Birds		
1	*Little grebe*	*Podiceps fuficollis*
2	*Little cormorant*	*Phalacrocorax niger*
3	*Darter or Snake bird*	*Anhinga rufa*
4	*Pond heron*	*Ardeolagrayii*
5	*Cattle egret*	*Bubulcus ibis*
6	*Painted Stork*	*Mycteria leucocephala*
7	*Open billed strok*	*Anastomus oscitans*
8	*Spoonbill*	*Platalea leucorodia, Linnaeus*
9	*Shoeveller*	*Anas clypeata linnaeus*
10	*White eyed pochard*	*Aythya nyroca*
11	*Ruddy shelduck*	*Tadorna ferruginea*
12	*Pintail*	*Anas acuta Linnaeus*
13	*Common Teal*	*Anas crecca Linnacus*
14	*Garganey Or Blue Winged Teal*	*Anas querquedula*
15	*Wigeon*	*Anas peneiope*
16	*Tufted Pochard*	*Aythya fuligula*
17	*Common Pochard*	*Aythya ferina*
18	*Redcrested Pochard*	*Netta rufina*
19	*Cotton Teal*	*Nettapus coromandelianus*
20	*Nekta Or Comb Duck*	*Sarkidiornis melanotos*
21	*Black winged Kite*	*Elanus caeruleus*
22	*Brahminy Kite*	*Haliastur indus*
23	*Common Buzzard*	*Buteo buteo*
24	*White Scavenger Vulture*	*Neophron percnopterus*
25	*The Pale Harrier*	*Circus macrourus*
26	*Marsh Harrier*	*Circus aeruginosus*
27	*Bonelli's Eagle*	*Hieraaetus fasciatus*
28	*Steppe Eagle*	*Aquila nipalensis*
29	*Shikra*	*Accipiter badius*
30	*Grey Partridge*	*Francolinus pondicerianus*
31	*Jungle Bush Quail*	*Perdicula asiatica*
32	*Grey Jungle Fowl*	*Gallus sonneratii*
33	*Common Peafowl*	*Pavo cristatus*

34	*Indian Moorhen*	*Gallinula chloropus*
35	*Coot*	*Fulica atra*
36	*Purple moorhen*	*Porphyrio porphyrio*
37	*White breasted water hen*	*Amaurornis*
38	*Red wattled lapwing*	*Vanellus indicus*
39	*Yellow wattled lapwing*	*Vanellus malabaricus scopili*
40	*Little Ringed Plover*	*Charadrius dubius*
41	*Marsh sandpiper*	*Tringa stagnatilis*
42	*Green SandPiper*	*Tringa ochropus*
43	*Common SandPiper*	*Tringa hypoleucos*
44	*Green Shank*	*Tringa nebularia*
45	*Stilt/ Avocets*	*Recurviorst*
46	*Black Winged Stilt*	*Himantopus himantopus*
47	*Jerdons Or Double Courser*	*Rhinoptilus bitorquatus*
48	*Sand grouse*	*Peroclididaae*
49	*Indian Sandgrouse*	*Pterocles exustus*
50	*Ring Dove*	*Streptopelia decaocto*
51	*Spotted Dove*	*Streptopelia chinensis*
52	*Little Brown Dove*	*Streptopelia senegalensis*
53	*Rose Ringed Parakeet*	*Psittacula krameri*
54	*Common Hawk Cuckoo*	*Cuculus varius*
55	*Asian koel*	*Eudynamys scolopaceus*
56	*Crow Pheasant Or Coucal*	*Centropus sinensis*
57	*Indian Great Horned Owl*	*Bubo bubo*
58	*Spotted Owlet*	*Athene brama*
59	*Indian Jungle Nightjar*	*Caprimulgus indicus*
60	*Franklin's Nightjar*	*Caprimulgus affinis*
61	*House Swift*	*Apus affinis*
62	*Palm Swift*	*Cypsiurus parvus*
63	*Crested Tree Swift*	*Hemiproene longipennis*
64	*Pied Kingfisher*	*Ceryle rudis*
65	*Small Blue Kingfisher*	*Alcedo atthis*
66	*White Breaster Kingfisher*	*Halcyon smyrnensis*
67	*Small Green Bee Eater*	*Merops orientalis*

68	*Indian Roller*	*Coracias benghalensis*
69	*Crimson Breasted Barbet*	*Megalaima haemacephala*
70	*Golden Backed Woodpecker*	*Pinopium bengalense*
71	*Ashy Crowned Finch Lark*	*Eremopterix grisea*
72	*Rufous tailed Finch lark*	*Ammomanes phoenicurus*
73	*Singing bush lark*	*Mirafra javanica*
74	*Dusky crag martin*	*Hirundo concolor*
75	*Common swallow*	*Hirundo rustica*
76	*Red rumped swallow*	*Hirundo daurica*
77	*Indian grey shrike*	*Lanius excubitor*
78	*Bay backed shrike*	*Lanius vittatus*
79	*Brown shrike*	*Lanius schach*
80	*Golden oriole*	*Lanius cristatus*
81	*Black Drongo*	*Oriolus oriolus*
82	*Rocket tailed drongo*	*Dicrurus paradiseus*
83	*White bellied drogo*	*Dicrurus caerulescens*
84	*Ashy swallow shrike*	*Artamus fuscus*
85	*Common myna*	*Acridotheres tristis*
87	*Jungle Myna*	*Acridotheres fuscus*
88	*Brahminy Myna*	*Sturnus pagodarum*
89	*Tree pie*	*Dendrocitta vagabunda*
90	*House Crow*	*Corvus splendens*
91	*Jungle Crow*	*Corvus macrorhynchos*
92	*Black headed Cuckoo Shrike*	*Coracina melanoptera*
93	*Small Minivet*	*Pericrocotus cinnamomeus*
94	*Common Iora*	*Aegithina tiphia*
95	*Redvented Bulbul*	*Pycnonotus cafer*
96	*White Browed Bulbul*	*Pycnonotus luteolus*
97	*Yellow Eyed Babbler*	*Chrysomma sinense*
98	*Common Babbler*	*Turdoides caudatus*
99	*Jungle Babbler*	*Turdoides striatus*
100	*White Headed Babbler*	*Turdoides affinis*
101	*Verditer Flycatcher*	*Muscicapa thalassina*
102	*Fantail Flycatcher (White Browed)*	*Rhipidura aureola*

