BIODIVERSITY IMPACT ASSESSMENT

REPORT FOR THE PROPOSED PROJECT ON

Rehabilitation and Upgradation of NH 565 from KM 133.922 to 154.900 to two lanes with paved shoulder in the State of Andhra Pradesh under NHDP IV

Located: Davupally in Guntur district and ends near Mallepalem Junction in Prakasam district) for 20.978 Km Road length

BY

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1.INTRODUCTION

Chapter 1

1.1. IMPORTANCE OF BIOLOGICAL SURVEY AND NEED FOR THE PRESENT STUDY

Roads especially highways have been recognized as arteries providing a range of services and carrying vital goods and people that are key drivers of the growing economy. Roads are known to boost economic growth in many sectors, like the farm sector through faster and timely of farm produce to markets and the tourism sector, particularly to remote locations, India has also embarked on developing and expanding the road network, as part of infrastructure development for its growing needs.

1.2. PROJECT BACKGROUND

Roads & Building Department of (NH Division) of Andhra Pradesh has been entrusted to implement an ambitious plan for the development of various national highway corridors to augment their capacity adequately for safe and speedy movement of traffic taking into account the traffic growth in such corridors in future decades. Such a network of good national highways is projected to be the minimum basic requirement for providing a level playing field for the producers and manufacturers in different regions of the country. The project road starts near Davupally at Km 133.922 of NH-565 and ends at Km 154.900 near Mallapalem Junction in the state of Andhra Pradesh. It passes through Guntur and Prakasam Districts of Andhra Pradesh.

The primary objective of the project road widening is to cater to the increased demand of traffic and address the safe & efficient movement of the traffic in forthcoming years. The other objective of widening and strengthening of project road is to promote economic development in the project region. The Project is proposed for 2 Lane with Paved Shoulder configuration interlinking different National Highways connecting Prakasam and Guntur

Districts of Andhra Pradesh. The proposed National Highway will provide better connectivity to several towns and cities viz. Macherla, Markapuram, and Yerragondapalem give an infrastructure fillip to the states of Andhra Pradesh, Telangana, and Tamil Nadu. ToR was obtained for the proposed project vide (10-2/2019-IA.III) dated 5th March 2019 and EIA has been prepared as per the approved ToR.

1.3. PROJECT DESCRIPTION

The project road is located in the Andhra Pradesh State. It passes through Guntur and Prakasam Districts of Andhra Pradesh. Majorly, it passes through Markapur WLM Forest division. Also, the road is within 10 km radius of NSTR (Nagarjunasagar- Srisailam Tiger Reserve) Zone. The land along the project road is mostly forest land and the remaining are agricultural land, except in built-up areas, where there is nominal barren land. Educational institutions and religious structures exist in some of the villages.

Rehabilitation and Up-gradation of NH-565 from KM 133.922 to 154.900 to two lanes with the paved shoulder in the State of Andhra Pradesh under NHDP IV with a total of 20.978 Km is in urgent need to improve the road network and conditions. Infact, less than 200/0 of all the census villages in the state are connected by all-weather roads. Even the existing roads lack longitudinal and cross drainage, retaining walls, roadside parapets and good road geometrics leading to longer journey times, slow speeds, and increased wear-tear of vehicles.

To reduce traveling time and to ensure faster movement of perishable farm produce (fruits and vegetables), better roads are the only feasible alternative resulting in greater utilization of resources and socio-economic development of the people. The success of the various investments by the government in the different sectors depends to a great extent on the adequacy of the transport infrastructure i.e. road network in the state.

Nature of the Project: 2-lane with paved shoulder configuration NH-565 from 133.922 km to 154.900 km. The entire project road traverses through rolling terrain except at isolated hill sections and settlements. The carriageway, in general, is of single lane with an average

lane width of 3.6 m. At present, the connectivity between Macharla and Markapuram is either via SH-56 or SH-88 which is two-lane with paved shoulder. The new proposed National Highway shall bring down the travel time distance. Moreover, the new National Highway facility is access controlled and hence will provide good riding quality, better safety, and reliable infrastructure. All of these elements will result in cost savings and efficiency improvement. The ToR was obtained for the proposed project vide (10-2/2019-IA.III) dated 5th March 2019 and EIA has been prepared as per the approved ToR.

The project road passes through Mutukuru Reserve Forest (KM 134/922 to KM 143/000) Guntur district and Markapur Reserve Forest (KM 143/000 to KM 154/900) Prakasam district.

- It starts near Davupally and ends near Mallapalem Junction village. It passes through Guntur and Prakasam districts in the state of Andhra Pradesh. 8.3 km of this project is passing through the Guntur District (Mandal Veladurthy) and 12.6 km is passing through Prakasam District (Mandal Pullalacheruvu)
- An area of 54 Ha. of Forest land is required for diversion.
- The proposed project road passes through the buffer zone of Nagarjunsagar Srisailam Tiger Reserve also known as “Rajiv Gandhi Wild Life Sanctuary”. Hence Wildlife Clearance is required. The process for Wildlife Clearance has been initiated.
- The geographical coordinates of the proposed road between 16016‟21.626"N, 79019‟16.226"E to 1608‟7.396"N, 79020‟3.498"E
- The railway station (Donakonda) is located at a distance of 37.2km, from the proposed site.
- The nearest airport to the project site is located at Vijaywada at a distance of about 143km away
- The project area falls under Seismic Zone-III as per Indian Standards, IS: 1893 (Part-1) 2002.

Wildlife encompasses both animals and plants. Wildlife conservation is not just aiming to protect Rare, Endangered, and Threatened species but also to achieve well-recognized means of achieving ecological security, human well-being, and sustainable development in

any country. Wildlife habitat is considered the environment used by an animal and is essential for food, mating, cover, and other requirements for survival. Whereas, linear projects such as roads are important to the country for economic growth and to meet the transportation needs of the people. Hence, incorporating ecological considerations into modern design techniques will result in a favorable win-to-win approach to safeguard the interests of both wildlife and people.

Through this mitigation plan, we could be able to minimize long-term impacts on flora and fauna of the region and also useful for habitat improvement activities, afforestation, research works, wildlife monitoring, awareness programs, and forest protection activities. Few potential infrastructure facilities proposed in this plan would certainly enrich conservation activities within the forest core areas. In this plan certain direct and indirect impacts were identified under different phases of the proposed activity and suggested certain mitigation measures. Certain guidelines are also given to persons involved in the construction activities which can be monitored by forest authorities.

1.4. GUIDELINES FOR WILDLIFE ISSUES DURING LINEAR EXPANSION PROJECTS

Mitigation strategies:

Mitigation strategies should be considered and applied in the planning stages of the project cycle.

Data collections and survey guidelines:

For existing facilities, which generally undergo enlargement or upgrading, the focus should be on any necessary repair or rehabilitation of prior environmental damage. For example, a road/railway passing near or through a wildlife area. special attention would be paid to the provision of wildlife mitigation measures.

Site-specific issues: Consideration of habitats, geographical location, topography, and vicinity of the existing road line to sites of high biodiversity value.

Species-specific issues: Surveys should be targeted to species of flora and fauna of high biodiversity value, those with a special international or national conservation status, endemic species, and species that are at elevated risk of impact from the proposed project facilities. For example, species with a relatively high collision risk of Carnivores and Herbivores of the region.

- Species with a relatively high risk of crossing the roads shall be listed out.
- Some species may be attracted to feeding areas, which could further increase the potential for collision. The habitats for food and water for animals on both sides of the track shall be considered. The areas having meagre food resources must be treated under critical habitat zones.
- Species at risk of habitat fragmentation and associated structures.
- Species with a relatively high risk of disturbance from noise (traffic movement and horn sound).

Season-specific issues: Surveys should take into consideration certain periods during the year when the project site may have a greater or different ecological function or value (e.g., migration, breeding season, or winter seasons). Surveys should usually be conducted for at least one season when at-risk wildlife is identified. Tiger and other major carnivore's breeding and mating seasons shall be considered.

Longer surveys may sometimes be necessary for areas with exceptional aggregations of at-risk migratory animals and where existing biodiversity data are limited. This would be determined during the project construction phase by the forest department. Surveys should be designed and implemented to adequately guide the underpasses to minimize collision risks to wild species. This is normally expected to entail gathering relatively precise information on the spatial patterns of site utilization by at-risk wildlife species as well as consideration of the locations of certain topographic, ecological, or other landscape features that may attract or otherwise concentrate the activity of movement of wildlife within the project area and its surrounding landscape.

1.5. SCOPE OF THE STUDY:

To prepare a wildlife mitigation plan by conducting a rapid assessment survey (one season Flora and fauna monitoring survey) in and around the proposed project area up to 10 km radius to identify REET (Rare, Endangered, Endemic, and Threatened) species of the area through direct and indirect methods.

1.6. THE KEY OBJECTIVES OF THE STUDY:

The objectives of the Mitigation plan are as follows:

- ✓ To conduct the biodiversity monitoring study in and around 10 km radius of the proposed project and quantify the biodiversity indices and identify the Rare, endangered, endemic, and threatened wildlife for IUCN and Scheduled- I species of the region.
- ✓ To predict impacts of the proposed project on direct habitat loss, barrier effect, disturbance leading to the displacement of animal groups, and collision risk in the study area.
- ✓ To assess potential animal crossing zones along the existing and proposed road track and to suggest wildlife crossings (Underpasses) at suitable places, which are comfortable and conducive for wildlife movement across the proposed road.
- ✓ To identify areas to build structures such as crossings, culverts, water holes, etc so as not to disrupt the wildlife behaviour and its activities.
- ✓ To suggest mitigation measures to minimize/avoid adverse impacts due to project-specific, site-specific and species-specific issues.
- ✓ To prepare budgetary on each component identified/suggested by the forest department for the next 10 years from project implementation.

2.STUDY AREA

Chapter 2

FIGURE 2 1: LOCATION OF THE PROJECT SITE

2.1. BIOGEOGRAPHIC DESCRIPTION OF THE STUDY AREA

The project study area is situated adjoining to Nagarjunasagar Srisailam Tiger Reserve (NSTR). This sanctuary is situated in the Nallamalais - an offshoot of Southern Eastern Ghats of Andhra Pradesh, the sanctuary is hilly terrain with plateaus, ridges, gorges and deep valleys which support tropical mixed dry deciduous forests with an undergrowth of Bamboo and Grass. The Project Tiger Circle, Srisailam is mainly constituted with the Nagarjunasagar Srisailam Tiger reserve, Rollapadu wildlife sanctuary and Gundla Braheswaram Wildlife Sanctuary. It spreads over Kurnool, Prakasam and Guntur Districts and is headed by the Field Director, Project Tiger Circle, Srisailam. The Circle consists of (4) wildlife/Territorial Divisions i.e., Atmakur WLM, Markapur WLM, Flying Squad and Bio-Diversity Research Division at Srisailam.

Climate

Nallamalais fall under dry region of Peninsular India. The hot period is from March to May, the temperature reaching up to 45°C. The average annual rainfall for whole of Nallamalais is about 74 cm. The full impact of rainfall is on Gundlabrahmeswaram plateau, which receives about 127 cm.

Rocks and Soils

The rocks fall into two distinctly recognizable formations, viz., the Cuddapah and Kurnool formations of the archean age. Sandstones in mixtures of quartzites, shales and outcrops of barites and manganese ores occur. There are three types of soil: red, mixed varieties and black. The red and mixed varieties occur along the bases of Nallamalais. Towards the interior of the forests, the soil is red with calcareous shales. The humus content is almost negligible. The black soil occurs in plains where cultivation is practised (Krishnan, 1956).

Flora and fauna of the region:

Champion and Seth (1968) classified the forest types of India under 16 type groups. But, due to heavy physical and anthropogenic influences the degraded stages of original climax vegetation types are hardly distinguishable. The following types were recognized in the

study area. The tiger reserve harbours endemic species like *Andrographis nallamalayana, Eriolaena lushingtonii, Crotalaria madurensis var, Dicliptera beddomei and premna hamitonii* making it a prospective germ plasm bank. It has been estimated that there are 1581 taxa spread over 149 families occuring in Nallamala which include 29 grass species and 353 medicinal species. Over 80 species of mammals,303 species of Birds, 54 species of reptiles ,20 amphibians, 55 fishes, 101 Butterfiles, 57 species of Moths,45 species of Coleopterans, 35 species of Odonata and numerous other forms of insects are found in the area. The recent Bio-systematic studies carried out by the scientists of Eco-Research and monitoring laboratories led to the discovery of certain new species which were hitherto not recorded. (Source : https://forests.ap.gov.in/tiger-res.phpest Department (ap.gov.in)).

The main types of forest biomes in the reserve are: southern tropical dry mixed deciduous forest, Hardwickia forest and Deccan thorn scrub forests with much Euphorbia scrub. Important plant species here are: *Anogeissus latifolia* (axle wood), *Cleisthanthus collinus* (odcha), *Terminalia* spp., *Pterocarpus marsupium, Hardwickia binata* (anjan tree), *Boswellia serrata* (Indian frankincense or salai), *Tectona grandis* (teak), *Mundulea sericea and Albizia* spp. (silk plants).

The main mammals in the reserve are: Bengal tiger, Indian leopard, Sloth bear, Ussuri dhole, Indian pangolin, chital, Sambar deer, Chevrotain, Blackbuck, Chinkara and Chowsingha. Lesser fauna includes Mugger crocodile, Indian python, Indian cobra, Rat snake, Bengal monitor, Indian star tortoise and Indian peafowl. Endemic reptiles like the skinks Ashwamedh writhing skink, Sharma's mabuya lizards and the Nagarjun Sagar racer snake, Wildboar, Mongoose, Porcupine are particular highlights of this region.

2.2. PROTECTED AREAS & ECO-SENSITIVE AREAS IN THE CORE AND BUFFER ZONES (UPTO TO 10 KM RADIUS)

The present study carried for the presence of important wildlife habitats and protected areas, breeding and nesting habitats of fauna and grassland area from core area. These important areas such as Protected areas (National Park, Wildlife Sanctuaries, Conservation Reserves etc. Wetlands of national importance, Ramsar sites, Important Bird Areas (IBAs),

classified by the Birdlife International and Bombay Natural History Society etc. Data collected and information gathered from primary and secondary sources on flora, fauna, protected area, natural habitats, wildlife species etc., were analysed and results are presented as follows.

Table 2.1: Details of protected areas, forests & ecologically sensitive areas

Ecological sensitive habitat	Direction and Distance from the project site.
Protected Areas	Yes, Nagarjunasagar Srisailam Tiger Reserve (Adjoining to the site) Sirigiripadu beat, Komarolu and Mallapalem beats. Rajiv Gandhi Wildlife sanctuary
Reserved Forests	Yes
Wildlife Corridors & Routes	Yes, (Adjoining to the site)
Wetlands / Water bodies	Yes, (Adjoining to the site)
Ramsar Site	NIL

Details of Forest Areas

The details of forest blocks are presented in Table-2.2. The major composition of degraded forest is *Acacia leucophloe, Acacia horrida, Boswellia serrata Dalbergia sisoo*.

