भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
National Highways Authority of India
(सड़क परिवहन एवं राजमार्ग मंत्रालय) भारत सरकार
(Ministry of Road Transport and Highways)
Government Of India

सत्यमेव जयते

NHAI/PIU-RMNG/14014/2022-23/

Date: 07.10.2022

To,

The Deputy Director,
Sathyamangalam Tiger Reserve,
HASSANUR FOREST DIVISION,
Tamilnadu.

Sub: Consultancy Services for Preparation of Detailed Project Report for the Rehabilitation and Upgradation of Tamil Nadu / Karnataka Border - Bangalore section of NH-209 in the State of Karnataka (DPR/Kar/Phase-IVB/2/2010) - BRT Stretch from Design chainage from 266+449 to Km 288+936 (22.487 Kms) - **Compliance to EDS reg.**

Ref: 1. Forest Proposal No. FP/TN/ROAD/121598/2021 in the State of Tamil Nadu.
2. Letter No.C.No.3986/2021/D, dated 21.10.2021.

Sir,

Please refer to the above cited subject, submitting herewith the compliances to the conditions (ref:2) in the following table along with the necessary draft undertakings required as per the stipulated conditions:

Sl No.	Comment	Compliance
1	Why the location at Karappallam (62 mts) was selected in this FCA Proposal while rest part of road is not included. If there is any specific reason such as construction of building/service road etc., Please submit the reasons.	The existing road passes though Core Area of BRT wildlife, to avoid this Core Zone, the realignment is proposed in Eco sensitive Non-Core Zone area.
2	Please give breakup of forest land diversion cost for both existing and alternative (recommended option) a) How much forest area will be diverted in case of existing route? b) While calculating forest land diversion cost, why the EROW was not excluded from the total forest land requirement.?	As per latest NPV rates, Rs. 12,28,590 per Ha is taken for Dense and ECO class 3 Forest Area, the forest land diversion cost is as below. 1) For Existing Road: 1.58 Cr. 2) For Realignment: 1.15 Cr. Further, a) An area of 12.84Ha is under Core Area of forest (BRT) for a length of 10.7 Km for existing route. b) An area of around 9.4 Ha is required for realignment. The forest department agreed to give 12m RoW for realignment.

Project Implementation Unit : Ramanagara
बसवनपुर (रमदेवरपाद), रामनगर, कर्नाटक – ५६२१२८ **Basavanapura (Ramadevarapada), Ramanagara, Karnataka - 562128**
Phone No.: 080 - 29780089, **E-mail :** piuramanagara@gmail.com, piuramanagara@nhai.org
Head Quarters : G-5 & 6. Sector -10, Dwarka, New delhi -110075. Ph.: 011-2507410

Sl No.	Comment	Compliance
3	Since the recommended option consists of 8.4 km green field and acquisition 4.4Ha, on what basis social impact if low in case of alternative option and why it is high in existing road? if the study is conducted submit the study report.	The social impact is high in existing alignment due to presence of built up, buildings etc.., Also the R&R cost will trigger for Existing Road.
4	Certificate needed for non-forest area land available in this location issued by the concerned authorities.	An undertaking for the same is uploaded in the Proposal as **Annexure-1**.
5	As per guidelines of Eco-friendly measures to mitigate the impact of the linear infrastructure on wildlife and forest, at least 100m of pass way of 1km length in linear infrastructure in elephant landscape and critical core tiger habitat is required. Hence at least 3 underpasses with 100m of passes way per 1 km will be required as the guidelines. The mitigation measures submitted along with this proposal does not match the requirements. Hence, three underpasses with prescribed dimensions may n submitted along wit GPS coordinates.	As a whole BRT Stretch, 5 EUPs 1 EOPS and required number of Cross Drainage structures are proposed. With this provision, wildlife habitat can cross the project Road comfortably. Please refer **Annexure - 2 List of Proposed EUP, VUP and SVUP Structures.**
6	Please submit the No. of RCC Culverts, dimension of it for forest area.	Details were attached in **Annexure - 3 Proposed List of Bridges and Culverts.**
7	The recommended option shows higher speed of 43-100km per hr. This will lead to increased human-wildlife conflict, Mitigation measures may be submitted with regard to it.	Speed brakers shall be provided as per IRC guidelines and Warning Signboards related to Wildlife shall be installed for road users. Please refer **Annexure-4 Mitigation Measures as per Wild Life Authorities.**
8	In case of approval of recommended option, what would be the **<u>Status of existing road</u>**. Since, simultaneous working of both the road will sandwich the portion of Sathyamangalam Tiger reserve and Biligiri Ranganathaswamy tiger reserve and will isolate the particular forest patch. This may act detrimental to Wildlife.	This is to inform that No Traffic Movement shall be allowed and not utilizing the existing BRT Road Stretch from Km 273.156 to Km 290.706. The Proposed new alignment will also avoid human animal conflict and an undertaking form NHAI is attached as **Annexure - 5. Undertaking Letter from PD, PIU, NHAI, Ramanagara regarding existing BRT stretch not utilizing for Traffic Movement.**

Thanking You,

Yours Faithfully

(B.T Sridhara)
GM(T) & PD
NHAI, PIIU-Ramanagara

Non availability of Non-forest land for the project from the concerned District Collector

Name of Project: Rehabilitation and Upgradation of Tamil Nadu / Karnataka Border – Bangalore section of NH-209 in the State of Karnataka (DPR/Kar/Phase-IVB/2/2010) – BRT Stretch from Design chainage from 266+449 to Km 288+936 (22.487 Kms)

The NHAI-PIU, Ramanagara has applied to district collector, Erode regarding issue of Certificate regarding non-availability of alternative suitable non-forest land. The application is still process, and we undertake that we shall obtain necessary certificate from concerned DC office, before final approval of diversion of forest land in this case.

