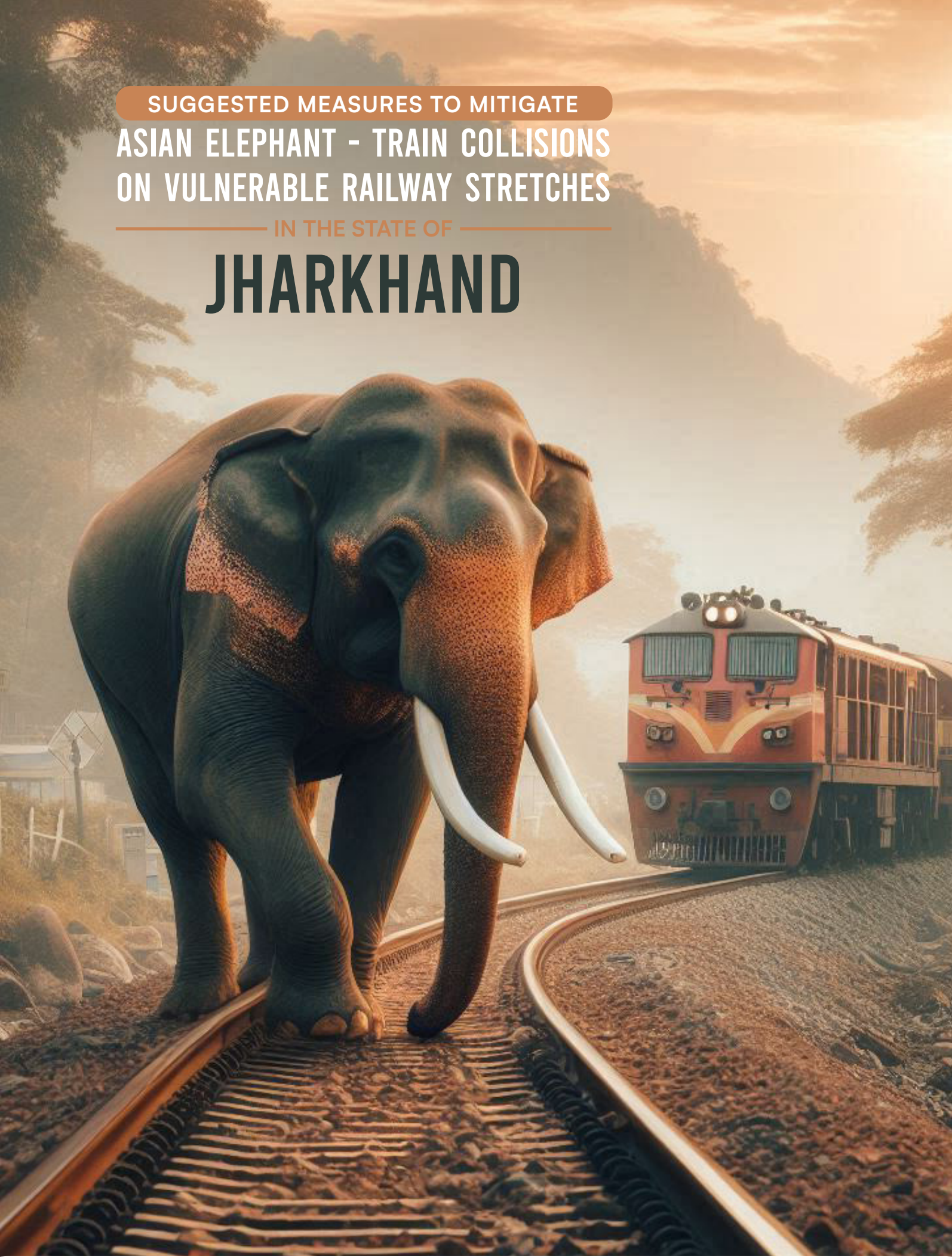
SUGGESTED MEASURES TO MITIGATE

ASIAN ELEPHANT - TRAIN COLLISIONS ON VULNERABLE RAILWAY STRETCHES

IN THE STATE OF

JHARKHAND



सत्यमेव जयते

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

AUGUST 2024

Photo Credits & Maps
Udaiveer Singh, Survey Team, AI Generated

Others : Creative Commons Attribution Licence

Graphics, Illustrations & Deisgn
Kashish Sherdia

Citation: PE-MoEFCC-WII (2024). Suggested Measures to Mitigate Asian Elephant - Train Collisions on Vulnerable Railway Stretches in the state of Jharkhand. Project Elephant Division, Ministry of Environment, Forest and Climate Change, Government of India and Wildlife Institute of India. Pp. 40

