017								
							3373	18-10-2017	23870		23870					
		3232	19-10-2016	139055	29798	168853	887	20-03-2017	26748	6596	33344					
		1106	07-04-2017				1293	26-04-2017	23290		23290					
		1294	26-04-2017				1940	20-06-2017	4532	10035	14567					
		1893	13-06-2017		16714	16714	2583	11-08-2017	14648	3197	17845					
8	Gurrampalem						2699	21-08-2017		16714	16714	14/2018	27-03-2018	62871	36482	99353
9	Gurrampalem	215	12-02-2018	21407	1680	23087	1060	09-03-2018	21407	1680	23087	59/2019	08-05-2019	21125		21125
		3232	19-10-2016	90070	31047	121117	715	03-03-2017	19121	10198	29319					
		1106	07-04-2017				716	03-03-2017	4936	2003	6939					
		1294	26-04-2017				887	20-03-2017	2611	1983	4594					
		1893	13-06-2017	39741	809	40550	1739	31-05-2017	12040	688	12728					
		2388	28-07-2017				1940	20-06-2017	5978	2590	8568					
							1986	23-06-2017	1052		1052					
							2583	11-08-2017	11970	3763	15733					
							2699	21-08-2017	39741	809	40550					
10	Sabbavaram						3372	18-10-2017	1518		1518	33/2018	12-07-2018	53925	22034	75959
		3232	19-10-2016	34214	4389	38603	573	22-02-2017	30237	3723	33960					
		581	22-02-2017	111		111	1739	31-05-2017	111		111					
11	Mogalipuram						1986	23-06-2017	6262		6262	18/2018	24-04-2018	24986	3723	28709
		3239	19-10-2016				716	03-03-2017	88482	6809	95291					
		3240	19-10-2016	251970	23665	275635	887	20-03-2017	40664	13051	53715					
		1106	07-04-2017	5149	30473	35622	1739	31-05-2017	11574		11574					
		1294	26-04-2017				1940	20-06-2017	12919	47904	60823					
		1296	26-04-2017				1986	23-06-2017	6920		6920					
		1893	13-06-2017	126724	20	126744	2583	11-08-2017	40689	21610	62299					
12	Amurthapuram	2388	28-07-2017				2699	21-08-2017	126724	20	126744	30/2018	04-06-2018	338820	100007	438827

Details of 3A, 3D and 3G															
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
		2390	28-07-2017				3372	18-10-2017	1214	5220	6434					
		215	12-01-2018	23598	10563	34161	3374	18-10-2017		16511	16511					
		3232	19-10-2016	172618	39878	212496	1060	09-03-2018	23598	10563	34161					
		3232	19-10-2016	43941	29602	73543	573	22-02-2017	18410	4736	23146					
		581	22-02-2017	1184	404	1588	1739	31-05-2017	1184	2064	3248					
		1106	07-04-2017	30		30	1940	20-06-2017	30		30					
		1150	11-04-2017				1986	23-06-2017	4707	5301	10008					
13	Anandapuram	1294	26-04-2017				2583	11-08-2017	1012		1012	02/2018	15-02-2018	25220	12101	37321
14	Anandapuram	215	12-01-2018	1315		1315	1060	09-03-2018	1315		1315	41/2018	23-08-2018	1315		1315
		3232	19-10-2016	57588	47490	105078	573	22-02-2017	31602	2407	34009					
		581	22-02-2017	2034	4775	6809	1739	31-05-2017	2034	4775	6809					
		1106	07-04-2017	1781		1781	1940	20-06-2017	1781		1781					
15	Gambeeram	1150	11-04-2017				1986	23-06-2017	5827	61188	67015	9/2018	05-03-2018	41274	68370	109644
16	Palavalasa	3232	19-10-2016	3342	130	3472	573	22-02-2017	1314	81	1395	05/2018	15-02-2018	1314	81	1395
		3239	19-10-2016	97509	22989	120498	715	03-03-2017	2104	6475	8579					
		1106	07-04-2017	4481	3805	8286	887	20-03-2017	18121	7445	25566					
		1295	26-04-2017				1940	20-06-2017	4481	3805	8286					
17	Rampuram						2583	11-08-2017	33670		33670	23/2018	03-05-2018	58256	17725	75981
		3232	19-10-2016	135143	65226	200369	573	22-02-2017	64567	32111	96678					
		581	22-02-2017				1739	31-05-2017								
		1106	07-04-2017	202		202	1940	20-06-2017	202		202					
		1150	11-04-2017				1986	23-06-2017	18058	3137	21195					
		1294	26-04-2017				2583	11-08-2017		243	243					
18	Sontyam	215	12-01-2018									17/2018	18-04-2018	79536	45240	124776
		3232	19-10-2016	1548	4725	6273	573	22-02-2017								
		581	22-02-2017	1412	8933	10345	1739	31-05-2017	1654	8690	10344					
19	Sontyam	215	12-01-2018				1060	09-03-2018	1538	4725	6263	55/2019	21-01-2019	1548		1548
20	Pendurthi	3239	19-10-2016	169853	4009	173862	1940	20-06-2017	37424	4977	42401	24/2018	07-05-2018	163812	15578	179390