Project Director
PIU, NHAI
Ramanagara

(B.T Sridhara)

General Manager
(Technical) cum Project
Director

PIU - Ramanagara

ANNEXURE-2 - NH-209 BRT STRETCH - ELEPHANT UNDERPASSES & VEHICULAR UNDERPASSES PROPOSAL

Sl. No.	Existing Chainage	Design Chainage	Existing Details										Existing Deck Width	Proposal	Proposed Details											TCS	Widening Schedule	Remarks
						Span Arrangement				Structure Details								Span Arrangement				Type of Structure						
			Type of Structures	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Size of Vent	Clear Height	Total Length	Super structure	Sub structure	Found ation			Proposed Type	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Span	Clear Height	Length	Super structure	Sub structure	Found ation	Proposed Deck Width			
	(km)	(km)	-	-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)			-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)	-	-	-
1	Realignment	193+296	-	-	-	-	-	-	-	-	-	-	-	New Construction	SVUP	Earthern road	12°	1	7.00	4.00	7.00	RCC Box	-	-	2x11.60	3A	Greenfield Alignment	Crossing earthern Road for fields
2	Realignment	193+855	-	-	-	-	-	-	-	-	-	-	-	LHS-MCW-New Construction; RHS-MCW-New Construction	VUP	MDR	-	1	15.00	5.50	15.00	RCC I-Girder + Deck Slab	RCC Abutment	Open	2x11.60	2A	Greenfield Alignment	Crossing MDR; LHS-, LHS-Ramapuram (Connecting to Existing NH-209 Road), RHS-Thiginarai Village; Regrade the cross road by 1.40m
3	-	203+600	-	-	-	-	-	-	-	-	-	-	-	New Construction	EUP	Elephant Crossing	-	3	30.00	8.00	90.00	PSC I-Girder + Deck Slab	RCC Abutment & Circular Pier	Open	12.00	4	Concentric	Elephant crossing location
4	274.026	204+425	Minor Bridge	Nala	5	3	1 x 5.5 + 1 x 10.7 +1 x 6.0	5.00	22.20	RCC Solid slab	PCC Wall type Abutment & Piers	Open	8.50	Reconstruction	Minor bridge cum EUP	Nala & Elephants	-	2	30.00	8.00	60.00	PSC I-Girder + Deck Slab	RCC Abutment & Circular Pier	Open	12.00	4	Concentric	Crossing Nala & Elephant crossing location
5	271.134	207+309	RCC Slab Culvert	-	-	1	4.40	1.70	4.40	-	-	-	8.20	Reconstruction	EUP	Nala & Elephants	-	2	30.00	8.00	60.00	PSC I-Girder + Deck Slab	RCC Abutment & Circular Pier	Open	12.00	4	Concentric	Elephant crossing location
6	-	209+325	-	-	-	-	-	-	-	-	-	-	-	New Construction	EUP	Elephant Crossing	-	2	30.00	8.00	60.00	PSC I-Girder + Deck Slab	RCC Abutment & Circular Pier	Open	12.00	4	Concentric	-
7	267.293	211+151	Pipe culvert	-	-	2	2.20	-	4.40	-	-	-	12.60	Reconstruction	EUP	Nala & Elephants	-	2	30.00	8.00	60.00	PSC I-Girder + Deck Slab	RCC Abutment & Circular Pier	Open	12.00	4	Concentric	-

ANNEXURE-3 - NH-209 BRT STRETCH - BRIDGES & CULVERTS PROPOSAL

Sl. No.	Existing Chainage	Design Chainage	Existing Details										Existing Deck Width	Proposal	Proposed Details											TCS	Widening Schedule	Remarks
						Span Arrangement				Structure Details								Span Arrangement				Type of Structure						
			Type of Structures	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Size of Vent	Clear Height	Total Length	Super structure	Sub structure	Foundation			Proposed Type	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Span	Clear Height	Length	Super structure	Sub structure	Foundation	Proposed Deck Width			
	(km)	(km)	-	-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)			-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)	-	-	-
1	Realignment	190+110	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	Balancing Culvert
2	Realignment	190+253	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	2B	Greenfield Alignment	Balancing Culvert
3	Realignment	190+400	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	5.00	3.00	-	-	-	-	-	2C	Greenfield Alignment	Balancing Culvert in Valley
4	Realignment	190+563	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	2B	Greenfield Alignment	Nala training to be done on LHS of length 130m.
5	Realignment	190+650	-	-	-	-	-	-	-	-	-	-	-	LHS-MCW-New Construction; RHS-MCW-New Construction	Minor bridge	Main Canal	20°	3	8.00 SQ Clear	-	24.00	RCC Box	-	-	2x13.50	2B	Greenfield Alignment	Canal with Vertical clearance of 4m on canal service road with clear span of 8.00m is provided
6	Realignment	190+950	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Field Channel	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	-
7	Realignment	191+320	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Field Channel	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	-
8	Realignment	192+078	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	5.00	3.00	-	-	-	-	-	2B	Greenfield Alignment	-
9	Realignment	192+160	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Field Channel	-	1	2.00	2.00	-	-	-	-	-	2B	Greenfield Alignment	Balancing Culvert
10	Realignment	192+846	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	22°	1	5.00	3.00	-	-	-	-	-	2B	Greenfield Alignment	-
11	Realignment	193+010	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	Balancing Culvert - Acts as PUP/CUP in dry condition
12	Realignment	193+260	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	12°	1	5.00	3.00	-	-	-	-	-	3A	Greenfield Alignment	Nala training on LHS of length 50m
13	Realignment	193+890	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	2B	Greenfield Alignment	Balancing Culvert
14	Realignment	194+033	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	23°	1	5.00	3.00	-	-	-	-	-	2C	Greenfield Alignment	-
15	Realignment	194+317	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	5.00	3.00	-	-	-	-	-	1A	Greenfield Alignment	Acts as PUP/CUP in dry condition
16	Realignment	194+470	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	Balancing Culvert
17	Realignment	194+750	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	2B	Greenfield Alignment	-
18	Realignment	194+847	-	-	-	-	-	-	-	-	-	-	-	LHS-MCW-New Construction; RHS-MCW-New Construction	Minor bridge	Nala	-	2	8.00 SQ Clear	-	16.00	RCC Box	-	-	2x13.50	2B	Greenfield Alignment	-
19	Realignment	195+185	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	Balancing Culvert
20	Realignment	196+410	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	4.00	2.00	-	-	-	-	-	2A	Greenfield Alignment	-
21	Realignment	196+820	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	3.00	2.00	-	-	-	-	-	2C	Greenfield Alignment	Balancing Culvert in pond (acts as inlet) in Valley
22	Realignment	196+892	-	-	-	-	-	-	-	-	-	-	-	LHS-MCW-New Construction; RHS-MCW-New Construction	Minor bridge	Nala	-	1	8.00 SQ Clear	-	8.00	RCC Box	-	-	2x13.50	2C	Greenfield Alignment	In Valley portion
23	Realignment	197+545	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	-
24	Realignment	197+790	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	2A	Greenfield Alignment	-
25	Realignment	197+845	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Pond	-	1	5.00	2.00	-	-	-	-	-	2A	Greenfield Alignment	-
26	Realignment	198+075	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	2A	Greenfield Alignment	-
27	Realignment	198+190	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	1A	Greenfield Alignment	Balancing Culvert
28	2.920(MDR)	198+689	Causeway	Nala to Addar Pallam Stream	-	-	-	-	20.00	-	-	-	10.50	Reconstruction	Minor bridge	Addar Pallam Stream	-	1	25.00	-	25.00	PSC I-Girder + Deck Slab	RCC Abutment	Open	12.00	4A	Concentric	-
29	Existing MDR	199+361	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	2.00	1.50	-	-	-	-	-	1	Concentric	-
30	Existing MDR	199+800	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	2.00	1.50	-	-	-	-	-	1	Concentric	-
31	Existing MDR	200+097	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	2.00	1.50	-	-	-	-	-	1	Concentric	-