SUGGESTED MEASURES TO MITIGATE

ASIAN ELEPHANT - TRAIN COLLISIONS ON VULNERABLE RAILWAY STRETCHES

IN THE STATE OF

JHARKHAND

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

AUGUST 2024

To minimize the risk of collisions between elephants and trains, the Ministry of Environment, Forest and Climate Change and the Ministry of Railways in India have jointly undertaken several measures. These include the construction of underpasses and overpasses for safe elephant passage, setting up of signage boards to warn locomotive drivers, and speed regulations in elephant corridors. Further, efforts have also been made to sensitize train drivers and railway staff about elephant movements and using technology to track and predict elephant movements near railway tracks .These collaborative efforts aims to safeguard elephant populations while ensuring the smooth operation of railway services, and are part of a comprehensive strategy to reduce train-elephant collisions.

By implementing early warning systems like DAS, underpasses, overpasses, level crossings and installing barriers at vulnerable points along railway tracks, the Ministry of Environment, Forest and Climate Change and the Ministry of Railways aim to create a safer environment for elephants while maintaining efficient rail operations.

The collaboration between the Ministry of Environment, Forest and Climate Change and the Ministry of Railways underscores the importance of inter-departmental cooperation in wildlife conservation. By aligning their efforts, these ministries are working towards a sustainable solution to mitigate the risk of elephant-train collisions.

A combination of technological innovations, such as the use of thermal imaging cameras and automated alert systems, & traditional methods, like patrolling and community involvement, are being employed by the Ministry of Environment, Forest and Climate Change and the Ministry of Railways to protect elephants from train accidents.

ACKNOWLEDGEMENT

Shri Bhupender Yadav
Hon'ble Minister, Environment, Forest and Climate Change, Govt. of India

Shri Kirtivardhan Singh
Hon'ble Minister of State, Environment, Forest and Climate Change, Govt. of India

Shri Ashwini Vaishnaw
Hon'ble Minister, Ministry of Railways, Govt. of India

Shri V. Somana
Hon'ble Minister of State, Ministry of Railways, Govt. of India

Shri Ranveet Singh
Hon'ble Minister of State, Ministry of Railways, Govt. of India

Ministry of Environment, Forest and Climate Change, Govt. of India

Ms. Leena Nandan
Secretary, MoEF&CC

Shri Jitendra Kumar
Director General of Forest & Special Secretary, MoEF&CC

Sh. C. P. Goyal
Former Director General of Forest & Special Secretary, MoEF&CC

Dr. S. P. Yadav
Former ADG, (PT & E), MoEF&CC

Dr. G. S. Bharadwaj
ADG, (PT & E), MoEF&CC

Principal Chief Conservators of Forests (Wildlife) of Elephant Range States

Ministry of Railways, Govt. of India

Ms. Jaya Varma Sinha
Chairman & Chief Executive Officer, Railway Board

Shri. Anil Kumar Lahoti
Former, Chairman & Chief Executive Officer, Railway Board

Shri. Vinay Kumar Tripathi
Former, Chairman & Chief Executive Officer, Railway Board

Shri Anil Kumar Khandelwal
Member Infrastructure

Shri N. C. Karmali
ED (Coord.)/Gati Shakti

Shri. Kamlesh Gosai
ED/Gati Shakti (Traffic)

Shri Dhananjaya Singh
ED/GS(Civil)-II

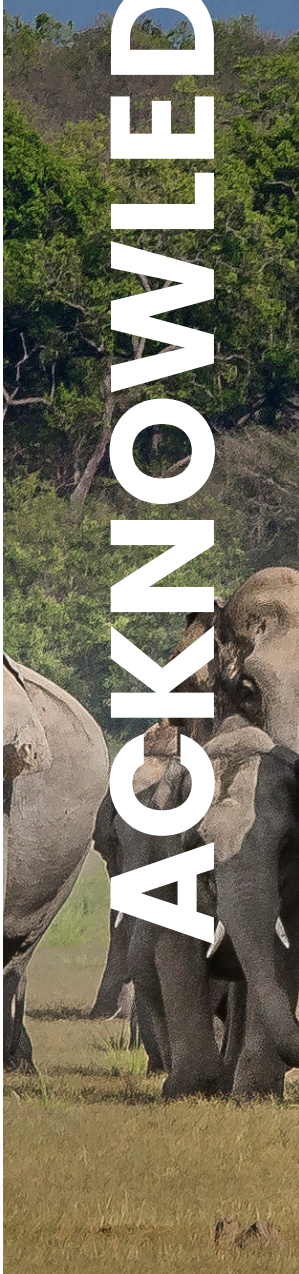
General Managers and Divisional Railway Managers of Various Railway Zones