103	*Paradise Flycatcher*	*Terpsiphone paradise*
104	*Greenish warbler*	*Phylloscoupus trochiloides*
105	*Largebilled Leaf warbler*	*Phylloscopus magnirostris*
106	*Tailor bird*	*Ortgitinys sutorius*
107	*Plain Wren warbler*	*Prinia subflava inornate*
108	*Ashy Wren warbler*	*Prinia socialis*
109	*Blyth's Reed warbler*	*Acrocephalus dumetorum*
110	*Magpie Robin*	*Copsychus saularis*
111	*Indian Robin*	*Saxicoloides fulicata*
112	*Black redstart*	*Phoenicurus ochruros*

Regarding status of important fauna listed under Schedule I of Wildlife (Protection) Act 1972 and IUCN classification of the area is explained under the chapter of conservation of Mega fauna.

Cross section of forest of the specified area

Chapter 3

Impacts of the Project on the Habitat, Flora & Fauna

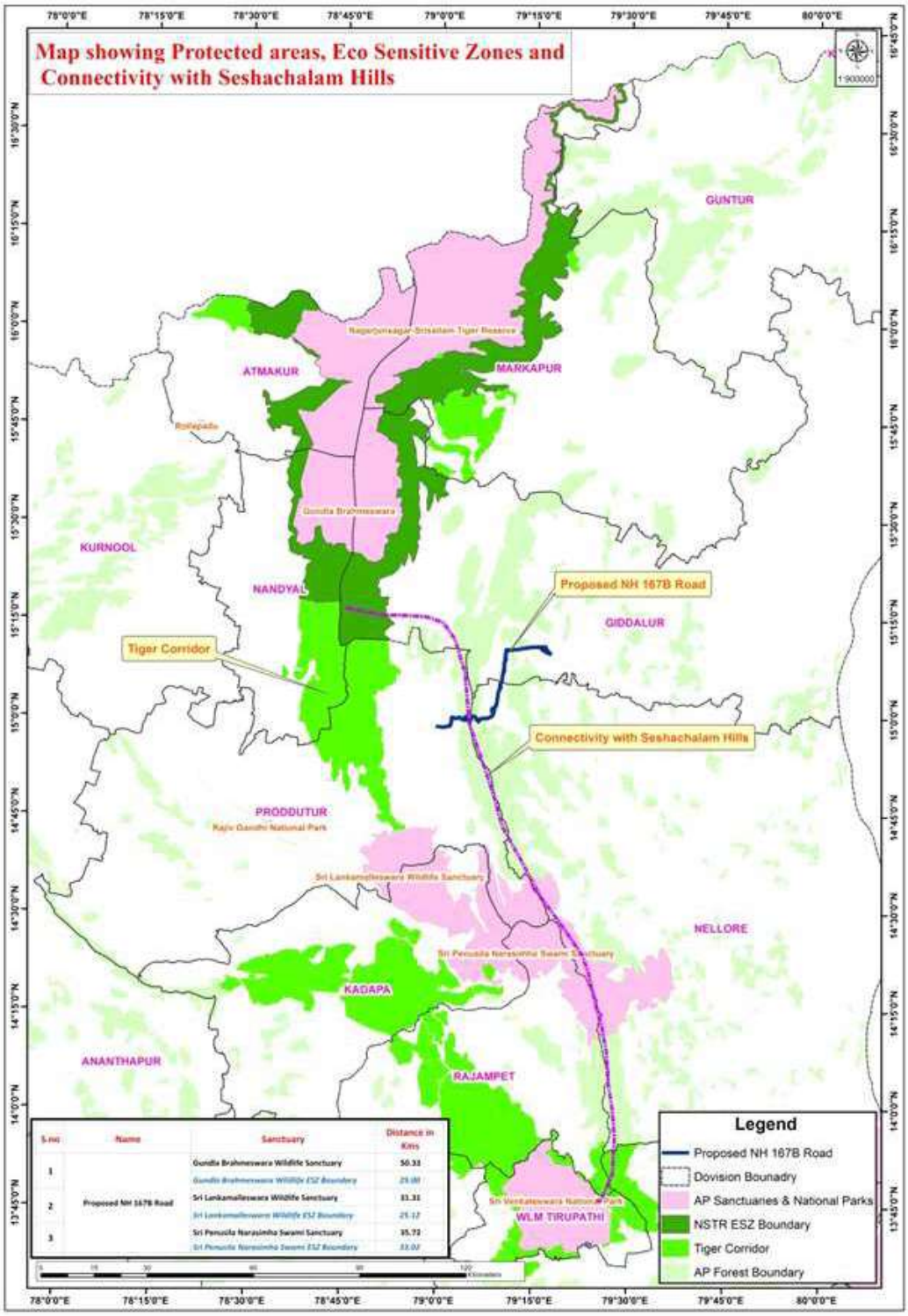
The proposed area of the diversion for the road is the centre of huge biodiversity of the state of Andhra Pradesh. The Protected areas of Sri Lankamalleswara Wildlife Sanctuary, Penusila Wildlife Sanctuary, ESZ of Gundla Brahmeswaram Wildlife Sanctuary (extended core of Nagarjunasagar Srisailam Tiger Reserve) and Notified Nagarjunasagar Srisailam Tiger Reserve (NSTR) Corridor of one of the largest Tiger Reserve of the Country are with in 30 Km radius to the proposed site. The Tiger Reserve is proliferating with tigers, presently with 60+ tigers spreading the territory to corridors right up to Seshachalam hills. The camera trap photos of Tiger in chamala valley during 2019 after 45-50 years shows the expansion of Tiger Corridor right from Nallamalais to Seshachalam hills. The Tiger Corridor is just 16 Kms away from the present proposed Road. The present area, though it is separated at places with habitations and having connectivity right up to Seshachalam hills via Penusila Narsimha wildlife sanctuary of Nellore area, Kadapa and Rajampet. The corridor supports and connects the two major wildlife habitat areas which are having very rich Biodiversity having presence of both flagship species of Tiger and Elephant in Andhra Pradesh. The proposed road is the prime link between velikondas to Seshachalam hills. The uniqueness of the area is inaccessible areas which are heaven for biodiversity. Most of the areas either side of the proposed road are inviolate areas where there is high density of wildlife. The presence of large predators Leopard and wild dogs seen regularly shows the presence of prey population. These hill ranges support some of the rare and endangered species both in floristic and in the faunal compositions. The Map down below elucidates the importance area and depicts the details of Protected areas.