ANNEXURE-3 - NH-209 BRT STRETCH - BRIDGES & CULVERTS PROPOSAL

Sl. No.	Existing Chainage	Design Chainage	Existing Details										Existing Deck Width	Proposal	Proposed Details											TCS	Widening Schedule	Remarks
						Span Arrangement				Structure Details								Span Arrangement				Type of Structure						
			Type of Structures	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Size of Vent	Clear Height	Total Length	Super structure	Sub structure	Foundation			Proposed Type	Type of Crossing (Nala / Drain / Canal / Field Channel / River)	Skew Angle	No. of Spans	Span	Clear Height	Length	Super structure	Sub structure	Foundation	Proposed Deck Width			
	(km)	(km)	-	-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)			-	(Deg.)	(No's)	(m)	(m)	(m)	-	-	-	(m)	-	-	-
32	Existing MDR	201+253	Slab culvert	Nala	-	1	Empty to 4.50	Empty to 1.80	-	-	-	-	7.50	Reconstruction	Box Culvert	Nala	-	1	5.00	2.00	-	-	-	-	-	1	Concentric	-
33	276.8	201+652	Minor Bridge	Nala	-	1	8.00	3.50	8.00	RCC Solid Slab	PCC Wall type Abutment	Open	8.30	Reconstruction	Minor bridge	Nala	-	2	10.00	-	20.00	RCC Solid Slab	RCC Abutment	Open	12.00	4A	Concentric	-
34	276.085	202+365	Buried	Drain	-	-	-	-	-	-	-	-	-	Reconstruction	Box Culvert	Drain	-	1	2	2	-	-	-	-	-	1	Concentric	-
35	275.871	202+562	Pipe culvert	Canal to Nala	-	2	2.20	-	4.40	-	-	-	12.50	Reconstruction	Box Culvert	Nala	-	1	5.00	3.00	-	-	-	-	-	1	Concentric	-
36	275.351	203+102	Pipe culvert	-	-	1	1.00	-	1.00	-	-	-	8.20	Reconstruction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4	Concentric	-
37	275.154	203+305	Box Culvert	Nala	-	1	5.60	3.10	5.60	RCC Box	-	-	8.90	Reconstruction	Minor bridge	Nala	-	1	8.00	-	8.00	RCC Solid Slab	RCC Abutment	Open	12.00	4	Concentric	-
38	273.268	205+177	RCC Slab culvert	-	-	1	2.50	0.90	2.50	-	-	-	8.10	Reconstruction	Box Culvert	Nala	-	1	3.00	2.00	-	-	-	-	-	1	Concentric	-
39	272.863	205+581	Stone slab culvert	-	17°	1	3.50	-	3.50	-	-	-	10.80	Reconstruction	Box Culvert	Nala	15°	1	4.00	2.00	-	-	-	-	-	1	Concentric	-
40	272.658	205+788	Pipe Culvert	-	-	1	0.30	-	-	-	-	-	-	Reconstruction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	1	Concentric	-
41	271.922	206+522	Pipe culvert	-	-	1	0.90	-	-	-	-	-	7.60	Reconstruction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4A	Concentric	-
42	271.76	206+685	Box Culvert	Canal TO Nala	-	1	4.50	3.20	4.50	-	-	-	8.10	Reconstruction	Minor bridge	Nala & Animals	-	1	8.00 SQ Clear	6.00	8.00	RCC Box	-	-	12.00	4A	Concentric	-
43	270.536	207+907	RCC Slab Culvert	-	-	1	2.70	3.00	2.70	-	-	-	8.00	Reconstruction	Minor bridge	Nala & Animals	-	1	6.00 SQ Clear	4.50	6.00	RCC Box	-	-	12.00	4A	Concentric	-
44	-	207+956	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	-	-	1	2.00	2.00	-	-	-	-	-	4A	Concentric	Balancing Culvert
45	270.125	208+318	Pipe culvert	-	-	2	0.90	-	1.80	-	-	-	10.10	Reconstruction	Box Culvert	Nala & Animals	-	1	4.00	2.10	-	-	-	-	-	1	Concentric	-
46	269.874	208+569	Pipe culvert	-	-	3	0.90	-	2.70	-	-	-	12.40	Reconstruction	Box Culvert	Nala & Animals	-	1	5.00	3.00	-	-	-	-	-	1	Concentric	-
47	269.321	209+121	RCC Slab Culvert1x0.60 to Pipe-1x0.90 as per Forest Dept Photos	-	-	1	0.90	-	-	-	-	-	12.40	Reconstruction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4	Concentric	-
48	269.064	209+379	RCC Slab Culvert	-	-	1	2.00	1.80	2.00	-	-	-	11.90	To be dismantled	-	-	-	-	-	-	-	-	-	-	-	4	Concentric	EUP substructure falling on culvert
49	Existing Alignment	209+390	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala & Animals	-	1	4.50	3.00	-	-	-	-	-	4	Concentric	Nala training to be done on bothsides of length 14m
50	268.885	209+558	Pipe culvert	-	-	1	1.20	-	1.20	-	-	-	7.80	Reconstruction	Box Culvert	Nala & Animals	-	1	3.50	2.50	-	-	-	-	-	4	Concentric	-
51	268.275	210+152	Pipe culvert	-	-	1	0.60	-	-	-	-	-	7.40	Reconstruction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4A	Concentric	-
52	268.05	210+392	Pipe culvert 2x0.90 as per Forest Dept. photos	-	-	2	0.90	-	-	-	-	-	10.00	Reconstruction	Minor bridge	Nala & Animals	-	2	8.00 SQ Clear	6.00	16.00	RCC Box	-	-	12.00	4A	Concentric	-
53	267.873	210+571	Pipe culvert	-	-	1	0.90	-	0.90	-	-	-	10.10	Reconstruction	Box Culvert	Nala & Animals	-	1	4.50	2.50	-	-	-	-	-	4A	Concentric	-
54	-	210+935	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4	Concentric	-
55	-	211+045	-	-	-	-	-	-	-	-	-	-	-	New Construction	Box Culvert	Nala	-	1	2.00	2.00	-	-	-	-	-	4	Concentric	-
56	267.115	211+325	RCC Slab Culvert	-	-	1	4.50	3.60	4.50	-	-	-	10.70	Reconstruction	Minor bridge	Nala	-	1	6.00 SQ Clear	4.00	6.00	RCC Box	-	-	12.00	4	Concentric	-
57	266.907	211+537	Pipe culvert	-	-	1	0.60	-	0.60	-	-	-	10.80	Reconstruction	Box Culvert	Nala	-	1	2.50	4.00	-	-	-	-	-	4A	Concentric	-
58	266.562	211+883	Stone slab culvert	-	-	1	0.60	1.00	0.60	-	-	-	10.60	Reconstruction	Box Culvert	Nala	-	1	2.50	4.00	-	-	-	-	-	4A	Concentric	-