TABLE 2.2 : DETAILS OF FORESTS IN STUDY AREA

S. No.	Details Forests	Distance from Site (km)
1	Mutukuru RF	Adjacent
2	Markapur RF	Adjacent
3	Eastern Nallamala RF	3.6
4	Kandlagunta RF	3.9

As per State Forest Report 2014, Markapur (WL) Forest Division lies in the south-eastern part of Prakasam district between latitudes 15^0 23'1'' and $16^0$18'16'' N and longitudes 78^0 47'48'' and 79^0 57'56'' E. Geographical area of the Division is 7,218 Km^2 which is 25.1% of the area of the district. The seasonal rivers like Gundlakamma, Sagileru, Musi, Paleru

and Manneru flow through the Division. The Gundlakamma River rises in Nallamala hills and the famous Cumbum Tank is formed across this river.

The total number of trees found along the project road is 1322. The right-hand side is 58 and the Left-hand side is 740. Various trees like Neem, Teak, and Bushes are found along the road. The climate of this Division is dry and salubrious, with temperatures ranging from 190C to 400C; the annual rainfall is about 871 mm, received mainly from Southwest monsoons. Sandstone mixed with quartzite and occasional shales are the characteristic rock formations on the Veligondas and at their extremes, bordering Kanigiri, the rocks gradually change into Gneisses or Granite composition. Outcrops of Barytes and Manganese ores occur in Veligondas. The soil types found mainly are red loamy, black cotton, sandy loam, and sandy. The population of the Division is 0.86 million (2011 Census), the per capita forest area is 0.26 Ha and the population density is 155 persons per Km2. There are about 48 Beats in the Division. The Sirigiripadu beat, Komarolu, and Mallapalem beat come under the project road.

2.3. IMPORTANCE TO THE COUNTRY, REGION

The Project is proposed for 2 Lane with Paved Shoulder configuration interlinking different National Highways connecting Prakasam and Guntur Districts of Andhra Pradesh. The proposed National Highway will provide better connectivity to several towns and cities viz. Macherla, Markapuram, and Yerragondapalem give an infrastructure fillip to the states of Andhra Pradesh, Telangana, and Tamil Nadu. The National Highway will be access-controlled and ensure high-speed traffic movement from Prakasam District to Guntur District. The proposed alignment is selected to cover one of the most important south arterial connectivity in the country, further interspersed with feeder highways on either side.

At present, the connectivity between Macharla and Markapuram is either via SH-56 or SH-88 which is two lanes with paved shoulder. The new proposed National Highway shall bring down the travel time distance. Moreover, the new National Highway facility is access

controlled and hence will provide good riding quality, better safety, and reliable infrastructure. All of these elements will result in cost savings and efficiency improvement.

The Project will further have the following benefits at the national and regional levels:

- High-speed connectivity and access: The projected National Highway is a proposed 2-lane with a paved shoulder. This will avoid traffic congestion and speed up the freight movement. It is expected that overall, the proposed National Highway will reduce the travel time.
- Aiding economic growth: The seamless connectivity will provide better access to vehicles as a link to the National Highways. The Project will reduce travel time and provide a boost to trade and commerce linked to the regions connected through this National Highway.
- Growth of backward areas: The biggest strength of the alignment is that it plans to cover backward districts of Andhra Pradesh. As a result of connectivity and access to other parts of the country, these backward areas will be aided to integrate with other parts of India. Further, freight and passenger traffic on the National Highway will help promote the ancillary economy of these regions.
- Decongestion of existing National and State Highways: The proposed National Highway will take away traffic pressures from Roads. Also, long-distance traffic will shift to the proposed National Highway, thereby leaving the SH for regional and local usage.
- Usage shift: Long-distance traffic will shift from existing road to the proposed National Highway, resulting in lesser congestion on these highways
- Improved safety: Due to access control, the Roadway & Travel Safety of the traffic connecting the cities will be enhanced as there will be minimum distractions & conflict zones
- Support to industry: Different types of industries like Manufacturing, Tourism, etc. along the proposed National highway will be facilitated in their business operation and reachability.

The following major types of traffic load are expected on the Project:

- Commercial and Industrial: Traffic on the existing roads is driven by local, commercial and industrial traffic. Industries such as cement, chemicals, and minerals are present along and around the proposed National Highway. These industries are expected to benefit from the National Highway.
- Tourist: Passenger traffic will be generated due to many places of tourist interest in the districts connected by the National Highway. Apart from places of historical importance such as forts and palaces, traffic would be augmented due to several famous religious places such as the Srisailam and wildlife parks and safaris like Amarabad Tiger Reserve.
- Health and Education: Faster connectivity and accessibility to AP will help in a higher flow of traffic from Telangana state, especially for higher education, tertiary healthcare, and specialized treatments. Reduction in travel time will allow patients to avail OPD / other medical services from the capital region.

3.METHODS ADOPTED

Chapter 3

3.1. SOURCES OF DATA COLLECTION:

- Primary field survey of flora and fauna near Core (up to 1 sq. km) and buffer (up to 10 sq. km radial distance) zones during site visit.
- Secondary data sources from forest department staff, road staff working in the track side, authentic websites, publications etc.

3.2. EQUIPMENT / INSTRUMENTS DEPLOYED

- Digital Camera (NIKON 42 X zoom)
- GPS (Available in Mobile and inbuilt camera)
- Binoculars (OLYMPUS 10 X 50 DPSI)
- Field observation book, Field guides, Pen, Measuring tape etc

The site visit undertaken from 12th to 15th November, 2021 by experts from M/s Greentech Enviros, and accompanied by the staff members of Satra Infrastructure Pvt Ltd. Seven sampling locations are studied in the study area and collected list of flora and fauna by using quadrant method and belt transect method.

3.3. VEGETATION SURVEY METHOD

Vegetation in the seven sampling locations has been estimated by direct counting of Tree species, their number, GBH value and distance and direction in Row. The status of each identified species was given in terms of four categories such as “Common”, “Sporadic”, and “Rare”. This status is mainly based on Density, Frequency and Abundance estimated during the field visit for Trees, Shrubs and Herbs.

Number of quadrates or belt transacts are finalized based on the Area – Species graph. 20 m X 20 m for tree species, 5 m X 5 m quadrates for shrubs and 1 m X 1 m quadrates for

herbs. In locations where the quadrants are not possible such as hilly areas and agricultural, plantation areas a belt transects of 100m X 10m are applied.

The above parameters are used to determine the following.

- Determining frequency, abundance, relative frequency, relative density, relative dominance and importance value indices using Mueller-Dombois-Ellenberge [1974] Method.
- The flora data collected from 7 sampling points are analysed quantitatively from MS Excel and PAST softwares.
- The biodiversity indices such as Shannon Index, Simpson index, A/F value, Dominance and Evenness e^H/S are statistically analysed and interpreted the data on ecosystem quality.

3.4. FAUNAL SURVEY METHOD:

Mammalian surveys were conducted by using line transect method in all major habitats and recorded the species through direct and indirect evidences. Bird surveys were be carried out through **Point count method** preferably during **dawn and desk**. Secondary data collected from forest department and local people in the study area.

4.SURVEY RESULTS

Chapter 4

4.1. KEY FINDINGS OF BIODIVERSITY MONITORING

- The present study was carried out in Winter season for the direct observation in the selected habitats of the study area and analysed the possible impacts on animals of the proposed road expansion and suggested mitigation measures.
- The entire study area was analysed on hypothetical cluster-based analysis.
- Mammals monitoring plan relay on direct field observations, indirect evidence, authentic information, the desktop study of available relevant literature as well as subject expert's professional judgment. After a review of relevant secondary information available for the area habitat and point surveys were undertaken in Monitoring surveys up to 10 km radius of the project area.

4.2. VEGETATION FOUND DURING THE FIELD STUDY:

Trees: The most common tree species occurring are *Adina cordifilia, Alangium salviifolium*

Angeissus latifolia, Azadirachta indica, Bridelia retusa, Cassia fistula, Cassine glauca, Chloroxylon swietenia, Cleistanthus collinus, Cochlospermum religiosum, Dalbergia lanceolaria, Diospyros melanoxylon, Gardenia turgida, Ehretia Leavis, Givotia moluccana, Haldinia cordifolia, Lagerstroemia parviflora, Litsea glutinosa, Madhuca longifolia, Millettia pinnata, Morinda pubescens, Phyllanthus emblica, Prosopis juliflora, Pterocarpus marsupium, Strychnos nux-vomica, Tectona grandis, Terminalia alata, Terminalia chebula, Wrightia arborea, Wrightia tinctoria, Xylia xylocarpa, Ziziphus xylopyrus

Shrubs: The most common shrubs are *Lantana camera, Hyptis suaveolens, Cassia auriculata, Calotropis procera, Prosopis juliflora, Acacia leucocephala, Catunaregam*

spinosa, Caesalpinia bonducella, Canthium parviflorum, Carissa carandas, Capparis sepiaria, Celastrus paniculata.

Herbs: *The most common herbs are Tridax procumbens, Cassia occidentalis, Crotan bonplantianum, Datura metel, Eclipta alba, Boerhavia diffusa, Tephrocia purpuria, Achyranthes aspera, Cassia tora, Abutilon indicum, Ipomoea macrantha.*

Climbers: The commonly seen climbers are *Capparis horrida, Abrus precatorius, Hemidesmus indicus, Clitoria ternatea, Cuscuta reflexa, Desmodium triflorum, Pergularia daemia, Desrris scandans, Hemidesmus indicus, Ipomoea pes-caprae, Ipomoea nil, Ipomoea macrantha, Mucuna pruriens, Evolvulous alsinoides, Gloriosa superba.*

Grasses: The common grass species are *Chloris barbata, Cyperus castaneus, and Cynodon dactylon Dactyloctenium aegyptium, Digitaria ciliaris, Eragrostis tenella, Fimbristylis cymosa, Ilaloipsis binata and Imperata cylindrica.*

Fig 4.1: Field photos near core and buffer zones of the study area:

Fig 4.2: Habit wise number of flora present in the study area:

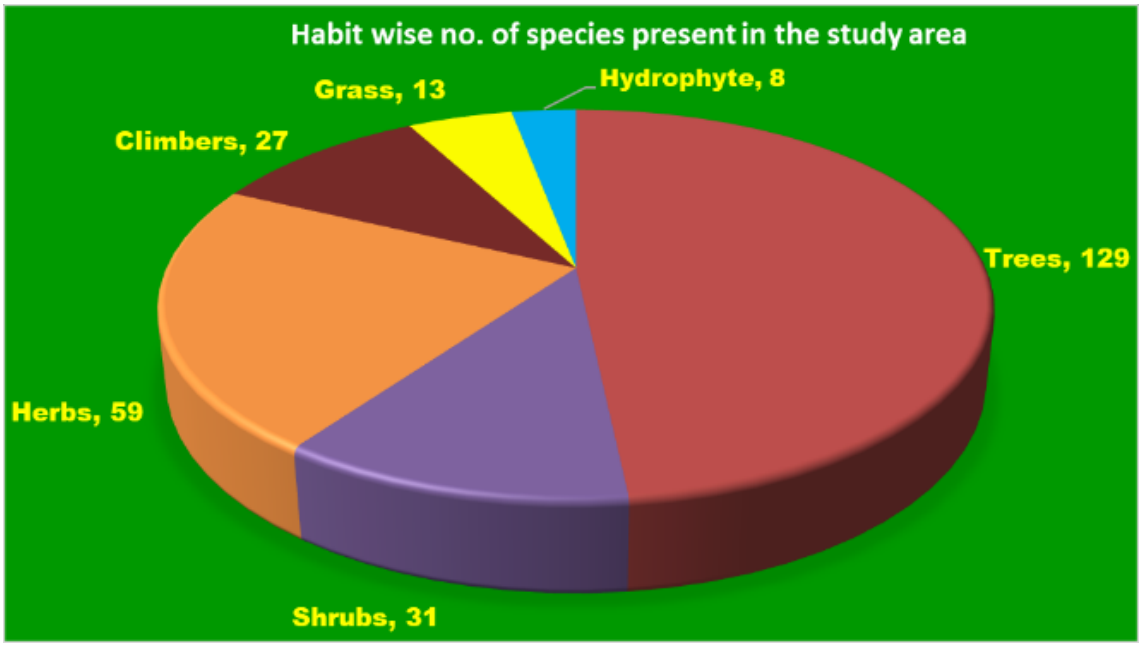


Fig 4.3: Zone wise number of flora present in the study area:

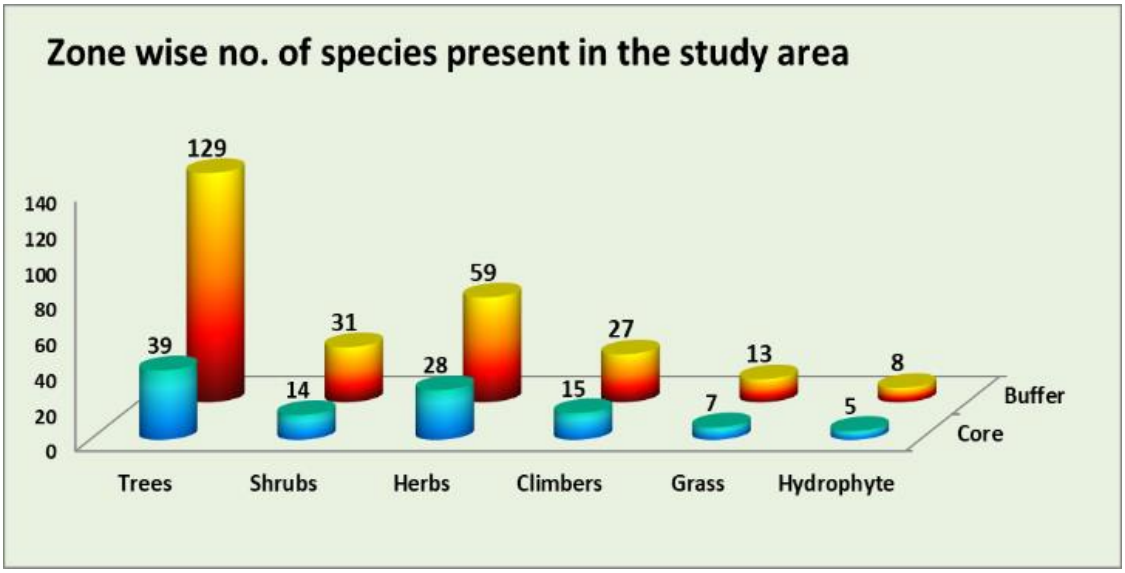


Table 4.1: Data interpretation of Biodiversity indices values of the sampling sites in buffer zone:

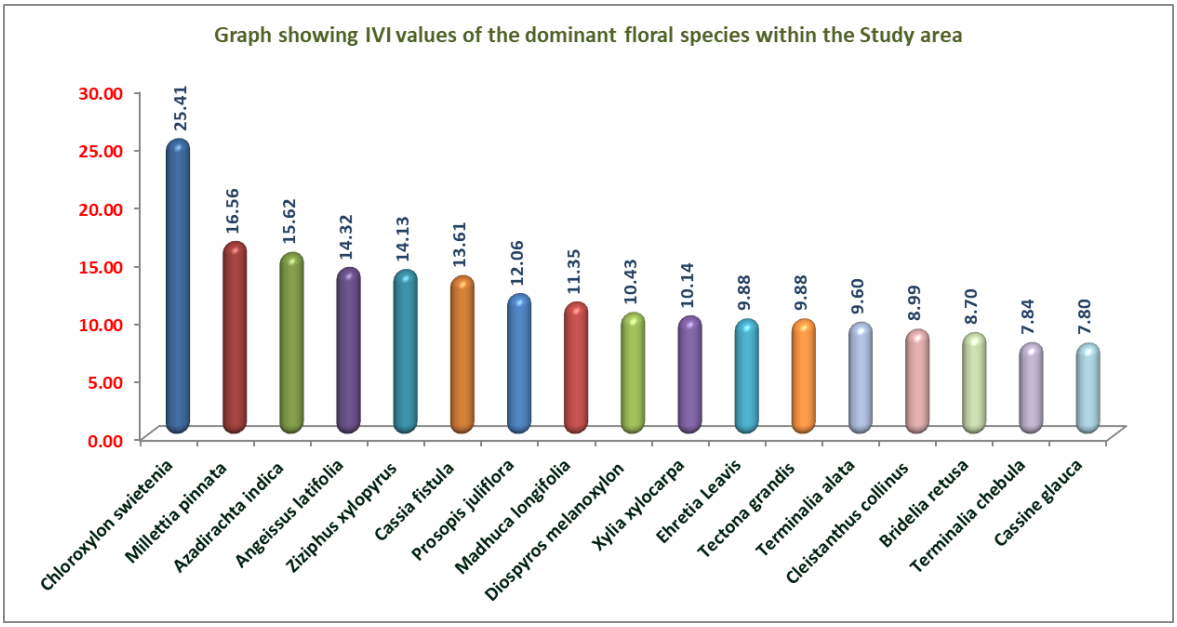
Biodiversity indices	Value	Indication and reason	Relevance to present mitigation plan

Shannon indices	**3.253**	**Good diversity** (Normal diversity in ecological studies is 1.5 to 3.5 range (Kerkhoff, 2010). **Reason:** Presence of reserve forests and adjoining to Srisailam Tiger Reserve	Contractor shall follow instructions given by forest department during entire working period.
Evenness e^H/S	**0.968 (96.8%)**	Indicates the species are evenly distributed in **core and buffer zones.**	All the species present in the core zone are also present in the buffer zone. Hence impact on vegetation present near core zone shall be compensated through afforestation activities of the similar species in the buffer zone as per guidelines taken from forest department.

4.3. FAUNA OF THE STUDY AREA

From the secondary data and indirect evidence during the site visit, the predominant species found are Tiger, Panther, Sloth bear, Jungle cat, Bonnet macaque (*Macaca radiate*), Rhesus macaque *(Macaca mulatta),* Wild boar (*Sus scrofa*), Spotted deer (*Axis axis*), Sambar (*Cervus unicolor*), and Nilgai (*Boselaphus tragocamelus*), Five striped palm squirrel (*Petaurista Pennanti),* Indian Giant Squirrel *(Ratufa indica),* Four-horned antelope (*Tetracerus quadricornis),* Indian hare (*Lepus nigricollis*), Grey House shrew *(Suncus murinus)* and Indian Tree shrew (*Anatha eliioti).* Birds are very common near the aquatic habitats and terrestrial habitats. Peafowls are found near the ponds. Among the reptiles, Skinks, Geckos, lizards are commonly sighted. Snakes such as Krait, Common Tree Snake, Saw scaled wiper, Russell's earth boa, Johns earth boa, Common wolf snake, Indian Cobra, Common Rat snake and Green pit viper are present.

Fig : 4.4 Graph showing Important Value Index of dominant tree species within study area



Distribution pattern (A/F ratio): The ratio between abundance and frequency was used to interpret the distribution pattern of species (Whitford, 1949). The distribution

pattern of species in the study area is identified as **random distribution** as the value of A/F ratio is **0.043.** This random distribution of species is mainly due to various ecosystems present in the buffer zone. The Shannon indices value of the study area is **3.253** indicates **Good diversity** (Normal diversity in ecological studies is 1.5 to 3.5 range (Kerkhoff, 2010). Population size and Dominance of the species is **3%** and Evenness is around **97%** (Indicates the species are evenly distributed in core and buffer zones). This might be due to contiguous patches of *Chloroxylon swietenia* species and natural species such *Azadirachta indica, Phoenix, Prosopis juliflora (near the villages), Peltophorum pterocarpum and Delonix regia (near roadside)*. The present study indicates A<B<C>D>E in frequency classification and as per the Raunkiaer's law of frequency classification indicates that species diversity is distributed maximum for 40 to 60%. This result indicates that most of the species frequency is more or less equal due to some of the plant species such as *Xylia xylocarpa, Syzygium cumini, Phoenix sylvestris, Dalbergia sissoo, Prosopis juliflora, Tectona grandis, Mangifera indica, Terminalia alata and Lantana camara* are **frequently found** floral species throughout the region.

5. IMPACTS OF PROJECT ACTIVITIES AND MITIGATION PLAN

Chapter 5

5.1. JUSTIFICATION OF THE PROJECT:

The proposed road doubling line has been aligned along the existing road line within the available road land boundaries as far as possible to minimise the forest land diversion/ acquisition. There is no alternative route to this alignment hence doubling line is proposed along the existing line in the forest corridor with limited vegetation removal.

5.2. SPECIES-SPECIFIC IMPACTS:

Impact of few animals found in this region:

Mouse Deer: Mouse-deer (tragulids) in general occupy a range of habitats from evergreen forests to plantations. They are an ancient group of frugivorous ungulates, small-bodied and active both day and night. They are often found in evergreen, semi-evergreen and deciduous forests, as well as in grassland and commercial plantations. The mouse deer is a solitary animal except during mating season and hence the communication is likely to be limited to males and females during mating periods. Their territories are relatively small reaching from 13 to 24 hectares but neighbours generally ignore each other rather than competing aggressively. They have a lifespan of 8-12 years in the wild. It is a rare species to spot in the wild since it is very shy and of cryptic nature. The conservation status of Indian mouse deer, according to IUCN (International Union for Conservation of Nature and Natural Resources), is Least Concern.

Impact: Very few populations are present near the study area. The loss of habitat due to the proposed project is limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Palm Civet: The Asian palm civet (*Paradoxurus hermaphroditus*), also called common palm civet, toddy cat and musang, is a viverrid native to South and Southeast Asia. Since 2008, it is IUCN Red Listed as Least Concern as it accommodates to a broad range of habitats.

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Wild Cats: Wildcat species are largely nocturnal and solitary, except during the breeding period and when females have young. The size of home ranges of females and males varies according to terrain, the availability of food, habitat quality and the age structure of the population. Male and female home ranges overlap, though core areas within territories are avoided by other cats. Females tend to be more sedentary than males, as they require an exclusive hunting area when raising kittens. Wildcats usually spend the day in a hollow tree, a rock crevice or in dense thickets. It is also reported to shelter in abandoned burrows of other species such as red fox (*Vulpes vulpes*).

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Spectacled Cobra: The Indian cobra inhabits a wide range of habitats throughout its geographical range. It can be found in dense or open forests, plains, agricultural lands (rice paddy fields, wheat crops), rocky terrain, wetlands, and it can even be found in heavily populated urban areas, such as villages and city outskirts. Preferred hiding locations are holes in embankments, tree hollows, termite mounds, rock piles and small mammal dens.

Impact: This is commonly present near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

Geochelone elegans is a terrestrial species and inhabits scrub forests, grasslands, and some coastal scrublands of arid and semi-arid regions, but also commonly inhabits human-dominated landscapes including fields, hedgerows, and plantations.

Impact: This is rarely seen near the study area. The loss of habitat due to the proposed project is very limited due to the presence of underpasses as a part of mitigative measures. Collision risk is evaluated as moderate.

5.3. WILDLIFE RELATED ISSUES:

The construction of proposed road can have a substantial impact on the degradation and loss of vegetation, natural ecosystems and habitats, fragmentation of habitats. Pollution and dust accumulation on vegetation, noise and vibration impact on wild animals are during operation state. The other major impacts are given in the table.

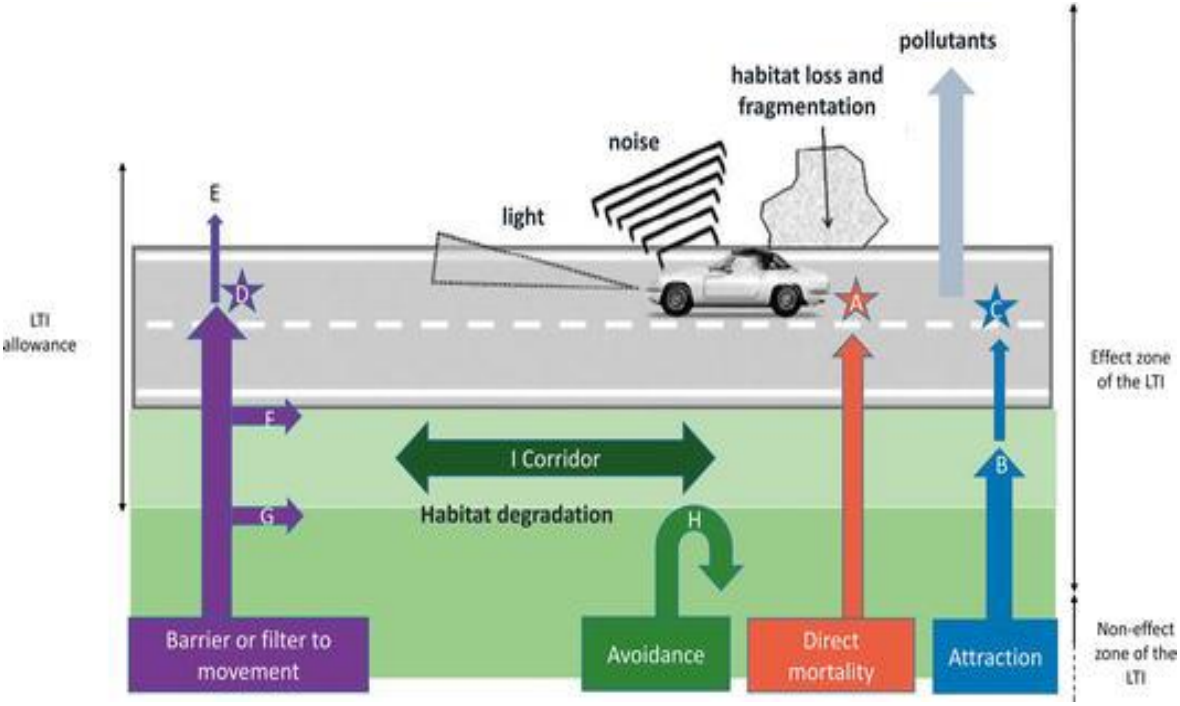


Fig 5.1 Schematic view of environmental effects of a linear transport infrastructure

The building of the LTI and the traffic induced a set of direct and indirect impacts on the biodiversity, in the effect zone of the LTI. (A) Direct mortality via collision with vehicles;

(B) attraction (e.g. scavengers for crushed fauna); (C) potential mortality of attracted animals; (D) direct mortality of crossing individuals; (E) successful crossing; (F) avoidance of the LTI; (G) avoidance of the LTI allowance degraded habitat; (H) avoidance of the LTI allowance; (I) corridor effect.

5.3.1. IMPACT STUDY FOR DIRECT HABITAT LOSS:

Due to the proposed project the major trees that are going to be removed are *Chloroxylon swietenia, Cleistanthus collinus, Cochlospermum religiosum, Dalbergia lanceolaria, Tectona grandis, Diospyros melanoxylon, Gardenia turgida, Ehretia Leavis, Givotia moluccana, Haldinia cordifolia, Lagerstroemia parviflora,, Prosophis juliflora* etc. There are no Rare and endangered floral species that are going to remove from the activity area. Moreover, all the species present in the expansion area and predominantly available throughout the buffer region.

The loss of other shrubs, herbs, climbers and grass species will also play a major role iin habitat loss for small vertebrates and invertebrates on a large scale. Apart from the direct removal of vegetation, long- term impacts due to traffic on surrounding flora also need to be considered. The dust and vehicular emissions also impact microfauna of the region. The effect on flowering will also impact on butterflies species habitat.

5.3.2. IMPACT ON BARRIER EFFECT:

The proposed road expansion project would create more barrier effects on both nocturnal and diurnal animals. Diurnal animals are active during the daytime, with a period of sleeping or inactivity at night. The timing of activity by an animal depends on a variety of environmental factors such as the temperature, the ability to gather food by sight, the risk of predation, and the time of year. Commonly classified diurnal animals include mammals, birds, and reptiles. Most of the primates are diurnal. In this region, the diurnal wild animals are Langurs, Sloth bears, Varanus, Squirrels, Butterflies etc. The barrier effect on these animals is limited due to daylight and other ecological parameters. Nocturnal animals are active at night. They often have special adaptions for nocturnal living, including large eyes for low-light vision, and heightened senses of hearing and smell. Examples of nocturnal

animals include Tigers, Panthers, Civets, bats, moths, owls, and wolves. The barrier effect is high in these animals and proper mitigation measures must be taken. Crepuscular animals are active at dawn and dusk. Especially deers, foxes, wolves, hats etc. The barrier impact on these animals is moderate and proper mitigation steps are to be taken while expansion work is undertaken.

Restriction on movement of animals due to movement of vehicles 24x7:

The vehicle movement in the reserve forest is throughout the day (24X7). Hence animals of both diurnal and nocturnal animals cannot cross the road all the time. Hence certain mitigation steps need to be taken in this regard. These steps are discussed in detail in next chapters.

Sound & light pollution due to vehicles and its impact on animal behaviour:

The noise and vibrations are also major causes of disturbances to natural wildlife and sensitive species such as Reptiles and birds. Short-term exposure of noise levels can affect the behaviour and physiology of birds, the reproductive system as birds avoid reproduction in noisy places. Animals also suffer human-like disabilities like hearing loss, loss of responsiveness, dizziness and disturbance. Traffic noise reduced foraging efficiency in most bats. Monkeys also live in noise-free areas as exhibited by a study in which continuous noise was supplied in the habitat of the monkeys. The common effects on animals are hearing loss, increased heart rate, increased risk of death, habitat loss, trouble in finding prey, trouble in finding mates as in frogs etc. (Source: Vehicular Noise Pollution: Its Environmental Implications and Strategic Control | Intech Open). Artificial light has several general effects on wildlife: Attracts some organisms (moths, frogs), resulting in them not being where they should be, concentrating them as a food source to be preyed upon, or just resulting in a trap that exhausts and kills them. Studies show that light pollution is also impacting animal behaviours, such as migration patterns, wake-sleep habits, and habitat formation. Bright lighting also affects the feeding patterns of some bat species and makes them more vulnerable to predators or likely to crash into buildings.