Due to necessity of the upgradation and widening of the road from Porumamilla to Chandrasekarapuram the impacts have been studied since last year and major threats and negative impacts of the Project proposal area as follows.

3.1 Fragmentation of the Habitat.

Habitat loss and fragmentation of landscapes into smaller isolated patches are a major reason for the extinction of species worldwide. Such small and isolated patches of fragmented habitat endanger the faunal diversity as compared to larger and continuous fragments. Many of the species that originally inhabited large forested tracts will disappear from these isolated fragments. Habitat loss and degradation is known to affect 89% of all threatened birds, 83% of mammals, and 91% of threatened plants globally. There are also

evidences that while some species can persist or thrive in fragmented landscapes, many species become more vulnerable because of their smaller populations, more prone to over-exploitation (thereby increasing human-wildlife conflict) and their lower ability to adapt to rapid environmental change.



The fragmentation due to road bisecting a continuous populaton into two or more sub populations. Rare populations which are in low number or low density and wider range species like tigers or leopards are having greatest threat. The home range of tiger varies in Andhra Pradesh varies 50- 120 sq.km will be the major sufferer for the fragmentation. These big cats require large expanses of land for their daily, seasonal and ecological needs. These large carnivores animals migrate movements between seasonal habitats for either food or mates and they require a large amount of area to maintain a viable population. The other low density populations into smaller subpopulations can lead to the smaller, more isolated subpopulations going extinct. Civets, Four horned antelope and smaller cat species are the examples for low density population which may likely to be extinct if the proper measures are not taken due to fragmentation.

The other major threat of fragmentation is low levels of genetic connectivity, due to this situation may lead to inbreeding with in the reduced and isolated populations. Inbreeding can cause the entire population to become more susceptible to diseases or other environmental stressors resulting lowering the reproductive rate and increasing the mortality rate. If some of the species not able to tolerate the demographic factors and stress those populations may vanish from the area and they become locally extinct.

Roads can alter the spatial proportion of a given patch of habitat such that the edge to area ratio changes the results of these changes can be dramatic particularly for species that are more vulnerable to predation at the edge of habitats such as is the case of many ground nesting birds that are preyed on by predators. This phenomenon may happen to smaller prey animals with predators also.

Leopards, Sloth bear and Wild dogs are seen regularly crossing the area. The flora consists of 80+ species and fauna existing here include Leopard, Sloth bear, Wild dog, Four horned antelope, Hyena, Jackal, fox, wild pig, Chital, sambar, hare, various species of bats, reptiles include Python, Bengal monitor lizard and 110+ species of avi fauna. The flora of the area which is enumerated for felling consists of 71 species and 12,428 no.s of trees to be felled which includes 2410 Red sanders / *Pterocarpus santalinus* species which is endemic to Andhra Pradesh trees, during the process of the Road. The other shrubs, herbs, grass species will be wiped out of the area which may account of another 30-40 species in the specified area. The abstract of enumeration list with due assessed values is attached as Annexure.

Possible threats due to fragmentation of the habitat by the upgradation and widening of the road are summarised here

1. Roads may reduce access to saltlicks or waterholes by wild animals in general, access to summer and winter ranges by ungulates, to wetland breeding sites by amphibians, and to upland nesting habitat by turtles.

2. Wild animals are known to use particular corridors to move between various patches. If they are obstructed the animals may stray into human localities and feed on crops and livestock, increasing conflict.