Annexure 4

LANDSCAPE-SPECIFIC MEASURES

Landscape connectivity is the degree to which habitats across the landscape are connected, facilitating wildlife movement and other ecological flows.

The following aspects and concepts need to be considered when locating and designing linear infrastructure and deciding on appropriate measures to mitigate impacts:

1) The concept of 'minimum viable population', which sets – and respects – a lower limit on the population size or numbers of individuals of a species (including their genetic diversity) to make sure that species will survive in the long term.

2) Source-sink dynamics of the landscape, which identifies the critical elements and quality of different ecosystems and habitats on which the persistence of wildlife depends, and describes how variation in habitat quality may affect the population growth and decline of organisms.

3) Metapopulation structure, which considers the geography of, and relationship between, different populations of the same species, to ensure the persistence of that species.

4) The 'Allee effect' with respect to the behavioural ecology of the species, habitat matrix and its porosity to the taxa (corridors for movement). This effect considers the correlation between population size or density, and the mean fitness of individual animals of a population or species, recognising that fitness tends to decline in smaller populations.

5) Mitigation measures should be designed and implemented to meet the collective needs of all target taxa and biodiversity values of the landscape; designing for the biggest or most demanding species will often ensure that the needs of other species would simultaneously be met. However, in certain cases, additional measures may be required for particular taxa or functional groups to provide for specific needs: e.g. structures designed for elephants will serve the purpose for most terrestrial mammalian species but may not be effective for strictly arboreal taxa, or for reptiles and amphibians; special mitigation measures will still be needed for them.

Table 8.1 summarises and Figure 8.1 illustrates the above points.

General rules for maintaining habitat connectivity across the landscape:

The general guidelines set out below to maintain connectivity across an identified species corridor are based on species ecology, such as home range and habitat use pattern, species communities across different landscapes and other ecological information.

i. If the width of the corridor through forest habitat is 1 km or less, the construction of flyovers should be undertaken in such a way that the entire stretch of forest remains connected.

ii. If the width of the corridor is 1-2 km, one underpass of 750 m should be provided across the landscape. The exact location of the underpass should be based on topographic features of the area and information about customary animal crossing zones. This 750 m stretch of elevated road could also be divided into two parts of minimum 300 m each, located within that corridor. Their location would depend upon the terrain, characteristics of the particular species and its movement patterns.

iii. If the width of the corridor is 3 km or more, or if the forest landscape is to be dissected by either a new road or the upgrading of an existing road, 300 m underpasses are suggested within every km stretch of the road. The exact location of the underpass should be based on topographic features, crossing zones, and the particular ecological requirements of the affected species.

iv. Other than maintaining connectivity for larger mammalian species, for amphibians or reptiles across the landscape, small pipe culverts or bridges should be constructed in every 100 m stretch of road.