Impact on the movement of reptiles and amphibians:

Roads are one of the most widespread human-caused habitat modifications that can increase wildlife mortality rates and alter behaviour. Roads can act as barriers with variable permeability to movement and can increase the distances wildlife travel to access habitats. The home range sizes of herpetofauna vary considerably in size. Some species may travel hundreds of feet and up to several miles in one day. Individuals may travel large distances to access habitat used for breeding, feeding or sheltering. These areas can become bisected by roads. Animals may avoid roads causing a barrier effect or not avoid roads resulting in reduced survivorship from road mortality. When roads act as barriers, this results in habitat fragmentation effects.

A study to evaluate road avoidance behaviour of reptiles at large spatial scales and the first to estimate energetic consequences of road avoidance in reptiles' results suggest that turtles avoid crossing roads, but do not avoid habitats adjacent to roads. Turtles expend more energy on movement in home ranges containing more roads, but the increased energetic expenditure is small compared with energetic investment in reproduction. Overall, our results suggest that reptiles avoid road crossings. However, the additional energy expenditure of reptiles interacting with roads is unlikely to negatively affect fitness through reduced reproductive output, and road crossing avoidance may have positive effects by reducing mortality risk. Mitigation of road impacts on reptile populations should continue to focus on reducing mortality from vehicle strikes.

(Source: https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.5515)

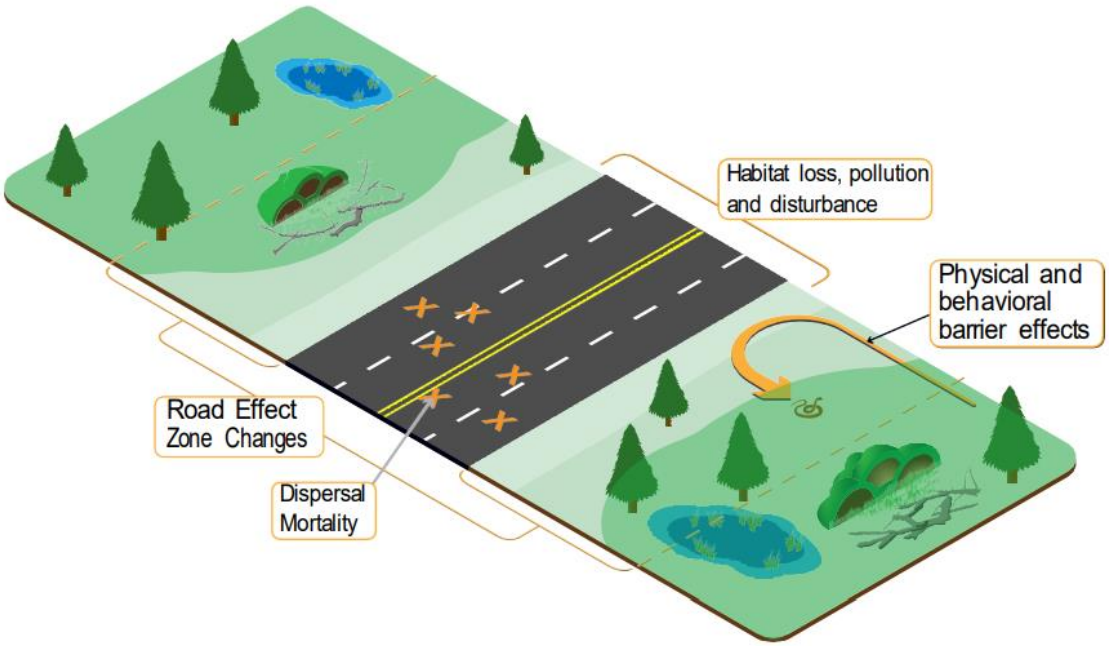


Fig 5.2 Schematic representation of influences within the Road Effect Zone (REZ).

Attraction to roadside habitat, and implications for amphibians and reptiles:

Roads and roadside habitats often attract amphibians and reptiles, to their detriment. Snakes and toads can be attracted to paved roads for thermoregulation (basking) and will linger on the warm surfaces to raise their body temperature, which increases the time they are at risk of being run over. Large snakes may be attracted to paved road surfaces for thermoregulation but also have wide home ranges or move long distances between winter hibernacula and summer feeding grounds. Long foraging movements within aquatic habitats also contributed to the snakes falling within the highest road risk categories.

Frogs become sexually mature around four years of age. They emerge from hibernation from February to March to seek out breeding grounds. Females lay their eggs in shallow water. Road mortality of amphibians is much higher during the breeding season as individuals migrate to breeding ponds (Beebee, 2012).

Fahrig and Rytwinski (2009) identified four situations in which roads create negative impacts on organisms:

(1) species are attracted to roads but are unable to avoid individual cars,

(2) species have high levels of movement, low reproductive rates, and low densities regardless of their reaction to roads,

(3) small animals avoid roadside habitat, and

(4) small animals not impacted by road-affected predators, who have no road/traffic avoidance, are unable to avoid oncoming traffic.

Habitat fragmentation impacts faunal breeding and reproductive complications:

Fragmentation means a splitting of contiguous areas into smaller and increasingly dispersed fragments. With an increasing degree of fragmentation, the individual fragments may become too small and too isolated from each other to support the species that depend on the fragmented habitat. Fragmentation reduces the amount of habitat available to

wildlife in the landscape and thereby diminishes population sizes and the number of species that can live in the landscape. In situations where roads cannot be removed or closed, or where traffic cannot be reduced, technical measures such as fauna passages and Eco ducts may be necessary to mitigate fragmentation and reconnect wildlife habitats.

Impact due to loss of termite mounds:

Recent work has shown that termite mound abundance and distribution both in space and time may be modulated by variation in abiotic and biotic resources. Termite mound communities can vary with changes in soil type, rainfall, ecosystem productivity, and herbivore presence, and termite mounds appear to increase in density with availability of dietary resources such as tree density, and decrease with intensive human land use. Some evidence also suggests that termite diets may shift in response to changing availability of plant resources. Due to present project proposal, in the core project area few termites mount is present near the road side. Due to removal of these termites' mounts, impact on both biotic and abiotic features of the area. Certain mitigation measures proposed in the next chapter for the removal of termite mounts in the unavoidable conditions.

Mitigation measures for reducing barrier effect to wild animals:

- The breeding sites of animals/amphibians, nesting sites of birds, thermoregulation surface sites of snakes will be avoided for any type of construction.
- Construction/modification of ponds will be done to provide breeding sites to amphibians.
- The construction of strips of surfaces (next to the road where high mortality of snakes are reported) that may attract snakes for the thermoregulation will be done.

Fig 5.3 Contructing stip of surface for thermoregulations for sankes.

- Construct more number of underpasses where animal crossings are more.
- Creation or improvement of water bodies will be done so that the animals have access to water.
- Plantation along the water body will be done to attract the animals towards it.
- The saltlicks areas will be protected from the reach of human beings. Limit the construction activity within the designated areas.
- Check the site for turtles trapped in, or in danger from civil works and use a qualified person to relocate the animal.
- Animal underpasses are proposed to be constructed for animals to cross the road. Different types of underpasses such as Box culverts, pipe culverts, and culverts with furniture will be constructed for passage of herpeto-fauna, amphibians etc.
- Fences shall be provided in combination with underpasses to direct animals away from the road.
- Vegetation or other habitat features (rocks, fallen timber) will be placed, planted or allowed to regrow so that animals are directed to preferred crossing locations.
- The plantation and lighting systems along the road should be made less attractive to birds to avoid collision of birds with vehicles.

5.3.3. IMPACT ON DISTURBANCE LEADING TO DISPLACEMENT OF ANIMAL GROUPS:

The major disturbance will be during road construction period. Certain standard guidelines are prepared for issuing to the contractor and full powers to forest authorities to take any action and modifications during construction phases with respect to wildlife protection and conservation.

Disturbances during post construction work or during traffic conditions:

The main disturbances are effect of animals on their feeding, breeding and behavioural aspects due to light, noise, vibrations, loss of vegetations, habitat, pollution etc. The native faunal species which are residents of the core project zone will get disturbed due to the above facts and displacement will occur in this region. They cannot adjust to the new habitat conditions as well as inter species competition for food and other functional aspects will occur.

5.3.4. IMPACT ON COLLISION RISK:

Collision risk study has been conducted by direct and indirect methods. Certain areas sensitive to wildlife crossings were observed during the study and suggest mitigation measures to overcome this problem. Many aspects are considered in this regard like slope, curvature, speed of the vehicles, animal escaping routes near the tracks, water bodies, underpasses, ramps etc. Langurs (Bonnet macaque (*Macaca radiate*), Rhesus macaque *(Macaca mulatta)* are very common throughout the region. They used to stay adjoining to the roads and sometimes causes problems to the vehicles. The passengers used to give some food, fruits etc which is also leading to accidents.

Collision impact on reptiles especially snakes, monitor lizards, civets, and other wild cats:

In the study area there are 17 species of reptiles found in this region. Certain nocturnal animals under Mammals are also observed during night time. The chances of road kills are more for civets and other wild cats along with amphibians and reptiles. During monsoon season, amphibians come out from hibernation for breeding. Collision risk is more for Amphibians than reptiles. During our research in this region during 2005, Prionailurus rubiginosus Rusty spotted Cat which is Near Threatened category from IUCN found near Dornal region on road kill. Usually, killings of only large mammals are reported while the smaller wildlife goes unnoticed. In the last few years, leopard, Sloth bears, Porcupine, langurs, sambar, chital, civet cats, etc have died on national highways. Road kills of King

cobra, monitor lizard, common krait, sand boa and frogs have been sighted on highways near forested habitats.

Factors that influence the occurrence of wildlife-traffic collisions

There are various factors that determine the risk of animal-vehicle collisions. The numbers of collisions generally increase with traffic intensity and animal activity and density. Temporal variations in traffic kills can be linked to biological factors which determine the species' activity e.g. the daily rhythm of foraging and resting, seasons for mating and breeding, dispersal of young, or seasonal migration between winter and summer habitats

Fig 5.4 Factors influencing the number of wildlife traffic accidents.

Mitigation measures for avoiding collision risk to wild animals:

- Speed limitations on roads can also offer a simple tool to change traffic flows in the road network and reduce disturbance and mortality in wildlife areas.
- Safety barriers/delineators hard shoulders on main roads
- Traffic signs and pavement markings.
- Underpasses and other grade separators at congested junctions
- Removal of junctions and direct access points on main roads.

- Improved median openings with stacking lanes.
- Separate provisions and direct access point.
- Service roads in towns and villages for segregating local and through traffic.

Fig. 5.5 Model speed breakers to be made during laying the road.

Road Signs (Danger boards/ Wildlife awareness boards/ Speed limits/ other hazardous indicators)

Awareness on wildlife crossings, information to vehicle drivers during particularly night-time precautionary measures shall be kept near both the sides of the road and forest check posts. The user agency shall take guidelines from the forest department while placing the boards and signs. All signs shall be placed on the left-hand side of the road. Where extra emphasis is warranted, they may be duplicated on the right-hand side as well. On non-kerbed, the extreme edge of the sign shall be 1.5m-2.0m from the edge of the carriageway. On kerbed portion, it shall not be less than 60cm from the edge of the kerb. Arrangement for proper surveillance by NHAI authority personnel after the expiry of the maintenance period by the construction agency.

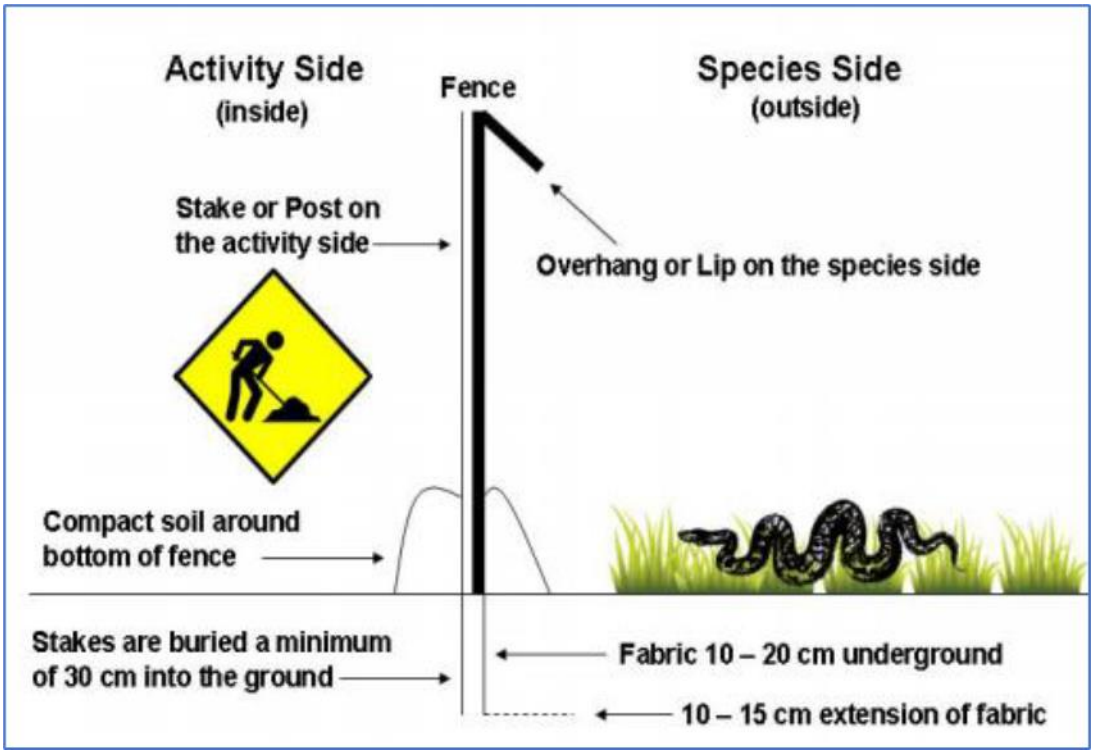


Fig: 5.6 Basic exclusion fencing (side view) used to prevent animals from traversing road surfaces. An overhang is used to prevent animals from climbing or jumping over the top of the fence.

5.4. IMPACTS VS MITIGATION MEASURES OF THE REGION

❖ Invariably the user agency is the responsible party to regulate the various activities and man-power relating to the highway widening project.

❖ Considering the importance of the Tiger Reserve, all the Trees to be felled due to road widening shall be transplanted in the nearest possible and viable forest area for the betterment of the habitat.

Table 5.1: Impacts Vs Mitigation measures and responsible authority to monitor the activities.