Wildlife Institute of India

Dr. Ruchi Badola
Dean, FWS, WII

Dr. S. Sathyakumar
Scientist G/Registrar, WII

Dr. Bivash Pandav
Scientist G/Research Coordinator



Ministry of Environment, Forest and Climate Change, Govt. of India

Shri Ramesh K. Pandey
IG, (PT & E), MoEFCC

Dr. Dheeraj Mittal
AIGF, (PT & E), MoEF&CC

Dr. Dharmendra Gupta
Director (S), (PT & E), MoEF&CC

Dr. K. Muthamizh Selvan
Addl. Director (S), (PT & E), MoEF&CC

Dr. Rajendra Kumar
Scientist D, (PT & E), MoEF&CC

Ministry of Railways, Govt. of India

Shri Anil Kumar Khandelwal
Member Infrastructure

Shri. Kamlesh Gosai
ED/Gati Shakti (Traffic)

Shri Dhananjaya Singh
ED/GS(Civil)-II

Wildlife Institute of India

Sh. Virendra R. Tiwari
Director

Dr. Parag Nigam
Scientist G & NO Elephant Cell

Dr. Bilal Habib
Scientist F & ANO Elephant Cell

Dr. Lakshminarayanan
Project Scientist

Sh. Udhayaraj A. D.
GIS Expert

Core Coordination Team

Dr. Bilal Habib
Scientist F & ANO Elephant Cell, WII

Dr. Akanksha Saxena
Project Scientist, WII

Shri Aditya Bisht
Project Consultant- B

SURVEY TEAM: WII & PE, MoEFCC

Dr. Zehidul Hussain
Principal Project Associate

CONTENTS

01. Introduction

In India, train collisions significantly impact elephants, disrupting their movements and leading to fatal accidents when railway lines intersect elephant habitats. Elephants play a crucial ecological role in maintaining the balance of the ecosystem. Between 2009-2010 and from 2011-2021, 186 elephants were killed on railway tracks (February 2023 | Wildlife Institute of India, an Autonomous Institute of MoEF&CC, Govt. of India (wii.gov.in). Being a long-lived social species, such a loss can heavily impact the entire herd dynamics and an entire generation of the species. To address this issue, the Ministry of Environment, Forest and Climate Change (MoEF&CC) and the Ministry of Railways held a meeting in June 2023 to discuss potential mitigation strategies for railway tracks. The Project Elephant Division of the MoEF&CC and State Forest Departments identified 110 railway segments within elephant reserves and other areas frequented by elephants, aiming to mitigate risks to both humans and elephants.

In Jharkhand, elephants are primarily found in forested regions such as West Singhbhum, Simdega, and Hazaribagh, where they inhabit dense forests and utilize well-established migratory routes. These majestic creatures are vital in maintaining ecological balance and contributing to forest regeneration and biodiversity. However, their movement patterns often intersect with railway tracks, leading to tragic collisions. These accidents frequently occur on railway lines that cut through their habitats, particularly during nocturnal migrations. Despite efforts to impose speed restrictions and implement mitigation measures, collisions remain persistent, resulting in significant elephant fatalities. Recent incidents highlight the urgent need for effective strategies to ensure the safety of both elephants and rail traffic. The report highlights in detail the survey done in the state of Jharkhand. The survey was done between 14/02/2024 and 22/02/2024.

02. Field Survey

The Wildlife Institute of India and the Forest Department conducted a joint field survey at the identified stretches, accompanied by concerned staff from the Department of Railways, from February 13th to 22nd, 2024. During the survey, records of wildlife presence and topographic features were documented. Sites with reported elephant activity, movement or recorded deaths or injuries were identified as vulnerable to collisions between wildlife and trains. Each of these locations was visited, inspected, and thoroughly deliberated upon. After careful consideration and inspection, mitigation measures were discussed at each of these locations. Mitigation measures such as wildlife level crossings, overpasses, and underpasses were suggested based on the feasibility of construction and criteria like proximity to the nearest forest patch, human settlement, water source, and seasonality of incidents. The entire stretch was surveyed on foot, and findings were confirmed through discussions with forest and railway officials. Details of the identified railway stretch and elephant crossing areas are given in Table 1 and Figure 1.

* The objective of the field survey was to minimise elephant-train collisions either by constructing underpasses and overpasses wherever possible, by reducing the time taken by elephants to cross the railway tracks by easing movement across the track through construction of ramps and level crossings, and by implementation of technology for early detection and warning systems.