Table 8.1. Placement of crossing structures across animal movement corridors of varying widths.

Landscape characteristic	Design measures for maintaining connectivity
Connectivity across 1 km species corridor	Entire 1 km stretch to be connected
Connectivity across 1-2 km species corridor	750 m underpass either as one structure or two 300 m each depending upon terrain and other conditions are suggested
Connectivity across 3 km species corridor or across the forest landscape to be divided by either a new road or upgrading of existing road	300 m underpasses are suggested at every km of the road
For smaller species such as amphibians and reptiles	Small pipe culverts or bridges at every 100 m stretch of the road are suggested

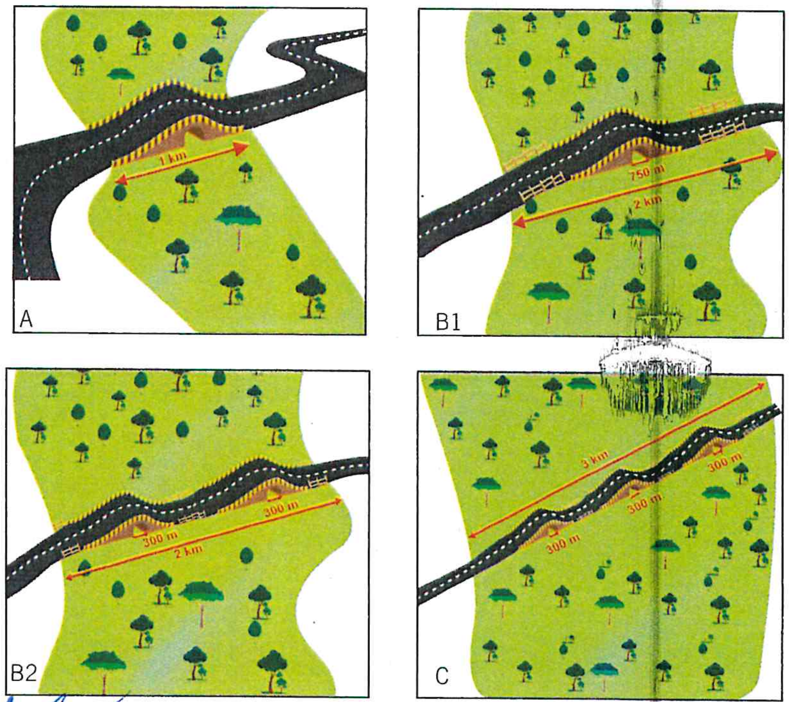


Figure 8.1. Underpass specifications suggested for different lengths of wildlife corridors: A) 1 km flyover for 1 km wide corridor; B1) one 750 m underpass, or B2) two underpasses of 300 m each for 2 km wide corridor; and C) 3 underpasses of 300 m each for a 3 km wide corridor.

SPECIES-SPECIFIC MEASURES

It is important to consider, and design wildlife crossings and animal passages to cater for, all of the species using the area affected by linear infrastructure, to improve the efficiency and effectiveness of mitigation solutions.

The following section focuses on the use of underpasses as a principal measure to mitigate negative impacts of roads and railways on terrestrial mammals. However, it is useful to note that these underpasses would also be used by other animal taxa.

Underpasses for terrestrial mammals

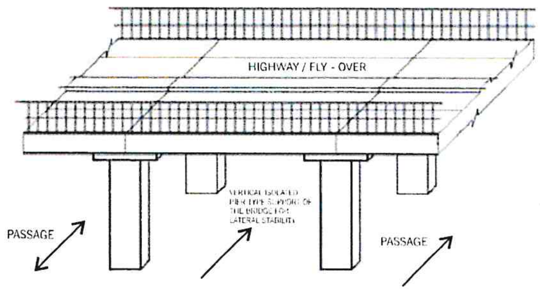
The following minimum design requirements of underpasses for specific terrestrial mammal species are based on the effectiveness of underpasses for mule deer, which have a shoulder height of 106 cm (Reed et al. 1975; Reed et al. 1979; Reed 1981; Ward 1982; Olbrich 1984; Reed & Ward 1987; Foster & Humphrey 1995; Putnam 1997).

- For chital, with a shoulder height of up to 75 cm, an openness index of 0.52 (metric) is needed.
- For sambar, with a shoulder height up to 160 cm, an openness index of 1.12 (metric) is needed.
- For gaur, shoulder height up to 175 cm, an openness index of 1.22 (metric) is needed.

Figure 8.2 shows the required underpass height in relation to animal size. In landscapes where sambar, gaur and tiger are the largest animals present, a minimum underpass height of 5 m would be acceptable if the viaduct were 300 m long and the span of the underpass were 28–30 m. For any other underpass with a viaduct of less than 300 m, and in landscapes where elephant and rhino are the largest animals in the community, the minimum height of the underpass should be 6-8 m to provide an openness ratio that could provide an optimum passage for these animals.

While approaching the underpass, the animal should preferably be able to view the horizon across the underpass in order to perceive any risks and opportunities on that side. Although a structure 5 m high and passage with a viaduct length of 300 m should be able to provide this view, a 7 m high passage would provide a more liberal view created by a higher openness ratio.

The design of the walls and the piers of an underpass can significantly improve the acceptability of passage structure by animals. Isolated piers are more favourable than wall-type piers: wall-type piers reduce lateral visibility and increase tunnel effects, especially for species that move in groups, such as chital. The inclusion of a cross beam at the top of isolated piers further improves their acceptability. Figure 8.3 shows line drawings and constructed animal underpasses with wall type and isolated piers.