Details of 3A, 3D and 3G															
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
		1893	13-06-2017	63251	8093	71344	1986	23-06-2017	17371	1699	19070					
		2389	28-07-2017				3373	18-10-2017	47546	809	48355					
							2699	21-08-2017	63251	8093	71344					
							1060	09-03-2018	36786	2105	38891					
		3239	19-10-2016	66616	2987	69603	573	22-02-2017								
		581	22-02-2017	9347	485	9832	1739	31-05-2017	9347	485	9832					
		1106	07-04-2017		405	405	1940	20-06-2017		405	405					
21	Pinagadi	1151	11-04-2017				1986	23-06-2017	16511	2265	18776	28/2018	24-05-2018	33199	4045	37244
22	Gorapalli	1893	13-06-2017	4452		4452	2699	21-08-2017	4290		4290	16/2018	05-04-2018	4290		4290
		3232	19-10-2016	108080	5979	114059	887	20-03-2017	73516	5342	78858					
		3239	19-10-2016				1940	20-06-2017	1312	2713	4025					
		1106	07-04-2017	1312	2713	4025	2583	11-08-2017	10208		10208					
		1294	26-04-2017				1060	09-03-2018	1740		1740					
23	Rajayyapeta	3239	19-10-2016	15720		15720						10/2018	05-03-2018	83185	8055	91240
		3239	19-10-2016				573	22-02-2017	22841	930	23771					
24	Pinagadi	581	22-02-2017				1986	23-06-2017				62/2019	03-10-2019	2912		2912
25	Pinagadi	215	12-01-2018	48480		48480	1060	09-03-2018	7282		7282	63/2019	03-10-2019	7243		7243
		291	30-01-2017	136741	102983	239724	1739	31-05-2017	23066	3157	26223					
		1893	13-06-2017	69221	13516	82737	1940	20-06-2017	12505		12505					
	Anankapalli South (Govarapalem Ward) & R.S.Ward	2387	28-07-2017				1986	23-06-2017	22662	1214	23876					
		215	12-01-2018	39091	5340	44431	2699	21-08-2017	65459	12909	78368					
							3375	18-10-2017		6274	6274					
							3987	21-12-2017	48839	1416	50255					
26	villages						1060	09-03-2018	33788	5340	39128	46/2018	05-11-2018	161292	13733	175025
27	Golagam (Batlapudi)	215	12-01-2018	40	131	171	1060	09-03-2018	40	131	171	25/2018	11-05-2018	40	131	171
		3232	19-10-2016	102833	11684	114517	887	20-03-2017	6242	324	6566					
28	Batajangapalem	1106	07-04-2017	28170	3278	31448	1293	26-04-2017				29/2018	30-05-2018	92956	14730	107686