Figure 1: Surveyed railway lines in the state of Jharkhand railway passing through sensitive elephant habitats as identified by the Project Elephant Division of MoEF&CC and the Wildlife Institute of India

Table 1: Details of railway stretches passing through sensitive elephant habitats of Jharkhand as identified by the Project Elephant Division of MoEF&CC and the Wildlife Institute of India

No.	Start latitude	Start longitude	End latitude	End longitude	Crossing width (km)
1	22.31392	85.11978	20.02147	86.173276	168
2	22.95802	86.08613	23.12208	85.935675	26.5
3	23.1324	85.92995	22.97963	86.074138	35.4
4	22.84699	86.04174	22.79609	86.091693	8
5	22.48389	86.79471	22.79553	85.958771	111.6
6	22.47983	86.17583	22.76361	86.20827	38.3
7	22.16287	85.4047	22.7235	85.8800523	116.6
8	22.11184	85.52171	22.15275	85.539039	7.4
9	22.16428	85.40576	22.22515	85.385679	9.9
10	22.05147	85.20632	22.10075	85.262603	13.5
11	23.92535	84.14739	23.6514	84.949005	144.4
12	23.60205	84.74013	23.68042	84.754519	22.2
13	23.66204	84.96256	23.74066	85.058223	63.1
14	23.67917	85.06017	23.69973	85.20376	16.2
15	24.01345	85.305	24.41114	85.844082	146.2
16	24.23858	85.815	24.42461	85.547235	40.1
17	24.52947	85.43736	24.42953	85.537659	15.7

03. Site-Specific Findings & Mitigation Measures

3.1. Stretches and mitigation measures suggested in Ranchi Forest Division

Table 2: Suggested mitigation measures in sensitive elephant crossing zones in the Ranchi Forest Division, Jharkhand

No.	Latitude	Longitude	Mitigation Type*	Remarks
1	23.64871	84.97488	-	Mitigation is not required as the existing structure is well suited for elephant crossing
2	23.65793	85.03000	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system	Elephant movement during monsoon
3	Start loc 23.69427 End loc 23.69224	Start loc 85.11262 End loc 85.11474	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system	There is a primary road running parallel to the track
4	Start loc 23.69617 End loc 23.69760	Start loc 85.18556 End loc 85.19357	Underpass 6.5 m (H) x 30 m (W)	The existing structure is not feasible for elephant crossing, modification of the structure required
5	23.69956	85.20071	Underpass 6.5 m (H) x 30 m (W)	Nearby culvert not feasible for elephant movement

**H = Height, W = Width*

3.2. Stretches and mitigation measures suggested in Jamshedpur Forest Division

Table 3: Suggested mitigation measures in sensitive elephant crossing zones in the Jamshedpur Division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	-	22.48139	86.75927	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system, signage	Elephant crossing from West Bengal to Jharkhand
2	180/01 – 180/13	Start loc 22.48041 End loc 22.48012	Start loc 86.74717 End loc 86.74297	Underpass 6.5 m (H) x 30 m (W)	
3	175/19 - 175/25	Start loc 22.48364 End loc 22.48350	Start loc 86.78967 End loc 86.78763	Barricade/Trench on both sides of the track	This crossing is close to the Kanimuhuri railway station and human settlement on one side

4	178/3	22.48193	86.76634	Underpass 6.5 m (H) x 30 m (W)	The track height gives feasibility for an underpass
5	184/18 - 184/22	22.47771	86.70165	Not feasible	Human settlement & facilitating elephant movement might increase conflict
6	187/23 - 17/29	Start loc 22.47455 End loc 22.47447	Start loc 86.67239 End loc 86.67055	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system, signage	This is a stretch of forest that elephants actively use for movement
7	188/10	22.47858	86.66577	Underpass 6.5 m (H) x 30 m (W)	Necessary barricading the track on either side for elephant movement into the underpass

**H = Height, W = Width*

Figure 2: Field survey with the forest department and railway officials for suggesting mitigation measures in sensitive elephant crossing zones

Figure 3: An elephant crossing zone identified for mitigation measure during the field survey

3.3. Stretches and mitigation measures suggested in Kolhan Forest Division

Table 4: Suggested mitigation measures in sensitive elephant crossing zones in the Kolhan Forest division