3. Roads will act as a source of ignitions of fire in a landscape or can create firebreaks that prevent the spread of natural fires that may be important in wildlife management.

4. Roads may block movement or some small animal species and subdivide their populations. Smaller populations are vulnerable to genetic changes due to genetic drift and inbreeding depression and to extinction risk.

5. Reduce the populations by dividing the corridor or road.

6. One of the direct impacts of the road improvement in the forest are collision with vehicles or road kills. There is no proper information documented in the area. Kills of reptiles or birds were never documented.

7. Road network always increase the access to poachers. Though specific poaching data is not available with the department, there is every likely hood of poaching and even chances of poaching of big cats in the specified area of diversion.

3.2 Littering the area

Littering is seen entire area, all along the road. Many places people are using like open drinking place, consuming food and leaving plastic and food wastage in the area. The plastic include carry bags, water bottles, Gutka packets, disposable plastic plates, glasses.

3.3 Human and Wildlife conflict

Wildlife has the innate urge to migrate and disperse over large landscape in their search to colonise new areas for survival of the species. This results in wildlife traversing long distances in search of suitable habitat for colonisation and at times wildlife stray out

of forest areas into human settlement and come in direct conflict with man. Herd animals and several wildlife perambulate and cover large distances in forest in search of food and new resources. Their seasonal migratory paths interconnect forest block, unreserves and marginal lands shall not brought under plough. Their migratory routes are well defined on ground and if known and identified, they should be left undisturbed and interconnected without barriers so that wildlife can move freely from one area to the other. Any break in the connectivity results in straying out of wildlife and conflict with humans. The conservation measures taken up in these forest blocks will facilitate the animals to remain in their natural habitat and prevent them from straying out of their habitat in search of water and food resulting in man animal conflict.

Alighting the passengers / travellers is highly dangerous, may lead to man animal conflict and it may cause the huge disturbance. Alighting also cause of littering all along the Road. The littering may include carry bags, garbage, plastic and water bottles.

All along the road the monkeys are there and people are offering food, fruits to monkeys. This is a slow and more obscure manifestation of human-wildlife conflict.

3.4 Noise

As there are no restrictions on horn, vehicle horn is also an impact on wildlife. This disturbs wildlife and forces them to abandon all proximate areas.

3.4 Fire

Ninety per cent of forest fires in India are man-made. Smoking and carrying fire substances and match boxes, cooking of food in the forests is serious threat to the habitat and wildlife.

All these perceived impacts/ threats due to this project needs to be removed through different measures to improve the habitat for Wildlife, so that their status can be enhanced, and healthy environment is created. The measures for the same have been outlined in the next chapter.

Chapter 4

Impact Mitigation Plan

Wildlife, like any other living species require the primary needs of food, shelter, water and territory to roam, hunt, search for food etc. Wildlife has the innate urge to migrate and disperse over large landscape in their search to colonise new areas for survival of the species. This results in wildlife traversing long distances in search of suitable habitat for colonisation and at times wildlife stray out of forest areas into human settlement and come in direct conflict with man. Herd animals and several wildlife perambulate and cover large distances in forest in search of food and new resources. Their migratory routes are well defined on ground and if known and identified, they should be left undisturbed and interconnected without barriers so that wildlife can move freely from one area to the other. Any break in the connectivity results in straying out of wildlife and conflict with humans. The conservation measures taken up in these forest blocks will facilitate the animals to remain in their natural habitat and prevent them from straying out of their habitat in search of water and food resulting in man animal conflict.

Considering the anticipated impacts/ threats posed by the proposed project as discussed in chapter 3, it is necessary to take suitable conservation and mitigative measures to minimize the assessed impacts on the wildlife and its habitat. The strategy of conservation measures will be properly juxtaposed within the cruising radii of wild animals. The vegetation will be maintained in optimum level of interspersion as regards density cover and stand height. It will be necessary to manage the perceived adverse impact in such a manner that this does least possible harm despite the project. The Plan provides for the protection and conservation of all important species of wildlife and its habitat. The plan is broadly divided in to two parts one is to conserve wildlife and provide the requirement of wildlife such as fodder and water by protecting the existing forests both sides to retain the wild animals with out much disturbance. The other part is to provide connectivity across the road to facilitate the movement of wildlife .

4.1 Provision of Wildlife crossings

Wildlife crossing structures are being designed and incorporated into road construction and expansion projects to help restore or maintain animal movements across roads. Engineered wildlife crossings are designed both to allow animals to cross roads and to reduce hazards to motorist and wildlife. Wildlife crossing structures are typically combined with high fencing, and together these measures have proved to reduce road related mortality

of wildlife and connect populations. Road networks continue to grow and expand throughout the nation hence authorities need to know the most effective approaches in designing safe roadways for motorists and wildlife. Crossings must link to a larger functional landscape and habitat complex that allows wildlife to disperse, move freely, and meet their daily and life requisites. Having studied the behaviour of wildlife in the proposed project area the conservation plan and mitigation measures suggested.