Phase/ Aspect	Impacts identified	Mitigation measures suggested	Responsible authority
Construction phase : Removal of vegetation near the project core area	✓ Loss of native species. ✓ Loss of habitat for wild animals. ✓ Habitat fragmentation ✓ Loss of food source for invertebrates. ✓ Loss of hiding place for faunal species from predators. ✓ Loss of bird nesting and breeding sites.	❖ Vegetation removed from the construction zone before commencement of construction. All works carried out such that the damage or disruption to flora other that those identified for cutting is minimum. ❖ Only ground cover/shrubs that impinge directly on the permanent works or necessary temporary works are removed with prior approval from the Environmental Expert. The Developer, under any circumstances not cut or	User Agency and NHAI work contractor

		damage trees. Trees identified under the project and cut only after receiving permission from the Forest Department of Andhra Pradesh. ❖ Tree transplantation shall be taken up to the nearby forest area or along the proposed highway. ❖ Compensatory afforestation at 1:3 shall be planted for trees which need to fell. ❖ For tree felling, permission shall be taken from concern authorities of Andhra Pradesh Forest Department	
Dust Pollution	✓ Accumulation of dust on plant leaves. ✓ Reduction of photosynthetic rate. ✓ Stunted growth and reduction of yield. ✓ Respiratory disorders to fauna and	❖ The Developer take precautions viz. water sprinkling etc. to reduce the level of dust generated from the construction site. All the plants sited at least 1 km in the downwind direction from the nearest human settlement. ❖ The Developer will provide necessary certificates to confirm that all crushers used in	User Agency and NHAI work contractor

	human habitations.	construction conform to relevant dust emission control legislation.	
Noise and vibration generated by heavy machinery. .	Noise induced psychological and behavioural changes occur to wild animals. Distrubance caused to human habitations.	❖ Dense vegetation along the road may be provided for attenuation of noise. ❖ Acoustic enclosure should be placed to cover the hammer and the exposed pile to reduce the air noise. The air noise levels can be reduced to about 60 dB with these measures ❖ Silence zone will be marked and provided with sign boards to alert drivers ❖ Noise buffers using diversity of tree species, with a range of foliage shapes and sizes, combination of shrubs and trees and evergreen species will be provided. ❖ Servicing of all construction vehicles and machinery done for exhaust silencers and will be checked and if found defective will be replaced. ❖ All the construction sites within 150m of the	User Agency and NHAI work contractor

		nearest habitation, noisy construction work such as crushing; concrete mixing works to be done from 6.00 AM to 6.00 PM. ❖ No noisy construction activities will be permitted around educational institutions / health centers (silence zones) up to a distance of 100 m from the sensitive receptors. ❖ Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to IC.	
Loss of top soil.	Loss of hibernating fauna.	❖ Topsoil on stripping shall be removed and stockpiled on sides to be used on the side slopes, for top cover of borrow areas and for plantation in pits ❖ Soil compaction for embankment work should be done immediately to avoid erosion.	User Agency and NHAI work contractor
Solid waste generation	Death to faunal species. Animal injuries.	❖ The Environmental Expert approved these disposal sites after conducting a joint inspection on the site	User Agency and NHAI work contractor

		with the Developer. ❖ Non- bituminous wastes dumped in borrow pits (preferably located in barren lands) covered with a layer of the soil. No new disposal site created as part of the project, except with prior approval of the Environment Expert. All waste materials completely disposed of and the site fully cleaned and certified by Environmental Expert before handing over.	
Construction activity	Degradation of Habitat Quality	❖ Precautions will be taken to avoid leakage of chemicals, any hazardous materials due to construction activities. ❖ Labour camps will be located far from habitat of any fauna ❖ Invasive alien species will be removed from time to time	User Agency and NHAI work contractor
Operation phase: Direct Collision	Injury and mortality due to direct collision. There is a potential impact	❖ With the proposed mitigative measures such as construction of culvers, road alignment, speed breakers etc,	User Agency and NHAI work contractor

	of direct animal hitting during animal crossing the roads.	❖ Injured animals shall be immediately taken to forest department or veterinary hospitals	
Impact of headlight glare on wild animals.	Restricts animal movement nearer to road	❖ Hedges along both sides of road will be provided to lower the intensity of lights	User Agency and NHAI work contractor
Degradation of habitat quality.	Water, air, soil and biodiversity of the region will get deteriorated in long term.	❖ Habitat improvement programmes shall be taken up on either side of the forest areas of the present road. ❖ Ecological monitoring by expert scientist must be done once in every 4 years to know the animal behaviour and migration status.	Forest department with the funds deposited by NHAI authorities as a part of WL report.
Langurs (Bonnet macaque (*Macaca radiate*), Rhesus macaque *(Macaca mulatta))* create problems to Vihicles.	Langurs are hundred in number and get killed during direct collisions.	Langurs must be rehabilitated from the existing range. Supply of sufficient food and water in forest premises shall be taken care.	Forest department with the funds deposited by NHAI authorities as a part of WL report.
Impact on turtle	Indian Star Toritoise movement will	❖ Limit the construction activity within the designated areas.	

	be restricted.	❖ Check the site for turtle trapped in, or in danger from civil works and use a qualified person to relocate the animal.	
Avoidance of Road by Animals	To avoid Injury and Mortality of animals	❖ Animal underpasses are proposed to be constructed for animals to cross the road. ❖ Different types of underpasses like Box culverts, pipe culverts, and culverts with furniture will be constructed for passage of herpeto-fauna, amphibians etc. ❖ Fences will be provided in combination with underpasses to direct animals away from the road. ❖ Vegetation or other habitat features (rocks, fallen timber) will be placed, planted or allowed to regrow so that animals are directed to preferred crossing locations. ❖ The plantation and lighting systems along the road should be made less attractive to birds to avoid	User Agency and NHAI work contractor

		collision of birds with vehicles.	
Reduce access	❖ Wild animals frequently move for food, water and mating. Access to other side of the road reduce where underpasses are not present.	❖ Construct more number of under passess where animal crossings are more. ❖ Creation or improvement of water bodies will be done so that the animals have access to water. ❖ Plantation along the water body will be done to attract the animals towards it. ❖ The saltlicks areas will be protected from reach of human beings.	User Agency and NHAI work contractor
Increased Human Pressure and Human-Wildlife Conflict	❖ Impact on wildlife with human activities.	❖ Caution signs will be provided to alert drivers about wildlife ❖ Speed limit will be restricted in and around dense habitation area to avoid any collision of animal. ❖ Parking shall be restricted to avoid any encounter of humans with animals. ❖ Temporary warning signs may be provided to warn drivers during specific time like breeding periods of animals or animal	User Agency and NHAI work contractor

		movement. ❖ Animal Detection Systems may be provided for detection of any animal near road. ❖ Poachers will be warned through sign boards	

5.5. PROJECT CONTRACTORS CONDITIONS DURING CONSTRUCTION PHASE:

- Maintaining records on Awareness programmes, Animal sightings, Deaths, accidents etc and shall inform to forest department for further action.
- Necessary guidelines shall be taken from forest authorities throughout the construction phase.
- The contractors to establish environmental units and implement public awareness programs during construction regarding the impacts caused by the construction activity.
- All building material for workers should be brought carried from outside the project area.
- Workers should be supplied all food material cooked near Y.Palem region.
- Project staff and workers should not be allowed to have fire-arms and animal traps etc.
- Forest fires must be avoided by the worker activities.
- Employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities;
- If any of the hunting activity is observed then the worker will be removed from the employment with immediate effect and legal action will be taken by forest department.
- There should be speed limit for the material carrying trucks/dumpers while traversing through the forest areas if at all. It is always better not to travel in the forest areas that would disturb the animal behaviour.
- Honking should be strictly prohibited in the forest area by the trucks and dumper used for the construction activity.
- No disposal of construction waste in the forest premises
- No earthen material or water from the springs present in the forest area will be used for the construction activity.
- Comply with environmental standards and strictly control workers to behave responsibly with respect to environmental issues;
- Site-specific waste collection and disposal management plan should be in place to, include good site practices such as: Providing the appropriate spill kits (e.g., containing

absorbent cloths and disposal containers) on-site during construction; Prohibition of dumping or burying wastes within Project site; Implementation of an on-going waste management program consisting of reduction, reuse, and recycling of materials.

- ❖ Work should be under ISO14001 accreditation for environmental management which also be imposed on all the subcontractors; and cover each spot where excavated material is stored when climate conditions require to effect dust control by usage of dust suppression substances.

5.6. UNDERPASSES FOR WILDLIFE MOVEMENT

Open- and closed-top tunnels have been used by snakes. Some snake species may have greater crossing success through open-top tunnels, while others may access road surfaces through the open top of the tunnel. Depending on the tunnel material and shape, lizards may be able to access the road surface through open-top tunnels.

There are 22 existing culverts in total with 17 pipe and 5 slab /arch culverts along the project stretch. The width of the existing culverts ranges from 7.4m to maximum of 12.5m. The height of the slab type existing culverts are 1.5 m. Now 12 additional box type culverts are recommended unded this proposal for movement of mammals, reptiles and amphibians. All the existing culverts which are in fair condition are proposed for widening without opening in the median portion. In general widening is proposed to match with the cross section of approach at the culvertlocation. The entire Slab culverts are proposed for widening as they are hydraulically adequateand structurally fair in condition in with course rubble masonry substructure and foundation isproposed for reconstruction with box culvert of equivalent or higher ventarea. New culverts with Boxtype, both with and without cushionare proposed depending upon the location, size, and finished road level (FRL) and invert level.

For wildlife movement, all pipe type are now reconstructed as Box model type. Out of which, for the movement of wild fauna such as Tigers, Leopards, Slothbears, Deers etc the height of the box types are ranges from 3m to 5 m and and width of the box type model

culvert ranges from 5m to 6m. Improvement Proposals of Culverts are given under annexure 8.1.

Fig: 5.7 A model tunnel for snakes, lizards and amphibian movement near highway.

6.PROJECT SPECIFIC MITIGATION PLAN WITH FINANCIAL OUTLAY

Chapter 6

6.1. MITIGATION MEASURES

Mitigation measures for the proposed road network evolved through a multi-step simultaneous process. We first evaluated the existing and proposed drainage and crossing structures on field, assessed the possibility of making the structures more suitable for wildlife movement and finally overlapped potential multi-taxa crossing zones to finalise the location and dimensions of the crossing structures.

The principal mitigation measure in the construction phase is strict application of standard specifications for erosion and sediment control, including routine inspections. The trees were cut are keeping at the minimum level by modifying alignments, eccentric and concentric widening. No construction vehicles are allowed to enter into the dense vegetation area. As per the study objectives, we studied impacts of the proposed project on direct habitat loss, barrier effect, disturbance leading to displacement of animal groups, collision risk in the study area by using appropriate standard methods.

The competent authority has the discretion to modify, add and delete any mitigation measure and financial plan during the time of issue of demand notice.

The details of the proposed mitigation measures are given below are for existing and proposed road network.

6.1.1. PLANTATION AND OTHER HABITAT IMPROVEMENT ACTIVITIES WITHIN THE FOREST AREAS.

a. Compensatory afforestation under supervisor of Forest department.

b. Maintenance of forest roads for monitoring and protection of wildlife and habitat.

6.1.2. DEVELOPMENT OF INFRASTRUCTURE

a. Underpasses shall be constructed at selected locations. The existing under passes must be maintained by NHAI contractor as per forest department suggestions.
b. Ramps / sloped pathway from rail level to natural forest in cutting portions suitably. As the work of Ramps and underpass bridges involves safety criteria due to running traffic, the construction of bridges to be done by NHAI under WL Mitigation plan duly showing the cost of such structures in Mitigation plan.

6.1.3. HABITAT ENRICHMENT WORKS

a. Water storage and retention structures and saucer pits shall be constructed to retain the rain water for summer season.
b. Automatic Solar water motors with borewell and storage pits
c. Tractors and tankers shall be purchased for filling water in saucer pits
d. Percolation tanks are to be developed Markapur division.
e. Solar based automatic water filling system will be placed for drinking purpose of wildlife.

6.1.4. WILDLIFE RESEARCH AND MONITORING WORKS

a. A wildlife monitoring station shall be established for further study on biodiversity of the region at Y.Palem.
b. Equipment for wildlife monitoring and research must be purchased for long-term monitoring aspects.
c. Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.

d. Experts on ecological aspects shall be appointed for studying the detailed mitigation plan. This work can be given to any reputed and experienced National, Regional level NGOs and Government organisations.

6.1.5. ROTECTION OF WILDLIFE

a) Mobile team for forest and wildlife protection during and after the project construction phase
b) Watch towers shall be constructed for wildlife monitoring with in the study area.
c) Fencing on the either side of the road shall be developed during construction phase.
d) Fire lines shall be created with 3M width within the reserve forest areas for 10 km length.

6.1.6. PUBLICITY AND AWARENESS

a. Publicity and awareness camps shall be conducted at local level.
b. Awareness among all the workers and contractors during project phase regularly.
c. 10 nos of Signage and boards to be placed at frequent intervals.

6.1.7. SPECIES SPECIFIC GENERAL MITIGATION MEASURES

a) Artificial saltlicks shall be arranged within the forest areas.
b) Wildlife alerting Alarm / sound systems near tunnels, cuttings, turnings etc.
c) Vehicle speed to be maintained and minimised as per norms.
d) Approach roads shall be constructed only near the project area.
e) For any work related for project, existing roads only to be utilised
f) Eco-friendly engineering practices shall be employed.
g) As and when required forest officials can conduct meetings with NHAI officials, contractors, workers, etc., and can inspect any project site, machinery, premises, etc.,
h) No waste of any kind / debris to be dumped in reserve forest area.

i) From time to time any conditions stipulated by forest officials for interest of wild life to be incorporated by contractors / user agency during construction phase.

6.2. FINANCIAL PLAN

Table: 6.1 Physical and Financial plan for the proposed project (Rs in Lakhs)

S.No	Particulars	Nos	Unit cost	Total amount (Rs in Lakhs)
1	Construction of Underpasses	6	25.00	150.00
2	Maintanance of Underpasses	6	LS	20.00
3	Conservation and Management of Langurs	LS	LS	10.00
4	Habitat improvement works in thre forest areas	LS	LS	20.00
5	Solar based automatic water filling system with borewell and storage pit	2	5.00	10,00
6	Establishing Salt licks	LS	4	4.00
7	Ramps / sloped pathway from road level to natural forest in cutting portions suitably	LS	LS	100.00
8	Detailed study to understand the long-term impact on wildlife due to expansion project	1 No	LS	25.00
9	Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.	3 times	2.00	6.00
10	Equipment for wildlife monitoring and research	LS	LS	10.00
11	Wildlife monitoring and interpretation centres at Y.PALEM	LS	LS	20.00
12	Fencing at selected locations	2 km	5.00	10.00
13	Percolation tanks	10 No	0.50	5.00
14	Water storage and retention structure / Saucer pits	10	LS	10.00

15	Automatic Solar water motors with borewell and storage pits	4	10.00	40.00
16	Tractor, tanker for filling water in saucer pits	3	12.00	36.00
17	Signage and boards	10	0.50	5.00
19	Publicity and Awareness camps	10	1.00	10.00
20	Fire lines creation	10 km	LS	5.00
21	Watch tower for wildlife monitoring	2 no	12.00	24.00
22	Maintenance of forest roads for monitoring and protection of wildlife and habitat	LS	LS	20.00
23	Mobile team for forest and wildlife protection during and after the project construction phase. The Mobile team should have minimum 10 protection watchers and monitoring needs to be done at least 15 years.	10 No	15 years@ 3 lakhs each	450.00
24	Overhead charges	LS	LS	10.00
	Grand total excluding the works to be executed by NHAI			**1000.00**

Assistant Executive Engineer (R&B)
N.H. Section : Narasaraopet

Deputy Executive Engineer (R&B)
N.H. Sub-Division, Guntur

Divisional Forest Office
(Wild Life) MARKAPUR

COUNTER SIGNED

Chief Conservator of Forests & Field Director
Project Tiger Circle, Srisailam

Prl. Chief Conservator of Forests (WL)
& Chief Wildlife Warden, A.P.