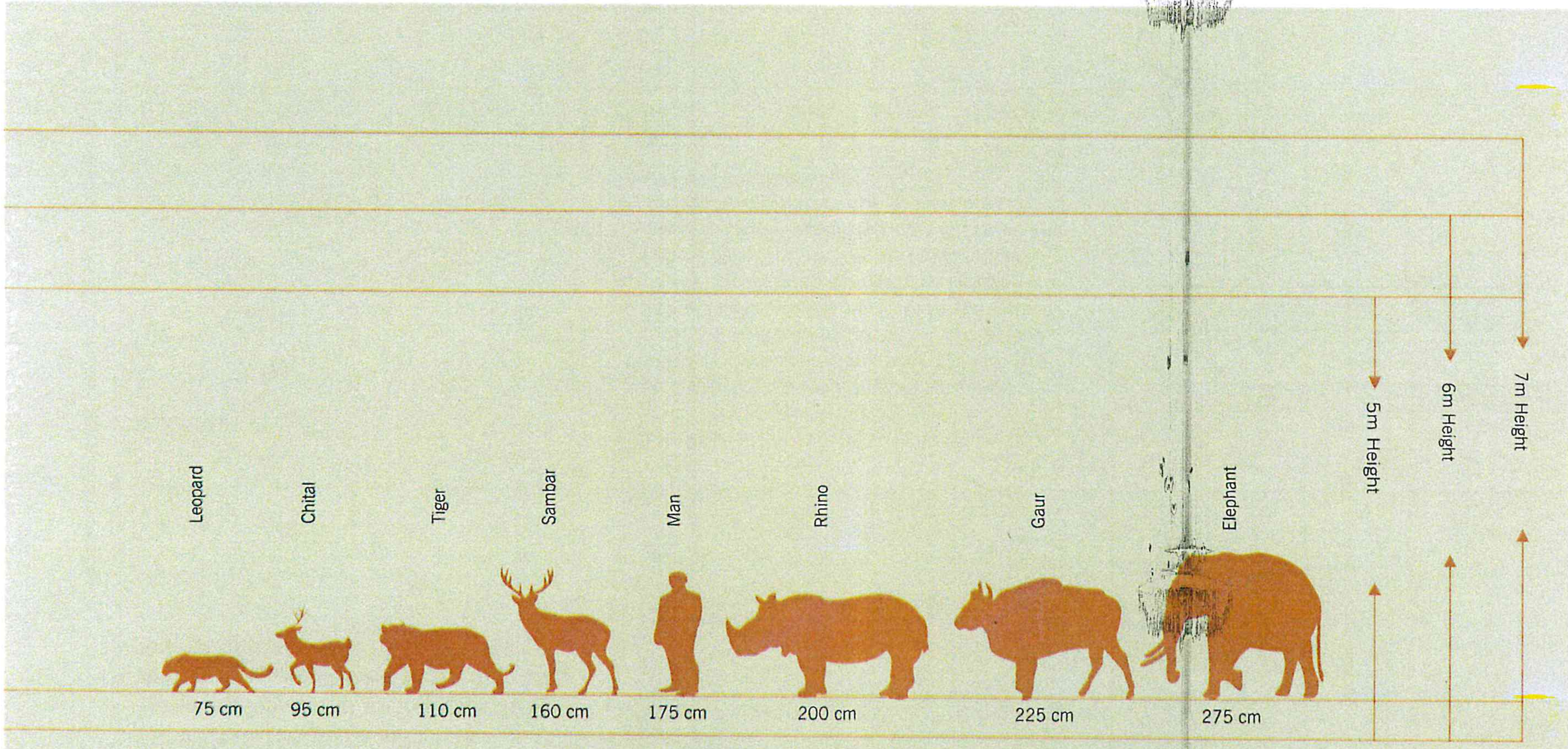


Figure 8.2. Underpass heights as they should relate to animals.

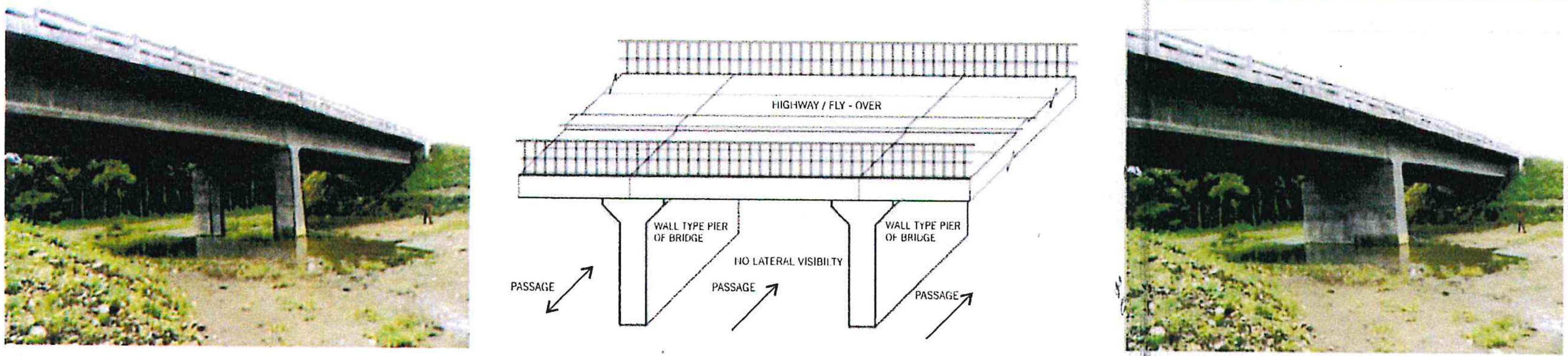


Figure 8.3. Diagrammatic representation of isolated and wall type piers. ***Source:*** *Adapted from Singh et al. 2010. Illustration by Niharika Saxena*

MITIGATION MEASURES FOR DIFFERENT LANDSCAPES

TIGER LANDSCAPES

Both underpasses and overpasses (passageways) are potential engineering solutions for mitigating the impacts of linear infrastructure in tiger landscapes. The following designs and norms for these structures should serve as the minimum requirements for mitigation in such landscapes where elephants do not occur. In landscapes where elephants are present, the design of mitigation structures would generally also meet the needs of tigers and most other biota.