The road leading to Chandrasekharapuram from the boundary of Kavalakuntla Extn A & B reserved forest is a barrier restricting the movement of animals. Daily, weekly or seasonal movements across landscape is necessary for the most terrestrial species. It may not be a serious threat for the smaller mammal and other terrestrial species but the large mammals may get highly affected. To prevent the impacts of fragmentation due to the road viz., limiting the availability of habitat, prevent access to water & other resources on the other side of the road, sub division of wildlife populations in to smaller and more vulnerable sub populations and affects the regular movement of wildlife, it is necessary to construct wildlife crossings in order to facilitate the smooth movement of animals all through its natural habitat. Wildlife crossings are a practice in habitat conservation, allowing connections or reconnections between habitats, combating habitat fragmentation. Wildlife passage (or crossing) structures are typically the most visible and engineering intensive green infrastructure employed to address wildlife needs along roads and highways, and often are the cornerstone of successful strategies to reduce the effect of roads on wildlife. In conjunction with wildlife fencing, these structures have dramatically reduced the incidence of wildlife-vehicle collisions as much as 98% (Clevenger et al. 2001, Dodd et al. 2007a, Olsson et al. 2008, Gagnon et al. 2015), thus enhancing motorist safety and reducing direct impact on wildlife populations.

The broad objectives of the Wildlife crossing structures

1. Facilitate connections between habitats and wildlife populations
2. improve motorist safety and reduce wildlife vehicle collisions.

Objective 1. Facilitate connections between habitats and wildlife populations

There are 4 types of wildlife overpasses and 7 types of wildlife underpasses. the overpasses include landscape bridge, wildlife overpass, multi-use overpass and canopy crossing. In the present project department proposing one wildlife overpass and two canopy crossings. Wildlife overpasses are the largest crossing structures to span roadways. These structures are intended to Accommodate the movement of a broad spectrum of wildlife

from large mammals to reptiles and even invertebrates. The overpass allow the natural movement of wild animals as they are less confining, quieter, have ambient natural conditions of rainfall, light and temperature and can be used by wide range of fauna . Most of the fauna of the area will utilise if habitat elements are provided on overpasses. Suitable vegetation is to be developed by planting trees on the area. The bridge is typically enhanced with habitat features such as native vegetation, rock or logs etc.,

Wildlife overpasses are generally 50 to 70 metres width. The wildlife overpass should be closed to public and any other human use our activities. In the present project there is only one possibility of Wildlife Over Pass which has been shown down below. 40 to 50 Mt width may be comfortable for the over pass. Due to terrain/ topographical features the present site is selected , suitable financial provision is made. Out of the total length of 7.5 Kms of the stretch, only 2.0 Kms are plain area and the rest of the area is hilly. The area proposed is the ideal with small hillocks, wild animals have least disturbance to cross over. Ideally 40-50 mts width bridge is essential in the area. The length is site specific , adjusted accordingly with slope not more than 25 degrees. The bridge may be rectangular or hour glass shaped depending the construction ability. If any crossovers are observed in either side of the proposed crossover, proper fencing also may done to drive or force to habituate the cross over through the over pass. The tentative location proposed for the over pass is

Google earth Screen shot along with GPS readings.

Some of the Wildlife Overpasses are given below.

2. Wildlife Bridge Over An Autobahn In Germany

3. Bridge for animals in the Netherlands

#24 Ecoduct In The Netherlands

Wildlife Overpasses constructed on NH 44 of India,

Planting pattern may be seen on the photo

Various types of wildlife underpasses which are in use across the world are Viaduct or flyover, Large mammal Underpass, Underpass with water flow, small to medium sized underpasses, modified culverts and Herptile tunnels facilitating reptiles to cross over. The underpasses play a vital role in restoring the connectivity. There are currently no standard design specifications for wildlife crossing structures adopted by the Department, however there are several examples of structures that have been utilized for different species and environmental circumstances. Since crossing locations can be expected to differ substantially from one another in terms of topography, facility type, focal species, grade, and other considerations, design specifications must be location, species, and goal-appropriate.

The following points to be kept in view while designing the underpasses in the corridor area.

- The crossing structure will only be effective if it is accessible and acceptable to the species that will potentially utilize it.
- The design and size of under pass greatly influence its use. Moreover the body size of the animal and its behaviour will influence the design of underpass.
- Greater the length, height and opening that allow an unobstructed view of habitat has a more chances of the use of the structure. Structures should be designed to enable animals to view the horizon from a distance and see habitat on the opposite side of the corridor.
- The location of the under pass is also a critical aspect. The crossing structure should allow for natural movement of the animal and it should be constructed at the location where the possibility of animals using them is high.
- Road cuts, steep deep-offs and cliffs may dissuade animals from making a successful crossing. Structures should be designed as flat and straight as the terrain permits crossing's with a steep grade reduce the openness of structures and appropriate use of vegetation (trees, shrubs and grasses) can play a significant role in enhancing the naturalness of an engineered structure.

Considering all the possibilities, the Wildlife Institute of India has published a book (WII, 2016) “Eco-friendly measure to mitigate the impact of linear infrastructure on wildlife” which guides the wildlife consultants, staff, NHAI authorities in the development of infrastructure in wildlife prominent areas. The tentative model road in wildlife prominent area should be as follows.