Table: 6.2 YEAR WISE FINANCIAL PLAN* (Rs. In Lakhs)

Year	1	2	3	4	5	6	7	8	9	10	Total
	2022-2023	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028	2028-2029	2029-2030	2030-2031	2031-2032	(Rs in Lakhs)
Construction of Underpass*	100	50	0	0	0	0	0	0	0	0	150.00
Maintanance of Underpasses*	2	2	2	2	2	2	2	2	2	2	20.00
Conservation and Management of Langurs	2	0	2	0	2	0	2	0	2	0	10.00
Habitat improvement works in thre forest areas	4	0	4	0	4	0	4	0	4	0	20.00
Solar based automatic water filling system with borewell and storage pit	0	5	0	5	0	0	0	0	0	0	10,00
Establishing Salt licks	1	0	1	0	1	0	1	0	0	0	4.00
Ramps / Sloped pathways	25	25	25	25	0	0	0	0	0	0	100.00
Detailed study to understand the long-term impact on wildlife due to expansion project	5	0	5	0	5	0	5	0	5	0	25.00
Ecological monitoring at a gap of every 4 to 5 years to understand the wildlife population and effectiveness of mitigation.	0	0	2	0	0	0	2	0	0	2	6.00
Equipment for wildlife monitoring and research	5	5	0	0	0	0	0	0	0	0	10.00
Wildlife monitoring and interpretation centre at Y.PALEM	20	0	0	0	0	0	0	0	0	0	20.00

Fencing at selected locations.	5	5	0	0	0	0	0	0	0	0	10.00
Percolation tanks	2	2	1	0	0	0	0	0	0	0	5.00
Water storage and retention structure / Saucer pits	0	0	0	4	3	3	0	0	0	0	10.00
Automatic Solar water motors with borewell and storage pits	10	0	10	0	10	0	10	0	0	0	40.00
Tractor, tanker for filling water in saucer pits	12	0	0	12	0	0	12	0	0	0	36.00
Signage and boards	1	1	1	1	1	0	0	0	0	0	5.00
Publicity and Awareness camps	1	1	1	1	1	1	1	1	1	1	10.00
Fire lines creation	1	1	1	1	1	0	0	0	0	0	5.00
Watch tower for wildlife monitoring	12	12	0	0	0	0	0	0	0	0	24.00
Maintenance of forest roads for monitoring and protection of wildlife and habitat	5	5	5	5	0	0	0	0	0	0	20.00
Mobile team for forest and wildlife protection during and after the project construction phase	45	45	45	45	45	45	45	45	45	45	450.00
Overhead charges	1	1	1	1	1	1	1	1	1	1	10.00
	259	**160**	**106**	**102**	**76**	**52**	**85**	**49**	**60**	**51**	**1000.00**

(Note: 1 & 2 User agency will execute the works with allocated funds)

Deputy Executive Engineer (R&B)
N.H. Sub-Division, Guntur

Assistant Executive Engineer (R&B)
N.H. Section : Narasaraopet

Divisional Forest Officer
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Pri. Chief Conservator of Forests (WL)
& Chief Wildlife Warden, A.P.

COUNTER SIGNED

Chief Conservator of Forests & Field Director
Project Tiger Circle, Srisailam

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8.ANNEXURES

Chapter 8

8.1. ANNEXURE 1

Table 8.1 a. List of proposed underpasses with location details. (GPS readings)

S No	GPS Reading		Existing Chainage (Km)	Design Chainage (Km)	Improvement Proposals					TCS	Proposed Width (m)
	Latitude	Longitude			Improvement Proposals	Type	No. of Vents	Clear span (m)	Clear Height (m)		
1	$16^0$15' 32.735"	$73^0$18'20.097"	-	136+319	New Construction	Box	1	5.0	3.0	TCS - 6&6A	13.3
2	16^0 13' 38.008"	$73^0$17' 56.757"	-	140+700	New Construction	Box	1	6.0	3.0	TCS - 6&6A	13.3
3	16^0 12' 43.624"	73^0 17' 38.384"	143/148	142+518	Reconstruction	Box	1	5.0	6.0	TCS - 6&6A	13.3
4	$16^0$11' 36.576"	$73^0$17' 18.587"	-	144+750	New Construction	Box	1	5.0	3.0	TCS - 6&6A	13.3
5	$16^0$10' 35.597"	$73^0$17' 33.146"	-	146+781	New Construction	Box	1	5.0	3.0	TCS - 2	15
6	16º 8' 36.101"	73º 19' 53.843"	-	153+285	New Construction	Box	1	5.0	3.0	TCS - 5&5A	13.25

Table 8.1 b List of improvement of exiting underpasses

S No	Existing Chainage (Km)	Design Chainage (Km)	Existing Structure Details				Improvement Proposals					TCS	Proposed Width (m)	Remarks
			Type	No of cells	Dia/span	width of structure	Improvement Proposals	Type	No. of Vents	Clear span (m)	Clear Height (m)			
1	136/092	135+991	Pipe	1	0.7	7.6	Reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
2	-	137+100	-	-	-	-	New Construction	Box	1	1.5	1.5	TCS - 1	15	-
3	140/130	139+954	Pipe	1	0.7	7.6	Reconstruction	Box	1	1.5	1.5	TCS - 4	13.25	-
4	141/477	140+917	Pipe	1	0.7	7.6	reconstruction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
5	142/137	141+574	Pipe	1	0.8	9	reconstruction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
6	-	142+035	-	-	-	-	New Construction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
7	-	142+234	-	-	-	-	New Construction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
8	143/364	142+730	Pipe	1	0.6	7.6	reconstruction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
9	143/814	143+181	Pipe	1	0.7	7.8	reconstruction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-

S No	Existing Chainage (Km)	Design Chainage (Km)	Existing Structure Details				Improvement Proposals					TCS	Proposed Width (m)	Remarks
			Type	No of cells	Dia/span	width of structure	Improvement Proposals	Type	No. of Vents	Clear span (m)	Clear Height (m)			
10	144/312	143+607	Pipe	1	0.9	7.6	reconstruction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
11	-	143+782	-	-	-	-	New Construction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
12	-	144+583	-	-	-	-	New Construction	Box	1	1.5	1.5	TCS - 6&6A	13.3	-
13	145/804	144+921	Pipe	1	0.7	7.6	reconstruction	Box	1	1.5	1.5	TCS - 3	14	-
14	146/225	145+382	Pipe	1	0.8	7.4	reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
15	146/604	145+732	Pipe	1	0.9	7.4	reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
16	-	146+343	-	-	-	-	New Construction	Box	1	2	1.5	TCS - 2	15	-
17	-	146+526	-	-	-	-	New Construction	Box	1	4	1.5	TCS - 2	15	-
18	149/405	148+442	Pipe	1	0.8	10	Reconstruction	Box	1	1.5	1.5	TCS - 5&5A	13.25	-
19	149/566	148+603	Pipe	1	0.7	7.9	reconstruction	Box	1	1.5	1.5	TCS - 5&5A	13.25	-

S No	Existing Chainage (Km)	Design Chainage (Km)	Existing Structure Details				Improvement Proposals					TCS	Proposed Width (m)	Remarks
			Type	No of cells	Dia/span	width of structure	Improvement Proposals	Type	No. of Vents	Clear span (m)	Clear Height (m)			
20	149/752	148+792	Slab	1	1	7.9	Reconstruction	Box	1	1.5	1.5	TCS - 5&5A	13.25	-
21	150/408	149+429	Pipe	1	0.8	17.4	reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
22	151/056	150+073	Slab	1	1	12	reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
23	151/346	150+365	Pipe	NV	-	7.6	reconstruction	Box	1	1.5	1.5	TCS - 3	14	-
24	151/605	150+623	Slab	1	1	12.1	reconstruction	Box	1	1.5	1.5	TCS - 1	15	-
25	152/577	151+595	Slab	1	4	7.9	reconstruction	Box	1	4	1.5	TCS - 1	15	-
26	153/709	152+717	Pipe	1	0.7	7.6	reconstruction	Box	1	1.5	1.5	TCS - 5&5A	13.25	-
27	153/789	152+797	Pipe	1	0.7	7.25	reconstruction	Box	1	1.5	1.5	TCS – 5	13.25	-
28	153/931	152+939	Pipe	2	1	7.6	reconstruction	Box	1	1.5	1.5	TCS - 5&5A	13.25	-

8.2. ANNUXURE -2 (LIST OF FLORA)

S.No.	Botanical Name	Common name	Family	Habit
1	*Acacia auriculiformis* Benth.	Australia thumma	Leguminosae	Tree
2	*Acacia chundra* (Rottler)Willd.	Sandra tree	Mimosaceae	Tree
3	*Acacia leucophloea* (Roxb.)	Tella thumma	Leguminosae	Tree
4	*Acacia nilotica* (L.) Delile	Nalla thumma	Leguminosae	Tree
5	*Acrocarpus fraxinifolius*	Galivana chettu	Fabaceae	Tree
6	*Adina cordifilia*	Bandaru	Rubiaceae	Tree
7	*Aegle marmelos* (L.) Corrêa	Velaga	Rutaceae	Tree
8	*Ailanthus excelsa* Roxb.	Pedda manu	Simaroubaceae	Tree
9	*Alangium salviifolium* (L.f.) Wangerin	Vuduga chettu	Cornaceae	Tree
10	*Albizia amara* (Roxb.) B.Boivin	Konda sigara	Leguminosae	Tree
11	*Albizia odoratissima*	Ganara	Mimosaceae	Tree
12	*Albizia lebbeck* (L.) Benth.	Dirisanam	Leguminosae	Tree
13	*Alstonia scholaris* R.BR.	Edakula pala	Apocynaceae	Tree
14	*Angeissus latifolia*	Vellama	Combretaceae	Tree
15	*Annona reticulata*	Ramaphalam	Annonaceae	Tree
16	*Annona squamosa*	Seethaphalam	Annonaceae	Tree
17	*Atalantia monophylla*	Karunimma	Rutaceae	Tree
18	*Azadirachta indica* A.Juss.	Vepa	Meliaceae	Tree
19	*Balanites aegyptiaca* Delile.	Gara	Zygophyllaceae	Tree
20	*Bauhinia purpurea* L.	Bodhanta	Leguminosae	Tree
21	*Bauhinia racemosa*	Are	fabaceae	Tree
22	*Borassus flabellifer* L.	Thadi chettu	Arecaceae	Tree
23	*Bridelia monoica*	Tella balli	Euphorbiaceae	Tree
24	*Bridelia retusa*	Anem	Euphorbiaceae	Tree
25	*Buchanania lanzan*	Jarumamidi	Anacardiaceae	Tree
26	*Butea monosperma* (Lam.) Taub.	Modhuga	Leguminosae	Tree
27	*Calophyllum inophyllum*	Pagada	Calophyllaceae	Tree
28	*Canthium dicoccum*	Noorillu	Rubiaceae	Tree
29	*Careya arborea*	Kumbi	Lecethydaceae	Tree
30	*Cassia fistula* L.	Rela	Leguminosae	Tree
31	*Cassia montana*	Konda tangedu	Caesalpinaceae	Tree
32	*Cassia siamea* Lam.	Seema thangedu	Leguminosae	Tree
33	*Cassine glauca* (Rottb.) Kuntze	Nirija	Celastraceae	Tree
34	*Casuarina equisetifolia*	Sarugudu	Casurinaceae	Tree
35	*Ceiba pentandra* (L.) Gaertn	Tella buruga	Malvaceae	Tree
36	*Chloroxylon swietenia*	Billudu	Meliaceae	Tree
37	*Chukrasia tabularis* A.Juss.	Konda vepa	Meliaceae	Tree
38	*Cinchona orixense*	Potaka	Rubiaceae	Tree
39	*Citrus limon* (L.) Burm. f.	Nimma	Rutaceae	Tree
40	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f.	Vadisaku	Euphorbiaceae	Tree
41	*Cochlospermum religiosum (L.) Alston*	Kondagogu	Bixaceae	Tree
42	*Cocos nucifera* L.	Kobbari	Arecaceae	Tree
43	*Dalbergia lanceolaria* L.f.	Yerrapatsaru	Leguminosae	Tree

44	*Dalbergia latifolia* Roxb.	Jiteegi	Leguminosae	Tree
45	*Dalbergia paniculata* L.f.	Pachari	Leguminosae	Tree
46	*Dalbergia sissoo* DC.	Sisu	Leguminosae	Tree
47	*Delonix regia* (Hook.) Raf.	Chittikesaram	Leguminosae	Tree
48	*Dendrocalamus strictus*(Roxb.) Nees	Sanna vedru	Graminae	Tree
49	*Dichrostachys cinerea*	Velthuru	Mimosaceae	Tree
50	*Diospyros ferrea*	Pisineka	Ebenaceae	Tree
51	*Diospyros sylvatica*	Gatha	Ebenaceae	Tree
52	*Diospyros melanoxylon* Roxb	Tunki	Ebenaceae	Tree
53	*Ehretia Leavis*	Gidugu	Boraginaceae	Tree
54	*Eucalyptus citriodora* Hook.	Lemon scented gum	Myrtaceae	Tree
55	*Eucalyptus tereticornis*	Nelagiri	Myrtaceae	Tree
56	*Ficus benghalensis* L.	Marri	Moraceae	Tree
57	*Ficus hispida* L.f.	Medipandu,Bemmedu akulu	Moraceae	Tree
58	*Ficus mollis*	Juvvi	Moraceae	Tree
59	*Ficus racemosa*	Medi	Moraceae	Tree
60	*Ficus religiosa* L.	Ravi	Moraceae	Tree
61	*Gardenia turgida*	Peddabikki	Rubiaceae	Tree
62	*Garuga pinnata*	Garuga	Burseraceae	Tree
63	*Givotia moluccana*	tella poliki	Euphorbiaceae	Tree
64	*Gmelina arborea*	Konda gummidi	Verbenaceae	Tree
65	*Grevia tilifolia*	Tada	Tiliaceae	Tree
66	*Grevillea robusta*	Silver oak	Protiaceae	Tree
67	*Haldinia cordifolia*	Pasupu-kadamba	Rubiaceae	Tree
68	*Hardwickia binata*	Yepi, Narayepi	Leguminosae	Tree
69	*Holarrhena pubescens*	Tedlapala	Apocynaceae	Tree
70	*Holoptelea integrifolia* Roxb.	Nemalinara	Ulmaceae	Tree
71	*Hymenodictyon orixense*	Bandaaru-chettu	Rubiaceae	Tree
72	*Ixora arborea*	Koravi	Rubiaceae	Tree
73	*Ixora parviflora*	Puttapala	Rubiaceae	Tree
74	*Kydia calycina*	Konda patti	Malvaceae	Tree
75	*Lagerstroemia parviflora*	Chennagi	Lythraceae	Tree
76	*Lannea coromandelica* (Houtt.) Merr.	Gumpena	Anacardiaceae	Tree
77	*Leucaena leucocephala* (Lam.) de Wit	Jabarichettu	Leguminosae	Tree
78	*Litsea glutinosa*	Naramamidi	Annonaceae	Tree
79	*Madhuca longifolia*	Ippa	Sapotaceae	Tree
80	*Mallotus philippensis*	Kunkuma	Euphorbiaceae	Tree
81	*Mangifera indica* L.	Mamidi	Anacardiaceae	Tree
82	*Manilkara hexandra*	Pala	Sapotaceae	Tree
83	*Melia azedarach*	Turka Vepa	Meliaceae	Tree
84	*Melia dubia*	Munnatikaaraka	Meliaceae	Tree
85	*Millettia pinnata* (L.) Panigrahi	Adivi ganuga	Leguminosae	Tree
86	*Mitragyna parvifolia* (Roxb.) Korth.	Nerkadamba	Rubiaceae	Tree
87	*Morinda pubescens*	Togaramogali	Moraceae	Tree
88	*Morinda tinctoria* Roxb.	Maddichettu	Rubiaceae	Tree
89	*Mundulea sericea*	Tella bitlu	fabaceae	Tree
90	*Murraya paniculata*	Gulimi	Rutaceae	Tree
91	*Naringi crenulata*	Korivelaga	Rutaceae	Tree