Underpasses

A minimum span of 30 m with a height of 5 m and a width of 5-8 m would work for most species in tiger landscapes. The 30 m span refers to clear open passageways – often these underpasses would have support pillars for the infrastructure and they should be excluded from the span measurement.

In critical tiger corridors as well as core areas of tiger reserves— if linear infrastructure is permitted at all— mitigation measures need to be especially stringent: the span needs to be a minimum of 50 m with the same dimensions of height (5 m) and width (5-8 m).

Overpasses

After accounting for structural construction requirements, the minimum passage width of an overpass needs to exceed 30 m. The overpass should not have a steep incline to the infrastructure crossing: slopes over 25 degrees should be avoided. Thus the length of the overpass is site specific and needs to be adjusted according to the lay of the land.

Density of mitigation structures

Besides the dimensions of the underpasses and overpasses, the density or numbers of such structures per unit length of the infrastructure is a crucial consideration for mitigating impacts. A passageway of over 50 m per 1 km length of infrastructure in forested habitats and over 100 m per 1 km length of infrastructure in critical tiger corridors would ensure that habitat connectivity is maintained and fragmentation is avoided.

It is important that wild animal movement is channelled to the passageway for crossing the infrastructure by using appropriate funnelling structures, either natural or artificial. At times it may be necessary, except at the underpasses and overpasses, to fence off the road or railway when passing through wildlife habitat. This fence may be essential to avoid mortality of wildlife, prevent accidents and ensure the safety of humans. Where fences are not required or are not feasible along the entire length of the infrastructure corridor, specific mitigation measures will still be required in the vicinity of topographic features that are known to trap wildlife on roads or railways: e.g. features like railway embankments need to be flattened as they act as traps for wildlife blinded in the headlamps of approaching trains.

Visual Barriers

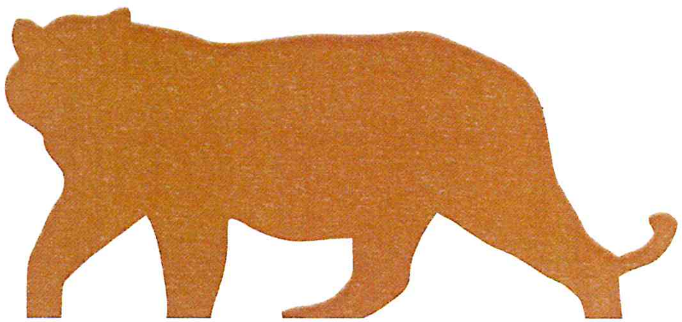
Visual barriers along the sides of the infrastructure need to be installed in such a manner that the traffic (vehicles/trains) is not visible from a distance or up close from the wild animal crossings. Care should be taken that vehicular lights do not escape the visual barrier at night as these visual clues could deter nocturnal species from using the underpass. Visual barriers can be camouflaged and enhanced by planting tall vegetation along the edges of the engineered structure.

Sound barriers

Both underpasses and overpasses need to be fortified with sound barriers to prevent any disturbance to wildlife that could potentially use these structures for passage across the infrastructure. Details of the design and construction of sound barriers are provided in chapter 11. The installation of appropriate sound and visual barriers cannot be over emphasized: without them, investments in constructing underpasses and overpasses can go to waste, as wildlife may never use them.

Olfaction and other sensory enhancers

Target wild animals can be encouraged to use the overpass or underpass by enhancing its porosity to wildlife through enrichment. These enrichments consist of a) use of appropriate substrate like soil, leaf litter, gravel, herbaceous vegetation b) attractants like food plants, carrion, pheromones, dung of conspecifics and scats in the case of carnivores like tigers. These enrichments require inputs from professional wildlife biologists and, if not appropriately used, can also act as deterrents to wildlife passage. Use of these enrichment approaches must be accompanied by rigorous evaluation and testing.



ELEPHANT LANDSCAPES

Roads and railways impact elephants in multiple ways. Loss and fragmentation of elephant habitat is the most severe problem arising from linear infrastructure development: it alters the elephant's home range and, consequently, may lead to an escalation of human-elephant conflict where these animals are forced into new areas. In addition, it may lead to elephant populations becoming isolated, resulting in a loss of their genetic diversity. To aggravate these impacts, elephants trapped in isolated areas rapidly destroy their own habitats.

Poorly planned roads and railway lines in elephant landscapes result in loss of both elephant and human life due to accidents. However, these critical problems can be addressed by appropriate mitigation measures. The principal mitigation measures proposed to minimise the impact of linear infrastructure in elephant landscapes are set out below.

Elevated linear infrastructure

Raising the linear infrastructure (road and railway line) on pillars above the ground is the best solution in elephant landscapes. A major consideration while elevating the linear infrastructure is height: the height of the pillars should be at minimum 8-10 m (thrice the height of an adult bull elephant) above ground, so as to provide safe passage for elephants. In the event that the costs of elevating infrastructure would be prohibitively expensive, other measures covered below should be considered.

Underpasses

The height of the underpass, to allow elephant movement, should be the major consideration. A minimum span of 50 m with a height of 6-8 m and a width of 10-12 m is desirable for movement of elephants.

The selection of sites for elephant underpasses should be carefully planned before road or railway design is finalised. Elephants tend to use fairly regular paths/trails and drainage lines in the forest. Such trails and drainage lines need to be identified by specialists trained specifically for this task (i.e. not untrained staff), following a thorough survey of the area. Underpasses should be located where the linear infrastructure corridor intersects with these paths/trails and drainage lines. Girder bridges are one of the best forms of underpass that can be provided for elephants' passage. Physical barriers should be erected along the remaining length of roads or railways in order to funnel elephant movement through these underpasses.