Details of 3A, 3D and 3G															
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
		1294	26-04-2017				1739	31-05-2017	4694		4694					
		1893	13-06-2017	14718	0	14718	1940	20-06-2017	32378	5989	38367					
		2388	28-07-2017				2583	11-08-2017	31545	2144	33689					
							2699	21-08-2017	14718		14718					
							3372	18-10-2017	12968		12968					
		3232	19-10-2016		21593	21593	580	22-02-2017	10158		10158					
		1106	07-04-2017		535	535	1940	20-06-2017		535	535					
		1294	26-04-2017				2583	11-08-2017	2347		2347					
29	DMS Puram	2388	28-07-2017				3372	18-10-2017		1578	1578	22/2018	25-04-2018	6799	4633	11432
		3232	19-10-2016	50947	10294	61241	1293	26-04-2017	6475	5584	12059					
		1106	07-04-2017	1133		1133	1940	20-06-2017	5504		5504					
		1294	26-04-2017				2583	11-08-2017	7284		7284					
30	Galibheemvaram	1893	13-06-2017	5220	6880	12100	2699	21-08-2017	5220	6880	12100	13/2018	27-03-2018	17442	12464	29906
		3232	19-10-2016	61020	40035	101055	573	22-02-2017	37362	12725	50087					
		581	22-02-2017	4146	2912	7058	1739	31-05-2017	4146	2912	7058					
31	Gudilova	1150	11-04-2017				1986	23-06-2017	4492	13638	18130	08/2018	27-02-2018	45105	25795	70900
		3232	19-10-2016	33673	7181	40854	716	03-03-2017	19274	8012	27286					
		3239	19-10-2016	46473	5994	52467	1739	31-05-2017	7365	161	7526					
		1106	07-04-2017	6708	2792	9500	1940	20-06-2017	7153	2792	9945					
		1294	26-04-2017				1986	23-06-2017	283		283					
		1295	26-04-2017				2583	11-08-2017	7548	4249	11797					
		1893	13-06-2017	1952	728	2680	2699	21-08-2017	1952	728	2680					
		2388	28-07-2017				3372	18-10-2017	486		486					
32	Koduru	2389	28-07-2017				3373	18-10-2017	5220		5220	20/2018	25-04-2018	39195	13920	53115
		3232	19-10-2016	26460	0	26460	573	22-02-2017	10825		10825					
		581	22-02-2017	8357	61	8418	1739	31-05-2017	8357	61	8418					
		1150	11-04-2017				1986	23-06-2017								
33	Mamidilova						2583	11-08-2017	1093		1093	01/2018	15-02-2018	20272	61	20333