92	*Nyctanthes arbor-tristis* L.	Parijatham	Oleaceae	Tree
93	*Ochna obtusa*	Tammi	Ochnaceae	Tree
94	*Pavetta indica* L.	Lakkapapidi	Rubiaceae	Tree
95	*Peltophorum pterocarpum* (DC.) K.Heyne	Kondachintha	Leguminosae	Tree
96	*Phoenix sylvestris* (L.) Roxb.	Eethachettu	Arecaceae	Tree
97	*Phyllanthus acidus*	Racha usiri	Phyllanthaceae	Tree
98	*Phyllanthus emblica* L.	Usiri	Phyllanthaceae	Tree
99	*Pithecellobium dulce* (Roxb.) Benth.	Sima chinta	Leguminosae	Tree
100	*Prosopis chilensis* (Molina) Stuntz.	Mulla thumma	Leguminosae	Tree
101	*Prosopis juliflora*(Sw.) DC.	English tumma	Mimosaceae	Tree
102	*Protium serratum*	Unduruka	Burseraceae	Tree
103	*Pterocarpus marsupium*	Yegisa	fabaceae	Tree
104	*Pterospermum xylocarpum*	Loluga	Malvaceae	Tree
105	*Samanea saman* (Jacq.) Merr.	Nidraganeeru	Sapindaceae	Tree
106	*Sapindus emarginata*	Kunkudu	Sapindaceae	Tree
107	*Schrebera swietenioides*	Esuka rasi	Oleaceae	Tree
108	*Sclechera oleosa*	Busi	Annonaceae	Tree
109	*Semecarpus anacardium*	Nalla jeedi	Anacardiaceae	Tree
110	*Sterculia urens*	Thapsi	Sterculiaceae	Tree
111	*Stereospermum personatum*(Hassk.)	Ambuvasini	Bignoniaceae	Tree
112	*Streblus asper*	Barrenka	Moraceae	Tree
113	*Strychnos nux-vomica*	Mushini	Loganiaceae	Tree
114	*Strychnos potatorum*	Induga	Loganiaceae	Tree
115	*Syzygium cumini* (L.) Skeels	Neredu	Myrtaceae	Tree
116	*Tamarindus indica* L.	Chintha	Leguminosae	Tree
117	*Tectona grandis* L.f.	Teak	Lamiaceae	Tree
118	*Terminalia alata*	Nallamaddi	Combretaceae	Tree
119	*Terminalia bellirica*	Thani	Combretaceae	Tree
120	*Terminalia catappa* L.	Badham	Combretaceae	Tree
121	*Terminalia chebula*	Karaka	Combretaceae	Tree
122	*Thespecia populnea*	Ganga Raavi	Malvaceae	Tree
123	*Thevetia neriifolia*	Pacha ganneru	Apocynaceae	Tree
124	*Vitex negundo* L.	Vavili	Lamiaceae	Tree
125	*Wrightia arborea*	Adaviankudu	Apocynaceae	Tree
126	*Wrightia tinctoria* (Roxb.) R.Br.,	Palakodisa	Apocynaceae	Tree
127	*Xylia xylocarpa* Roxb	Konda thangedu	Leguminosae	Tree
128	*Ziziphus mauritiana* Lam.	Reni	Rhamnaceae	Tree
129	*Ziziphus xylopyrus*	Gotti	Rhamnaceae	Tree
130	*Desmodium pulchellum*	Kuradia gachha	Fabaceae	Shurb
131	*Desmodium velutinum*	Gitanaramu	Fabaceae	Shurb
132	*Grewia rothii*	Miri Chara	Malvaceae	Shurb
133	*Grewia hirsuta*	Chimachipuru	Tiliaceae	Shurb
134	*Helicteres isora*	Guvardara	Sterculiaceae	Shurb
135	*Leea asiatica*	Amkador	Vitaceae	Shurb
136	*Woodfordia fruticosa*	Jargi	Lythraceae	Shurb
137	*Abutilon indicum* (L.) Sweet	Thutturubenda	Malvaceae	Shrub
138	*Agave americana* L.	Gitta nara	Asparagaceae	Shrub
139	*Caesalpinia bonduc* (L.) Roxb.	Gacha podha	Leguminosae	Shrub
140	*Caesalpinia pulcherrima* (L.) Sw.	Rathna gandhi	Leguminosae	Shrub

141	*Calotropis gigantea* (L.) Dryand.	Tella jilledu	Apocynaceae	Shrub
142	*Calotropis procera* (Aiton) Dryand.	Erra jilledu	Apocynaceae	Shrub
143	*Capparis zeylanica* L.	Aru donda	Capparaceae	Shrub
144	*Caralluma umbellata* Roxb.	Kundeti kommulu	Apocynaceae	Shrub
145	*Carissa carandas* L.	Kalvi	Apocynaceae	Shrub
146	*Catunaregam spinosa* (Thunb.) Tirveng.	Manga	Rubiaceae	Shrub
147	*Clerodendrum phlomidis* L.f.	Kond-takal	Lamiaceae	Shrub
148	*Datura stramonium* L.	Ummetha	Solanaceae	Shrub
149	*Erythroxylum monogynum* Roxb.	Dedaraaku	Erythroxylaceae	Shrub
150	*Euphorbia cactus*	Jemudu	Euphorbiaceae	Shrub
151	*Euphorbia tirucalli* L.	Tirukalli	Euphorbiaceae	Shrub
152	*Grewia hirsuta* Vahl.	Jaani Chettu	Tiliaceae	Shrub
153	*Grewia flavescens* Juss.	Jana	Malvaceae	Shrub
154	*Hyptis suaveolens* (L.) Poit.	Danthitulasi	Lamiaceae	Shrub
155	*Ipomoea carnea* Jacq.	Rubber mokka	Convolvulaceae	Shrub
156	*Jasminum angustifolium* Vahl.	Adavi malli	Oleaceae	Shrub
157	*Jasminum roxburghianum* Wall. ex C.B.Clarke	Garuda malli	Oleaceae	Shrub
158	*Lantana camara* L.	Pulikampa	Verbenaceae	Shrub
159	*Leonotis nepetifolia* (L.) R.Br.	Rana bheri	Lamiaceae	Shrub
160	*Opuntia dillenii* (Ker Gawl.) Haw.	Naga jamudu	Cactaceae	Shrub
161	*Phoenix acaulis* Roxb.	Chitteetha	Palmae	Shrub
162	*Senna auriculata* (L.) Roxb.	Tangedu	Leguminosae	Shrub
163	*Senna occidentalis* (L.) Link	Kasintha	Leguminosae	Shrub
164	*Solanum pubescens*.Willd.	Uchintha	Solanaceae	Shrub
165	*Solanum surattense* Burm. f.	Nela vakudu	Solanaceae	Shrub
166	*Xanthium strumarium*L.	Marula-Mathangi	Asteraceae	Shrub
167	*Ziziphus oenopolia* (L.) Mill.	Pariki	Rhamnaceae	Shrub
168	*Azolla pinnata subsp.* africana (Desv.)	Mosquito fern	Salviniaceae	Hydrophyte
169	*Eichornia crassipes* Solms.	Gurrapu dekka	Pontederiaceae	Hydrophyte
170	*Ipomoea aquatica* Forssk.	Thooti Koora	Convolvulaceae	Hydrophyte
171	*Lemna minor* Hegelm.	Duck Weed	Araceae	Hydrophyte
172	*Marsilea quadrifolia* L.	Araa koora	Marsileaceae	Hydrophyte
173	*Nelumbo nucifera* Gaertn.	Indian Lotus	Nelumbonaceae	Hydrophyte
174	*Typha angustata* L.	Jammu	Typhaceae	Hydrophyte
175	*Vallisneria spiralis* L.	Punatsu	Hydrocharitaceae	Hydrophyte
176	*Acalypha indica* L.	Muripindi	Euphorbiaceae	Herb
177	*Achyranthes aspera* L.	Uttareni	Amaranthaceae	Herb
178	*Aerva lanata* (L.) Juss	Thelaga pindi	Amaranthaceae	Herb
179	*Aeschynomene aspera* L	Neeti jeeluga	Leguminosae	Herb
180	*Ageratum conyzoides* (L.) L.	Vasavi	Asteraceae	Herb
181	*Aloe vera* (L.) Burm.f.	Kithanara	Tiliaceae	Herb
182	*Alternanthera sessilis* (L.) R.Br. ex DC.	Ponagantiaku	Amaranthaceae	Herb
183	*Amaranthus spinosus* L.	Mulla thotakoora	Amaranthaceae	Herb
184	*Amaranthus viridis* L.	Chilakathotakoora	Amaranthaceae	Herb
185	*Argemone mexicana* L.	Brahmadandi	Papaveraceae	Herb
186	*Barleria prionitis* L.	Pachagorinta	Acanthaceae	Herb
187	*Blumea mollis* (D. Don) Merr.	Kukkapogaku	Asteraceae	Herb
188	*Boerhavia diffusa* L.	Atikimamidi	Nyctaginaceae	Herb

189	*Borreria hispida* Spruce ex K.Schum.	Madana	Rubiaceae	Herb
190	*Catharanthus roseus* (L.) G.Don	Billaganneru	Apocynaceae	Herb
191	*Celosia virgata* Jacq.	Guruga	Amaranthaceae	Herb
192	*Cleome viscosa* L.	Kukka vomintha	Cleomaceae	Herb
193	*Crotalaria juncea* L.	Janumu	Leguminosae	Herb
194	*Croton bonplandianus* Baill.	Vana mokka	Euphorbiaceae	Herb
195	*Eclipta alba* (L.) Hassk.	Guntagalagara	Asteraceae	Herb
196	*Euphorbia hirta* L.	Nanubalu	Euphorbiaceae	Herb
197	*Evolvulus alsinoides* (L.) L	Vishnukrantha	Convolvulaceae	Herb
198	*Fimbristylis cymosa* R.Br.	Pulupu gaddi	Cyperaceae	Herb
199	*Gomphrena serrata* L.	Tella bendumalli	Amaranthaceae	Herb
200	*Hygrophila auriculata* (Schumach.) Heine	Mundla gobbi	Acanthaceae	Herb
201	*Indigofera hirsuta* L.	Kolapattitulu	Leguminosae	Herb
202	*Indigofera linnaei* Ali	Chalapachi	Leguminosae	Herb
203	*Justicia procumbens* L.	Water Willow	Acanthaceae	Herb
204	*Leucas aspera* (Willd.) Link	Tummi	Lamiaceae	Herb
205	*Ludwigia perennis* L.	Lavangakaya mokka	Onagraceae	Herb
206	*Mimosa pudica* L.	Atthi pathi	Leguminosae	Herb
207	*Mollugo cerviana* (L.) Ser.	Threadstem carpetweed	Molluginaceae	Herb
208	*Ocimum canum* Sims.	Kukka Tulasi	Lamiaceae	Herb
209	*Oldenlandia umbellata* L.	Chiru veru	Rubiaceae	Herb
210	*Oxalis corniculata* L.	Indian Sorrel	Oxalidaceae	Herb
211	*Parthenium hysterophorus* L.	Vayyaribhama	Asteraceae	Herb
212	*Pavonia zeylanica* Cav.	Karubenda	Malvaceae	Herb
213	*Phyllanthus amanus*	Nela Usiri	Euphorbiaceae	Herb
214	*Phyllanthus maderaspatensis* L.	Nalla Usirika	Phyllanthaceae	Herb
215	*Plumbago zeylanica* L.	Agnimaata	Plumbaginaceae	Herb
216	*Portulaca oleracea* L.	Pappu Kura	Portulacaceae	Herb
217	*Ruellia tuberosa L.*	Jurbula gadda	Acanthaceae	Herb
218	*Scoparia dulcis* L.	Potti boli	Plantaginaceae	Herb
219	*Sesuvium portulacastrum* (L.) L.	Thikka Kura	Aizoaceae	Herb
220	*Sida acuta* Burm.f.	Medabirusaku	Malvaceae	Herb
221	*Sida cordifolia* L.	Chiru Benda	Malvaceae	Herb
222	*Sida spinosa* L.	Naga bala	Malvaceae	Herb
223	*Sonchus oleraceus* (L.) L.	Ratrinta	Compositae	Herb
224	*Sphaeranthus indicus* L.	Bodasaramu	Asteraceae	Herb
225	*Tephrosia purpurea* (L.) Pers.	Vempali	Leguminosae	Herb
226	*Trianthema portulacastrum* L.	kadaraku	Aizoaceae	Herb
227	*Tribulus terrestris* L.	Cinnpalleru	Zygophyllaceae	Herb
228	*Tridax procumbens* (L.) L.	Gaddichamanthi	Asteraceae	Herb
229	*Triumfetta pentandra* A.Rich.	Chirusitrika	Malvaceae	Herb
230	*Urena lobata* L.	Pedda benda	Malvaceae	Herb
231	*Vanda tessellata*	Kodikalla chettu	Orchidaceae	Herb
232	*Vernonia cinerea* (L.) Less.	Sahadevi	Compositae	Herb
233	*Waltheria indica* L.	Nalla Benda	Malvaceae	Herb
234	*Ziziphus nummularia* (Burm.f.) Wight & Arn.	Nela regu	Rhamnaceae	Herb
235	*Apluda mutica* L.f.	Mauritian grass	Poaceae	Grass
236	*Aristida hystrix* L.f.	Threeawn Grass	Poaceae	Grass