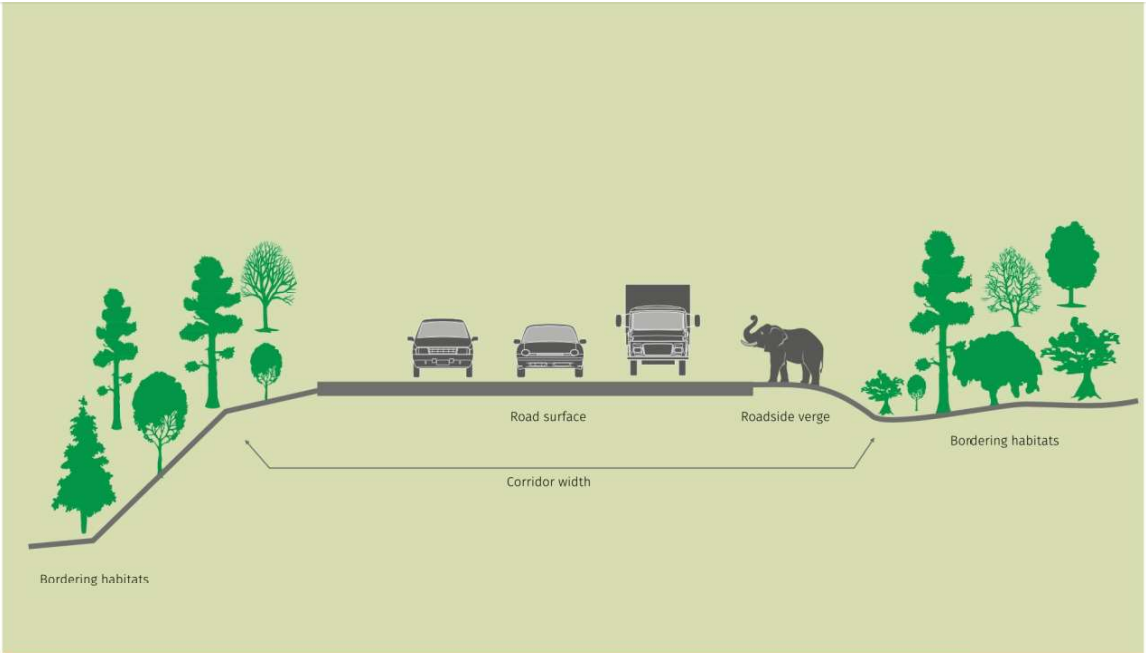


Figure 6.1. Components of a road transportation corridor. **Source:** *Illustration by N. S. Bist*

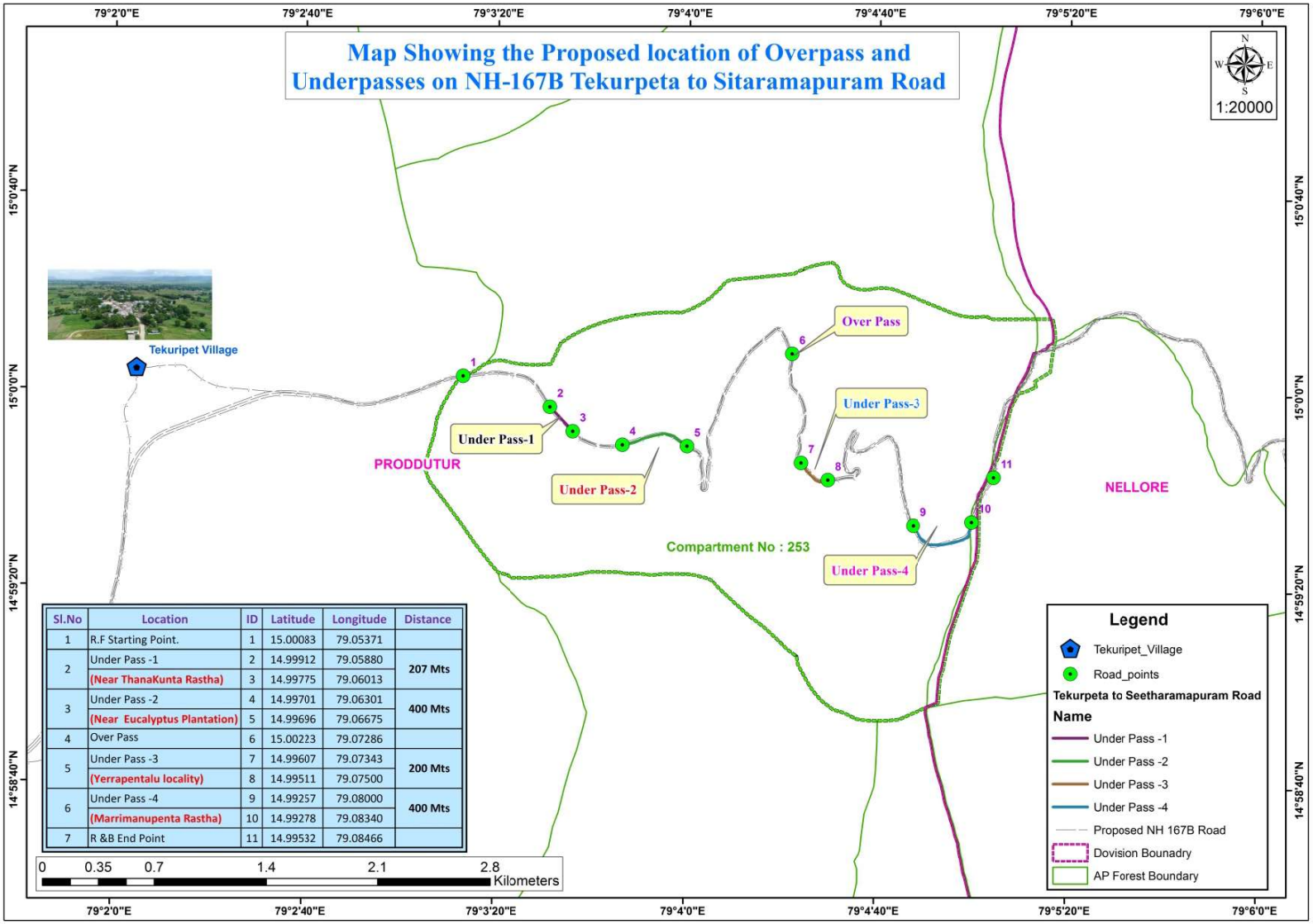
The purpose of this cross section is that an animal should have roadside verge, so that the animal think twice before crossing on the road. This is essential because we are not providing underpasses all over the road. Out of 7500 mts length of the road the feasibility of wildlife underpasses are to a length of 1100-1200 mts, as the most of the terrain is hilly. The plain area which is suitable for construction of underpasses is around 1400 mts. With due allowance, department is proposing the underpasses of 1000 mts for which financial provision is made. The book states that if the width of the corridor / length of road passing through the wildlife prominent areas or protected areas is more than 3 Km, there should be 300 Mt under pass at every kilometre. The wildlife institute of India has prescribed 5 metres height for all the wild animals in central India landscape and tiger corridors. This prescription holds good our present project area