Details of 3A, 3D and 3G																
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
		102	12-01-2017	3116	31035	34151	1739	31-05-2017	364	9468	9832					
		1893	13-06-2017	1862	3399	5261	2699	21-08-2017	1862	3399	5261					
34	NGR Bit - 1	2386	28-07-2017				3371	18-10-2017	2084		2084	06/2018	20-02-2018	3147	9589	12736
		102	12-01-2017	17781	8384	26165	1739	31-05-2017	668		668					
		1893	13-06-2017				2699	21-08-2017								
35	NGR Bit - 2	2386	28-07-2017				3371	18-10-2017	4269	5261	9530	07/2018	20-02-2018	6251	8377	14628
		3232	19-10-2016	52334	1721	54055	573	22-02-2017								
		3239	19-10-2016	36160	5070	41230	1739	31-05-2017	19211	6028	25239					
		581	22-02-2017	9781	3682	13463	1986	23-06-2017	11370	3315	14685					
		1150	11-04-2017				3373	18-10-2017	2670	2792	5462					
		1151	11-04-2017													
36	Rebaka	2389	28-07-2017									21/2018	25-04-2018	25169	5201	30370
		3232	19-10-2016	24191	13221	37412	715	03-03-2017	11078	324	11402					
		3239	19-10-2016	22319	1062	23381	1739	31-05-2017								
		1150	11-04-2017				1940	20-06-2017	5240		5240					
		1151	11-04-2017				1986	23-06-2017	10440	11170	21610					
		581	22-02-2017	8667	1536	10203	2699	21-08-2017	202		202					
37	Sankaram	1893	13-06-2017	202		202						15/2018	29-03-2018	17309	21944	39253
		3239	19-10-2016	371	6621	6992	1739	31-05-2017	910	3399	4309					
38	Tarluwada	581	22-02-2017	910	3399	4309						04/2018	15-02-2018	910	3399	4309
39	Batajangapalem	215	12-01-2018	17484	10	17494	1060	09-03-2018	17484	10	17494	37/2018	13-08-2018	12546	10	12556
40	Koduru	215	12-01-2018	10958	808	11766	1060	09-03-2018	10958	808	11766	40/2018	18-08-2018	10465	808	11273
41	Rebaka	215	12-01-2018	22621	3736	26357	1060	09-03-2018	24887	1470	26357	39/2018	18-08-2018	22612	3736	26348
42	Sankaram	215	12-01-2018	12665	2724	15389	1060	09-03-2018	12665	2724	15389	38/2018	18-08-2018	13125	2072	15197
43	Galibheemvaram	215	12-01-2018	2086		2086	1060	09-03-2018	2086		2086	36/2018	13-08-2018	1093		1093
44	Gudilova	215	12-01-2018	1092	3764	4856	1060	09-03-2018	3075	1781	4856	35/2018	13-08-2018	1092	3723	4815
		3232	19-10-2016				887	20-03-2017								
45	Batajangapalem						1293	26-04-2017	10125	4007	14132	47/2018	20-11-2018	4451		4451

Details of 3A, 3D and 3G																
		3A notification details					3D notification Details					3G Award Details				
S. No.	Village	3A SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3D SO No	Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)	3G Award Number	3G Award Date	Private Land (Sq. mts)	Govt Land (Sq. mts)	Total (Sq. mts)
46	Batajangapalem	215	12-01-2018				1060	09-03-2018				48/2018	20-11-2018	4937		4937
		1106	07-04-2017				1940	20-06-2017								
47	Galibheemvaram	1294	26-04-2017				2583	11-08-2017				49/2018	23-11-2018	5584		5584
48	Koduru	215	12-01-2018				1060	09-03-2018				54/2018	26-11-2018	493		493
		3239	19-10-2016				1739	31-05-2017								
49	Koduru	1295	26-04-2017				2583	11-08-2017				51/2018	24-11-2018	3797		3797
50	Rebaka	3232	19-10-2016				573	22-02-2017				50/2018	24-11-2018	1457		1457
		3232	19-10-2016				715	03-03-2017								
51	Sankaram	581	22-02-2017				1739	31-05-2017	5908	10277	16185	53/2018	26-11-2018	4088		4088
52	Sabbavaram			1811	0	1811	1060	09-03-2018	1811		1811	57/2010	28-01-2019	38001		38001
	Total (Sq. m)		**Sq m**	**3074772**	**846495**	**3921267**			**2023331**	**607237**	**2630568**			**1801793**	**548480**	**2350273**
	Total (ha)		**ha.**	**307.4772**	**84.6495**	**392.1267**			**202.3331**	**60.7237**	**263.0568**			**180.1793**	**54.848**	**235.0273**