237	*Brachiaria eruciformis*	Mauritius signal grass	Poaceae	Grass
238	*Chloris barbata*	Uppu Gaddi	Poaceae	Grass
239	*Chloris virgata* Sw.	feather fingergrass	Poaceae	Grass
240	*Cymbopogon citratus*	Lemon grass	Poaceae	Grass
241	*Cynodon dactylon* (L.) Pers.	Bermuda grass	Poaceae	Grass
242	*Cyperus castaneus*	Black flatsedge	Poaceae	Grass
243	*Cyperus flavidus*	Rice flat sedge	Cyperaceae	Grass
244	*Cyperus rotundus* L.	coco-grass	Cyperaceae	Grass
245	*Digitaria ciliaris*	Southern crabgrass	Poaceae	Grass
246	*Eragrostis tenella* (L.) P.Beauv.ex Roem.& Schult.	Love grass	Poaceae	Grass
247	*Heteropogon contortus* (L.)	Black speargrass	Poaceae	Grass
248	*Abrus precatorius* L.	Gurivinda	Leguminosae	Climber
249	*Ampelocissus latifolia*	Adavi Draksha	Vitaceae	Climber
250	*Ampelocissus tomentosa*	Adavi Draksha	Vitaceae	Climber
251	*Asparagus racemosus* Willd.	Pilli Gaddalu	Asparagaceae	Climber
252	*Cayratia pedata*	Gummadi teega	Vitaceae	Climber
253	*Cissus quadrangularis* L.	Nalleru	Vitaceae	Climber
254	*Clitoria ternatea* L.	Sanku-Pushpamu	Leguminosae	Climber
255	*Cocculus hirsutus*	Cheepuru theega	Menispermaceae	Climber
256	*Combretum albidum*	Bandi kattu teega	Combretaceae	Climber
257	*Cryptolepis buchananii*	Adavipala teega	Apocynaceae	Climber
258	*Cuscuta reflexa* Roxb.	Sitamma pogunalu	Convolvulaceae	Climber
259	*Derris scandens*	Nalla Teega	Fabaceae	Climber
260	*Dioscorea pentaphylla* L.	Adavi gunusuthega	Dioscoreaceae	Climber
261	*Gymnema sylvestre*	Podapatri	Asclepiadaceae	Climber
262	*Ipomoea macrantha* Roem. & Schult.	Fence Morning glory	Convolvulaceae	Climber
263	*Ipomoea nil* (L.) Roth.	Kolli Vittulu	Convolvulaceae	Climber
264	*Ipomoea obscura* (L.) Ker Gawl.	Golla jiddu aku	Convolvulaceae	Climber
265	*Jasminum auriculatum*	Banamallika	Oleaceae	Climber
266	*Merremia tridentata* (L.) Hallier f.	Seethamma jada	Convolvulaceae	Climber
267	*Mucuna pruriens (*L.) DC.	Dulagondi	Leguminosae	Climber
268	*Olax scandens*	Turakavepa	Olacaceae	Climber
269	*Passiflora edulis* Sims.	Fashion fruit	Passifloraceae	Climber
270	*Pergularia daemia* (Forssk.) Chiov.	Dustapu-Teega	Apocynaceae	Climber
271	*Rivea hypocrateriformis* Choisy.	Bodditeega	Convolvulaceae	Climber
272	*Tinospora cordifolia* (Willd.) Miers.	Tippa teega	Menispermaceae	Climber
273	*Ventilago maderaspatana*	Surugudu	Rhamnaceae	Climber
274	*Wattakaka volubilis*	Dudipalatiga	Asclepiadaceae	Climber

8.3. ANNUXURE –3 (LIST OF FAUNA)

8.3.1. MAMMALS

S.No.	Scientific Name	Common Name	WPA Status	IUCN
1	*Panthera tigris*	Tiger	Part I of Schedule I	EN
2	*Panthera pardus*	Leopard	Part I of Schedule I	EN
3	Melursus ursinus	Sloth bear	Part I of Schedule I	VU
4	*Hyaena hyaena*	Hyena	Schedule III	NT
5	*Hystrix indica*	Porcupine	Schedule IV	LC
6	*Sus scrofa*	Wild pig	Schedule III	LC
7	*Felis chaus*	Jungle cat	Schedule II	LC
8	*Viverricula indica*	Civet Cat	Schedule II	LC
9	*Cuon alpinus*	Wild Dog	Schedule II	EN
10	*Paradoxurus hermaphroditus*	Palm Civet	Schedule II	LC
11	*Semnopithecus entellus*	Deccan Hanuman Langur	Part-II of Sch-II	LC
12	*Macaca mulatta*	Macaque Rhesus	Part-I of Sch-II	LC
13	*Herpestes edwardsii*	Indian grey Mongoose	Part II of Schedule II	LC
14	*Axis axis*	Spotted Deer	Schedule III	LC
15	*Cervus unicolor*	Sambar	Schedule III	VU
16	*Boselaphus tragocamelus*	Nilgai	Schedule III	LC
17	*Bendicota bengalensis*	Indian mole rat	Schedule V	LC
18	*Mus musculus*	House Mouse	Schedule V	LC
19	*Ananthana ellioti*	Tree shrew	Schedule V	LC
20	*Rattus rattus*	House rat	Schedule V	LC
21	*Bendicota indica*	Bandicoot rat	Schedule V	LC
22	*Mus booduga*	Little Indian Field mouse	Schedule V	LC
23	*Cynopterus sphinx*	Short-Nosed Fruit Bat	Schedule V	LC
24	*Rousettus leschenaulti*	Fruit bat	Schedule V	NT
25	*Pipistrellus coromandra*	Indian Pipistrelle	Schedule V	LC
26	*Rhinopoma hardwickii*	Lesser Mouse-Tailed Bat	Schedule V	LC
27	*Lepus nigricollis*	Black-naped Hare	Schedule IV	LC
28	*Funambulus palmarum*	Three striped palm squirrel	Schedule IV	LC

8.3.2. AVES

Scientific Name	*Common Name*	*IUCN Status*	*IWPA (1972) Status*
Phalacrocorax niger	*Little cormorant*	*LC*	*Sch-IV*
Ardea cinerea	*Grey heron*	*LC*	*Sch-IV*
Ardeola grayii	*Pond heron*	*LC*	*Sch-IV*

Scientific Name	*Common Name*	*IUCN Status*	*IWPA (1972) Status*
Bubulcus ibis	*Cattle egret*	*LC*	*Sch-IV*
Egretta garzetta	*Little egret*	*LC*	*Sch-IV*
Ixobrychus cinnamomeus	*Chestnut bittern*	*LC*	*Sch-IV*
Pseudibis papillosa	*Black ibis*	*LC*	*Sch-IV*
Porphyrio porphyrio	*Purple moorhen*	*LC*	*Sch-IV*
Pavo cristatus	*Indian Peafowl*	*LC*	*Sch-I*
Fulica atra	*Coot*	*LC*	*Sch-IV*
Vanellus indicus	*Red wattled lapwing*	*LC*	*Sch-IV*
Strptopelia chinensis	*Spotted dove*	*LC*	*Sch-IV*
Psittacula cyanocepahala	*Blossomheaded parakeet*	*LC*	*Sch-IV*
Eudynamis scolopacea	*Koel*	*LC*	*Sch-IV*
Athene brama	*Spotted owlet*	*LC*	*Sch-IV*
Apus affinis	*House swift*	*LC*	*Sch-IV*
Cypsiurus parvus	*Palm swift*	*LC*	*Sch-IV*
Ceryle rudis	*Lesser Pied kingfisher*	*LC*	*Sch-IV*
Merops leschenaultii	*Chestnutheaded bee-eater*	*LC*	*Sch-IV*
Merops philippinus	*Blue tailed bee-eater*	*LC*	*Sch-IV*
Merops orientalis	*Small green bee-eater*	*LC*	*Sch-IV*
Coracias benghalensis	*Indian roller*	*LC*	*Sch-IV*
Megalaima viridis	*Small green barbet*	*LC*	*Sch-IV*
Megalaima haemacephala	*Crimson breasted barbet*	*LC*	*Sch-IV*
Pitta brachyura	*Indian pitta*	*LC*	*Sch-IV*
Ermeopterix grisea	*Ashycrowned finch-lark*	*LC*	*Sch-IV*
Hirundo concolor	*Dusky crag martin*	*LC*	*Sch-IV*
Hirundo rustica	*Eastern swallow*	*LC*	*Sch-IV*
Dicrurus adsimilis	*Black drongo*	*LC*	*Sch-IV*
Dicrurus caerulescens	*Whitebellied drongo*	*LC*	*Sch-IV*
Dicrurus paradiseus	*Greater racket-tailed drongo*	*LC*	*Sch-IV*
Artamus fuscus	*Ashy swallow-shrike*	*LC*	*Sch-IV*
Sturnus malabaricus	*Greyheaded myna*	*LC*	*Sch-IV*
Sturnus pagodarum	*Brahminy myna*	*LC*	*Sch-IV*
Acridotheres tristis	*Common myna*	*LC*	*Sch-IV*
Corvus splendens	*House crow*	*LC*	*Sch-IV*
Corvus macrorhynchos	*Jungle crow*	*LC*	*Sch-IV*
Pericrocotus cinnamomeus	*Small minivet*	*LC*	*Sch-IV*
Pycnonotus cafer	*Redvented bulbul*	*LC*	*Sch-IV*
Turdoides affinis	*Whiteheaded babbler*	*LC*	*Sch-IV*
Copsychus saularis	*Magpie-Robin*	*LC*	*Sch-IV*
Saxicoloides fulicata	*Indian robin*	*LC*	*Sch-IV*

Scientific Name	*Common Name*	*IUCN Status*	*IWPA (1972) Status*
Monticola solitarius	*Blue rock thrush*	*LC*	*Sch-IV*
Zoothera citrina	*White-throated ground thrush*	*LC*	*Sch-IV*
Turdus merula	*Blackbird*	*LC*	*Sch-IV*
Parus major	*Grey tit*	*LC*	*Sch-IV*
Parus xanthogenys	*Yellowcheeked tit*	*LC*	*Sch-IV*
Anthus hodgsoni	*Indian tree pipit*	*LC*	*Sch-IV*
Anthus trivialis	*Tree pipit*	*LC*	*Sch-IV*
Motacilla flava	*Yellow wagtail*	*LC*	*Sch-IV*
Dicaeum agile	*Thickbilled flowerpecker*	*LC*	*Sch-IV*
Dicaeum erythrorhynchos	*Tickell's flowerpecker*	*LC*	*Sch-IV*
Nectarinia zeylonica	*Purplerumped sunbird*	*LC*	*Sch-IV*
Nectarinia asiatica	*Purple sunbird*	*LC*	*Sch-IV*
Zosterops palpebrosa	*White-eye*	*LC*	*Sch-IV*
Passer domesticus	*House sparrow*	*LC*	*Sch-IV*
Ploceus philippinus	*Baya*	*LC*	*Sch-IV*
Ploceus manyar	*Streaked weaver bird*	*LC*	*Sch-IV*
Lonchura punctulata	*Spotted munia*	*LC*	*Sch-IV*
Lonchura malacca	*Blackheaded munia*	*LC*	*Sch-IV*
Anas poecilorhyncha	*Spot-billed Duck*	*LC*	*Sch-IV*

*Status assigned by the IUCN, where – CR – Critically Endangered; EN – Endangered; LC – Least Concern; NT – Near Threatened; VU – Vulnerable, DA – Data Deficient, NE – Not Evaluated, R : Resident; RM : Resident Migratory; M: Migratory. All the birds observed from the study area.

8.3.3. REPTILES

Scientific Name	**Common Name**	**IUCN**	**IWPA**
Bungarus caeruleus	Common Krait		Not listed
Dendrelaphis tristis	Common Tree Snake	LC	
Echis carinatus	Saw scaled wiper		
Eryx conicus	Russells earth boa		
Eryx johii	Johns earth boa		
Lycodon aulicus	Common wolf snake		
Naja naja	Indian Cobra	LC	Sch- II
Ptyas mucosus	Common Rat snake	LC	Sch- II
Trimeresurus gramineus	Green pit viper	LC	Sch- IV

Hemidactylus flaviviridis	North house gecko		
Cyrtodactylus kacchensis	Black rock gecko		
Hemimidactylus brooki	House gecko	LC	
Vipera russelli	Russel's Viper	LR	Sch- II
Calotes rouxi	Forest Calottes	LC	
Calotes versicolor	Common garden lizard	LC	
Mabuya carinata	Common Skink	LC	
Chamaeleon zelanicus	Chameleon	VU	Sch- II

8.3.4. AMPHIBIANS

Species	Common name	IUCN status	IWPA (1972) Status
Duttaphrynus stomaticus Lüken	Marbled toad	LC	Schedule IV
Duttaphrynus melanostictus Schneider	Common Indian toad	LC	Schedule IV
Microhyla ornata (Dumėril & Bibron)	Ornate narrow mouthed Frog	LC	Schedule IV
Uperodon globulosus (Günther)	Indian balloon frog	LC	Schedule IV
Uperodon systoma Schneider	Marbled balloon frog	LC	Schedule IV
Hoplobatrachus crassus (Jerdon)	Jerdon's bull frog	LC	Schedule IV
Hoplobatrachus tigerinus (Daudin)	Indian bull frog	LC	Schedule IV
Euphlyctis hexadactylus (Lesson)	Indian pond frog	LC	Schedule IV
Sphaerotheca breviceps (Schneider)	Indian burrowing frog	LC	Schedule IV
Euphlyctis cyanophlyctis (Schneider)	Skittering frog	LC	Schedule IV

8.3.5. BUTTERFLIES

S. No.	Scientific Name	Common Name	Status
	Family – Nymphalidae		
1	*Acraea violae*	Tawny Coster	C
2	*Danaus chrysippus chrysippus*	Plain Tiger	VC
3	*Danaus genutia genutia*	Striped Tiger	C
4	*Precis almana almana*	Peacock Pansy	C
5	*Precis hierta hierta*	Yellow Pansy	VC
	Family -Lycaenidae		
6	*Castalius rosimon rosimon*	Common Pierrot	Schedule I of Part IV
7	*Chilades laius*	Lime Blue	VC
8	*Freyeria trochylus*	Grass Jewel	VC
9	*Tarucus nara*	Rounded Pierrot	VC
	Family -Pieridae		
10	*Colotis eucharis eucharis*	Plain Orange Tip	C

11	*Ixias pyrene sesia*	Yellow Orange Tip	VC
12	*Catopsilia pomona*	Common Emigrant	VC
13	*Eurema hecabe simulata*	Common Grass Yellow	VC
	Family -Hesperiidae		
14	*Borbo bevani*	Bevan's Swift	R
	Family -Papilionidae		
15	*Papilio demoleus*	Lime Butterfly	UC