Overpasses

Construction of overpasses in flat terrain is not desirable in elephant landscapes. Overpasses can be considered as a mitigation measure only when the linear infrastructure passes through a stretch with steep terrain on both sides: the steep terrain on both sides of the road or railway can be connected with an overpass of at least 10-12 m in width.

Creating level crossings (for railway tracks)

The presence of embankments to make the track level, and even ballast (1 or 2 feet) in flat areas, makes it difficult for elephants to get off the track quickly when a train approaches. Level-crossing type approaches including ramps are advisable in places where elephant trails regularly cross railway tracks. The identification of locations for these types of level crossings requires well-trained teams who understand elephant movement and have the ability to evaluate elephant paths. However, level crossings should not be considered as a stand-alone option: this form of mitigation is not a replacement for elevated tracks, underpasses and overpasses. Level crossings should be created in addition to the above mentioned structures, because they are less safe than the latter.

Density of mitigation structures:

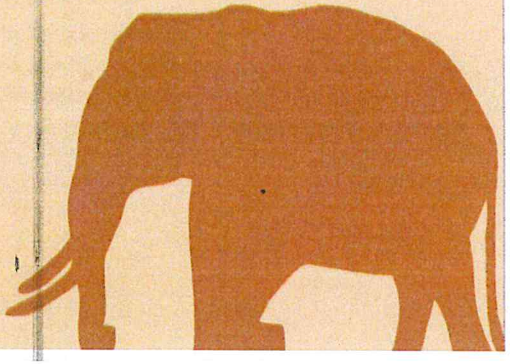
The density and numbers of mitigation structures is an important consideration for addressing the impacts of linear infrastructure in elephant landscapes. If elevating the linear infrastructure above the ground on pillars is not possible due to prohibitive costs, at least 100 m of passageways per 1 km length of linear infrastructure in elephant landscapes would ensure habitat connectivity.

Visual barriers

Visual barriers as proposed in tiger landscapes are applicable for elephant landscapes.

Sound barriers

Since elephants are sensitive to sound, all mitigation measures such as elevated structures, underpasses and overpasses need to be fortified with sound barriers. Details of the design and construction of sound barriers are provided in chapter 11.



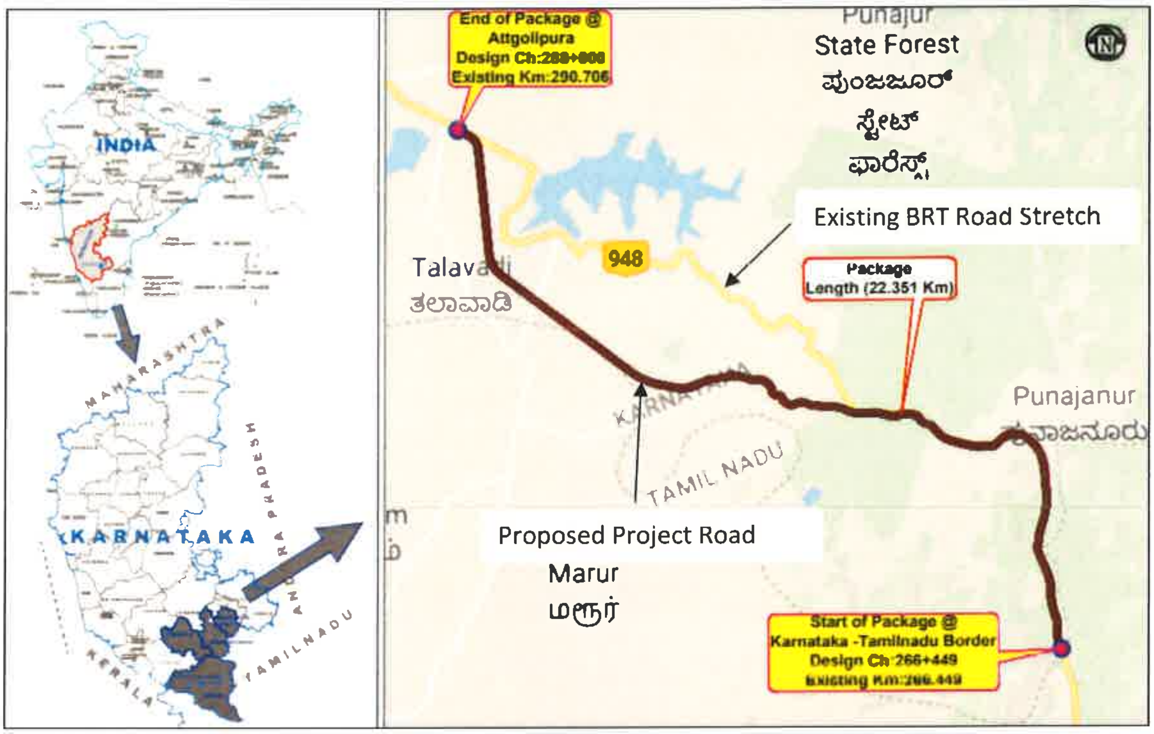
Annexure 5

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
National Highways Authority of India
(सड़क परिवहन एवं राजमार्ग मंत्रालय) भारत सरकार
(Ministry of Road Transport and Highways)
Government Of India

सत्यमेव जयते

UNDERTAKING

This is to inform that **No Traffic Movement** shall be allowed and shall **not utilize the existing BRT Road Stretch** from Km 276.820 to Km 290.706 by National Highways Authority of India after obtaining the approval from Forest department for the proposed New Alignment and after the proposed new alignment is constructed. The proposed new alignment will also avoid human animal conflict and an existing length of 13.886Km passing through forest region will also be saved. The Map Showing existing BRT Road Stretch and Proposed New Road Alignment is detailed below.



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