Appendix G Compensation Disbursement Status

Compensation Disbursement Status as on 31-10-2019

Statement showing the progress on payment of Land Compensation to the Awardees - NH -16, Visakhapatnam as on 31-10-2019											
Sl No	Name of the village	Extent for Award passed & Amount sanctioned		Payments made		Balance to be distributed for notices served U/s 3E(1)		Payment Percentage		PAP Details	
		Sq.mts.,	Amount Rs.	Sq.mts.,	Amount Rs.	Sq.mts.,	Amount Rs.	Area	Amount	Number of PAPs	PAPs compensated
1	3	4	5	6	7	8	9	10	11	12	13
Anakapalli Mandal											
1	Anakapalli	161,292	605,772,179	59,928	438,310,910	101,364	167,461,269	37.15%	72.36%	175	134
2	Batlapudi	40	50,089	-	-	40	50,089	0.00%	0.00%	2	0
3	Koduru	53,545	107,392,389	36,359	74,419,099	17,186	32,973,290	67.90%	69.30%	134	75
4	Rebaka	49,238	138,519,862	42,773	120,114,048	6,465	18,405,814	86.87%	86.71%	164	139
5	Shankaram	34,466	87,626,876	26,981	76,131,554	7,485	11,495,322	78.28%	86.88%	109	80
	Sub-Total 1	**298,581**	**939,361,395**	**166,041**	**708,975,611**	**132,540**	**230,385,784**	**55.61%**	**75.47%**	**584**	**428**
Anandapuram Mandal											
6	Anandapuram	26,535	178,340,498	18,540	126,735,949	7,995	51,604,549	69.87%	71.06%		
7	Gambheeram	41,274	334,693,278	34,517	280,668,544	6,757	54,024,734	83.63%	83.86%		
8	Gandigundam	78,174	345,192,070	58,271	269,411,752	19,904	75,780,318	74.54%	78.05%		
9	Gangasani Agraharam	10,804	43,226,138	10,804	43,226,138	-	-	100.00%	100.00%		
10	Gudilova	46,197	188,847,568	41,916	171,968,780	4,281	16,878,788	90.73%	91.06%	94	81
11	Mamidilova	20,272	9,654,559	17,192	67,732,713	3,080	11,921,846	84.81%	85.03%	34	28
12	NGR Puram -1	3,147	13,806,544	2,972	13,124,967	175	681,577	94.44%	95.06%	24	21
13	NGR Puram -2	6,251	39,498,383	5,554	36,774,452	697	2,723,931	88.85%	93.10%	45	38
14	Palavalasa	1,314	10,602,095	1,314	10,602,095	-	-	100.00%	100.00%		