A viaduct is the largest of the underpass structures for wildlife use. This type of structure maintains or elevates the grade of the road, allowing for the passage of fauna below. The largest span and clearance will allow for use by a wide range of wildlife. These structures can be adopted for amphibians and semi aquatic and semi arboreal species in addition to the large mammals, small mammals and reptiles. The design of the walls and appears of an underpass can significantly improve the acceptability of passive structure by animals. Isolated piers are more favourable than wall type piers, Because isolated piers increase the lateral visibility and reduce tunnel effects. These viaducts have been proposed in the present project area.

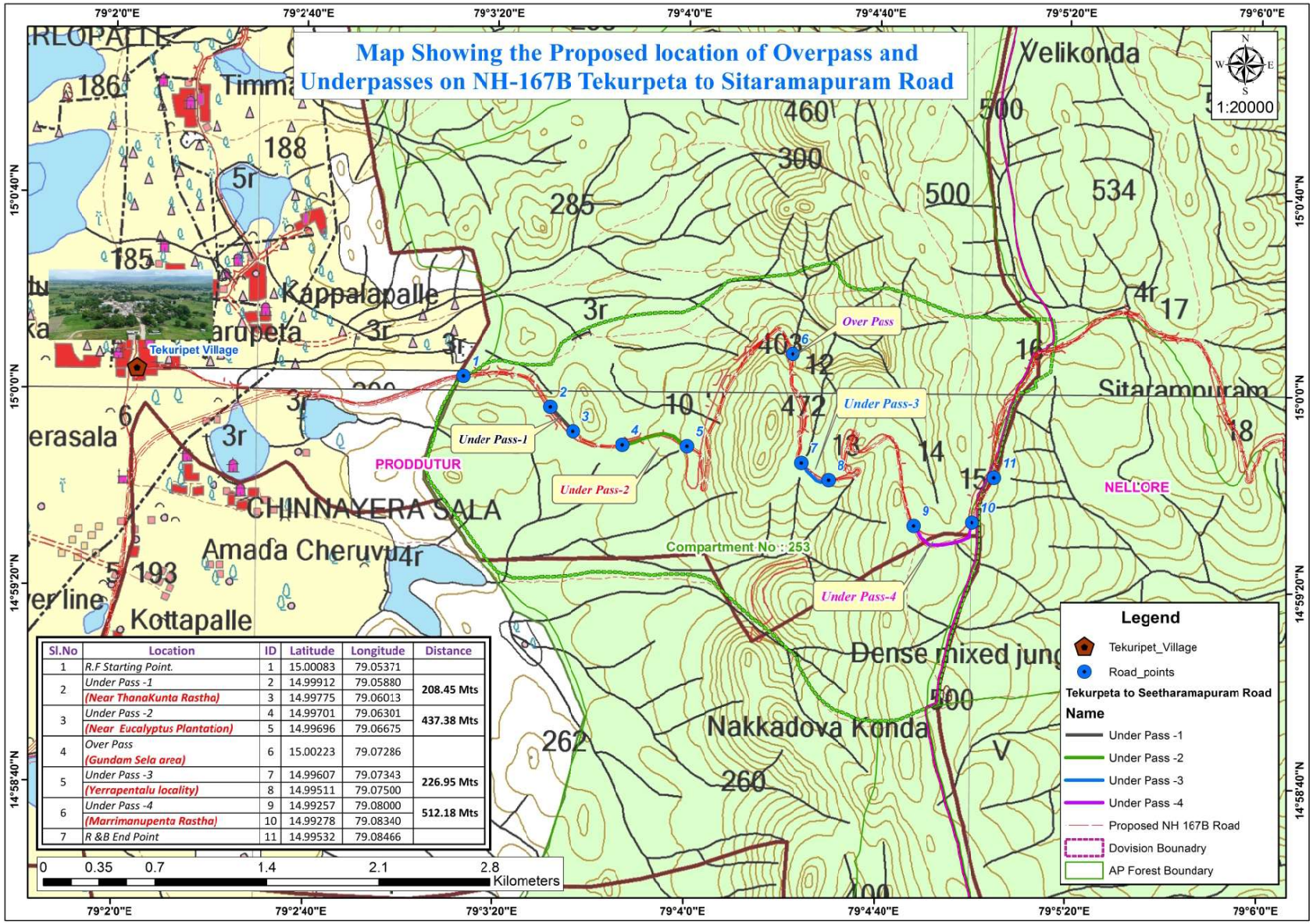
Both underpasses and overpasses need to be fortified with sound barriers to prevent any disturbance to wildlife, without them investments in constructing underpasses and overpasses can go to waste as wildlife may never use them. It is important that wild animal movement is channeled to the passageway for crossing the infrastructure by using appropriate funnelling structures either natural or artificial.

Considering all the above factors, basing on the study of animal crossings during the last year, after thorough inspection has made on the proposed road along with Wildlife consultants, National Highway authorities and came to conclusion to finalise the location of underpasses or overpass in the entire stretch of the road. Due to hilly terrain, the underpasses are restricted to 1000 mts against the requirement of 2100 Mts as per the Wildlife Institute of India manual on "Eco friendly measures to mitigate impacts of linear infrastructure on wildlife". Though the plain area of length 1385 mts is available, restricted the underpasses to 1000 mts and the no. of passes proposed at (4) places. The reduction of the length proposed is to facilitate the Engineers in designing the underpass considering the topographical features. The suggested exact location of these under passes / overpasses are given in the following table. The details have shown on the Maps also.

Sl. no.	Local name of location	Latitude & Longitude of starting point of underpass	Latitude & Longitude of end point of underpass	Actual distance	Span/ length of underpass proposed
1	Overpass (Gundam Sela area)	15.00223 79.07286		Only one location is taken as the length may vary either side with a min. 50 Mts.	
2	Underpass 1 (near thana kunta rasta)	14.99912 79.05880	14.99775 79.06013	208.45mts	150 mts
3	Underpass 2 (near Eucalyptus plantation)	14.99701 79.06301	14.99696 79.06675	437.38 mts	300 mts
4	Underpass 3 (Yerra pentalu locality)	14.99607 79.07343	14.99511 79.07500	226.95 mts	150 mts
5	Underpass 3 (Marri manu penta rasta)	14.99257 79.08000	14.99278 79.08340	512.18 mts	400 mts
	Total	**1384.96 mts**	**1000 mts**		



Sl.No	Location	ID	Latitude	Longitude	Distance
1	R.F Starting Point.	1	15.00083	79.05371	
2	Under Pass -1	2	14.99912	79.05880	207 Mts
	(Near ThanaKunta Rastha)	3	14.99775	79.06013	
3	Under Pass -2	4	14.99701	79.06301	400 Mts
	(Near Eucalyptus Plantation)	5	14.99696	79.06675	
4	Over Pass	6	15.00223	79.07286	
5	Under Pass -3	7	14.99607	79.07343	200 Mts
	(Yerrapentalu locality)	8	14.99511	79.07500	
6	Under Pass -4	9	14.99257	79.08000	400 Mts
	(Marrimanupenta Rastha)	10	14.99278	79.08340	
7	R &B End Point	11	14.99532	79.08466	



Sl.No	Location	ID	Latitude	Longitude	Distance
1	R.F Starting Point.	1	15.00083	79.05371	
2	Under Pass -1	2	14.99912	79.05880	208.45 Mts
	(Near ThanaKunta Rastha)	3	14.99775	79.06013	
3	Under Pass -2	4	14.99701	79.06301	437.38 Mts
	(Near Eucalyptus Plantation)	5	14.99696	79.06675	
4	Over Pass (Gundam Sela area)	6	15.00223	79.07286	
5	Under Pass -3	7	14.99607	79.07343	226.95 Mts
	(Yerrapentalu locality)	8	14.99511	79.07500	
6	Under Pass -4	9	14.99257	79.08000	512.18 Mts
	(Marrimanupenta Rastha)	10	14.99278	79.08340	
7	R &B End Point	11	14.99532	79.08466	

A tiger uses the National Highway-44 underpass (Picture courtesy Wii Dehradun)

Photos of Under passes constructed on NH 44 of India

To maintain the connectivity other than larger mammalian species, for amphibians or reptiles across landscape, small pipe culverts are bridges should be constructed in every 100 metres stretch of the road. Pipe culverts are typically With round pipes of having less than 1.5 metre diameter made up smooth steel, corrugated metal or concrete. Their primary purpose is to convey water under roads. A variety of wild animals has been observed using them as passageways. They are often used by small mammals, reptiles and amphibians. They have also been used as a fish passages. These pipe culverts or culverts modified by using furniture which include Guard rails or wooden planks, certain species of wild animals use this type of passages. At least one crossing structure should be located within an individual's home range. Because most reptiles, small mammals, and amphibians have small home ranges, metal or cement box culverts should be installed at intervals of 300mt-500mts; at least 2-3 no's per Kilometre, though the prescription as per the WII manual of underpasses is one each for 100 Mts.The National High way authority will place the proposal accordingly in their estimates of the roads, as they need to construct the water ways across roads. Both the possibilities need to be worked together and planned.

Source: Photograph by Public works department, Government of the Netherlands

Source: Photograph from Clevenger and Huijser 2011.

Another design generally followed in the linear infrastructure is box type culvert. While designing the roads , these type of boxculverts are usually designed for the passage of water/ drainage purpose, as the culvert heights are not up to the mark for the cross over, by increasing the height of the culverts , these culverts also facilitate the connectivity of wild animals.