Statement showing the progress on payment of Land Compensation to the Awardees - NH -16, Visakhapatnam as on 31-10-2019											
Sl No	**Name of the village**	**Extent for Award passed & Amount sanctioned**		**Payments made**		**Balance to be distributed for notices served U/s 3E(1)**		**Payment Percentage**		**PAP Details**	
		Sq.mts.,	**Amount Rs.**	**Sq.mts.,**	**Amount Rs.**	**Sq.mts.,**	**Amount Rs.**	**Area**	**Amount**	**Number of PAPs**	**PAPs compensated**
1	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
15	Sontyam	81,084	358,772,400	75,865	335,849,012	5,219	22,923,388	93.56%	93.61%		
16	Tarluvada	910	5,694,968	910	5,694,968	-	-	100.00%	100.00%	1	1
	Sub-Total 2	**315,962**	**1,598,328,501**	**267,855**	**1,361,789,370**	**48,108**	**236,539,131**	**84.77%**	**85.20%**	**198**	**169**
Pendurthi Mandal											
17	Gorapalli	4,290	29,282,472	3,140	21,432,862	1,150	7,849,610	73.19%	73.19%		
18	Gurrampalem	88,732	476,718,747	51,575	244,192,716	37,157	232,526,031	58.12%	51.22%		
19	Pendurty	163,812	566,696,950	63,858	220,873,122	99,954	345,823,828	38.98%	38.98%		
20	Pinagadi	33,199	95,549,608	17,572	48,478,525	15,627	47,071,083	52.93%	50.74%		
21	Rajayyapeta	83,185	294,680,402	62,282	211,502,538	20,903	83,177,864	74.87%	71.77%		
22	Rampuram	58,256	161,895,962	45,136	124,095,661	13,121	37,800,301	77.48%	76.65%		
23	Saripalle	-	-	-	-	-	-				
	Sub-Total 3	**431,474**	**1,624,824,141**	**243,563**	**870,575,424**	**187,912**	**754,248,717**	**56.45%**	**53.58%**	**-**	**-**
Sabbavaram Mandal											
24	Amruthapuram	338,820	432,241,963	110,726	149,128,258	228,094	283,113,705	32.68%	34.50%		
25	Asakapalli	37,056	73,950,313	22,746	44,178,232	14,310	29,772,081	61.38%	59.74%		
26	Batajangalapalem	114,732	261,556,158	96,574	223,089,255	18,158	38,466,903	84.17%	85.29%	258	188
27	DMS Puram	6,799	8,996,289	6,799	8,996,289	-	-	100.00%	100.00%	6	6
28	Galibheemavaram	24,119	35,864,291	17,447	30,542,843	6,672	5,321,448	72.34%	85.16%	22	10
29	Iruvada	111,300	148,130,311	70,461	94,897,816	40,840	53,232,495	63.31%	64.06%		
30	Mogalipuram	25,192	145,670,667	11,392	66,054,572	13,800	79,616,095	45.22%	45.35%		
31	Sabbavaram	93,382	347,556,047	51,044	188,828,558	42,338	158,727,489	54.66%	54.33%		
	Total	**751,400**	**1,453,966,039**	**387,189**	**805,715,823**	**364,212**	**648,250,216**	**51.53%**	**55.42%**	**286**	**204**
	Grand TOTAL	**1,797,417**	**5,616,480,076**	**1,064,647**	**3,747,056,228**	**732,771**	**1,869,423,848**	**59.23%**	**66.72%**	**1,068**	**801**
Source: CALA											

Compensation Disbursement Status after 31-10-2019

Statement showing the progress on payment of Land Compensation to the Awardees - NH -16, Visakhapatnam after 31-10-2019								
Sl no.	**Date**	**Cheque no.**	**Name of the village**	**Description of land**	**Award no/proceedings no**	**No of claimants**	**Deposited amount**	**Extent Sq. m**
1	2	3	4	5	6	7	8	9
1	27-02-2020	1526	Sankaram	Government		2	110827	
	27-02-2020	1526	Koduru	Government		1	1537480	
	27-02-2020	164	Iruvada	Government		1	1341714	
2	11-03-2020	1626	Gurrampalem	Private	59/2019	6	12207564	2175
3	07-04-2020	1583	Pendurthii	Private	24/2018	22	42231195	12223
4	08-04-2020	1582	Pendurthi	Private	61/2019	2	13838466	3288
5	13-04-2020	618	Iruvada	Government		1	1341714	
	13-04-2020	619	Sankaram	Government		1	47406	
6	14-04-2020	1584	Pinagadi	Private	28/2018	16	11634435	4351
	14-04-2020	1585	Pinagadi	Private	28/2018	1	68927	
	14-04-2020	615	Rampuram	Private	23/2018	12	6252493	2468
7	15-04-2020	723	Gandigundam	Private	12/2018	32	23279708	5926
	15-04-2020	724	Gandigundam	Private	42/2018	7	14033161	3143
8	29-04-2020	1679	Asakapalli	Private	52/2018	5	10524009	6045
	29-04-2020	1677	Asakapalli	Private	52/2018	5	108032	
					Total	**117**	**138557131**	**39619**
	Total amount sanctioned	**₹ 5,61,64,80,076**						
	Total amount disbursed	**₹ 3,88,56,13,359**						
	Payment Percentage	**69.18%**						

Appendix H Air Pollution Isopleth Maps

Appendix I Pollution Monitoring Equipment Calibration Certificates

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