No.	Latitude	Longitude	Mitigation Type*	Remarks
1	22.61076	85.54562	Existing minor bridge	Barricading in a funnel shape of 500m on each side of the existing structure. Elephant crossing from Lotapahar, Kolhan forest division to Lonjo, Porahat Forest division
2	22.50757	85.32440	Overpass	Barricading from the Mahadeosal Railway Station to the start point of the overpass
3	22.49071	85.30433	Underpass 6.5 m (H) x 30 m (W)	Elephant movement from Raibera, Kolhan Division to Polaburu-Amjaharan forest. Additionally, the area below the Karo bridge should be barricaded on each side
4	22.43629	85.24181	Underpass 6.5 m (H) x 30 m (W)	The existing underpass should be stretched from 363/32 to 363/27. Funneling and habitat enrichment are suggested on both sides to route elephant movement through the underpass
5	22.42141	85.21741	Underpass 6.5 m (H) x 30 m (W)	Barricading on both sides of the railway track from the underpass openings

**H = Height, W = Width*

3.4. Stretches and mitigation measures suggested in Saranda Forest Division

Table 5: Suggested mitigation measures in sensitive elephant crossing zones in the Saranda Forest division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	376/11A	22.35308	85.17491	Level crossing, Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system, signage	The level of the railway track is the same as the ground level, speed limit, signages
2	380/25A	22.33125	85.14146	Underpass 6.5 m (H) x 30 m (W)	Underpass opening should be barricaded along the railway track to make elephant use of the structure
3	378/25A - 378/21A	22.33999	85.15836	Underpass 6.5 m (H) x 30 m (W)	Funnel-shaped barricading on either side of the railway track up to 1000 m from the underpass

**H = Height, W = Width*

3.5. Stretches and mitigation measures suggested in Hazaribagh Forest Division (West)

Table 6: Suggested mitigation measures in sensitive elephant crossing zones in the Hazaribagh Forest division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	86/9 - 86/10	23.92949	85.33662	Underpass 6.5 m (H) x 30 m (W)	Funnel-shaped barricading on either side of the railway track from the underpass
2	91/17 - 99/18	23.88684	85.31751	Underpass 6.5 m (H) x 30 m (W)	
3	-	23.87722	85.32505	Existing Bridge	The bridge can facilitate elephant movement. However, barricading the existing crossing along the railway track is required with modification of area under the bridge for smooth elephant movement
4	94/11 - 94/16	23.87203	85.33463	Existing overpass	Already existing overpass. Need to barricade the overpass along the railway track to make elephant use this structure. Need to install sound and light barriers along the existing overpass
5	97/8 - 97/9	23.86885	85.35922	Underpass 6.5 m (H) x 30 m (W)	
6	364/7 - 363/23	24.29331	85.76437	Existing Bridge	This existing bridge can facilitate elephant movement. However, area close the bridge on either side it flat and elephant use these flat surfaces to cross railway track. It should be noted to construct barrier to prevent elephant crossing along the track and make use of the area under the bridge
7	-	24.28372	85.78254	Overpass	It should be noted that the railway concrete boundary along the railway track should not obstruct elephant movement

**H = Height, W = Width*

3.6. Stretches and mitigation measures suggested in Saraikela Forest Division

Table 7: Suggested mitigation measures in sensitive elephant crossing zones in the Saraikela Forest Division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	295/4	23.00077	86.10413	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system	Flat area with forest on one side and dam on the other side
2	289/11 - 289/8	Start loc 22.97355 End loc 22.97302	Start loc 86.08498 End loc 86.08716	Leveling of slope both side of the track with signage	Existing small culvert, underpass not feasible due to track height. Modification of slope angle to the track
3	289/15	22.97407	86.03040	Overpass	
4	290/7 - 290/8	22.97649	86.07639	Underpass 6.5 m (H) x 30 m (W)	Modification of existing structure can be done with height clearance of 6 m. However, details aspect of water logging related during monsoon due to the structure should be explored
5	292/15 - 292/16	22.99277	86.0336	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system/signage/ slope modification	The surface is flat with elephant using the Chandil dam area for usage.
6	292/15 - 293/3	22.99349	86.0569	Underpass 6.5 m (H) x 30 m (W)	The existing structure should be modified for elephant movement
7	385/S29 - 386/S5	Start loc 22.89043 End loc 22.88789	Start loc 86.06996 End loc 86.06969	Underpass 6.5 m (H) x 30 m (W)	The track is well above the ground and area feasible for underpass for elephant movement
8	394/S18	22.83194	86.01914	Underpass 6.5 m (H) x 30 m (W)	The track is well above the ground and area feasible for underpass for elephant movement
9	286/26 - 286/30	Start loc 22.75017 End loc 22.75056	Start loc 85.5296 End loc 85.85406	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system/signage/ slope modification	Flat surface on either side of the track
10	289/2 - 289/06	22.74510	85.83740	Underpass 6.5 m (H) x 30 m (W)	Triple line crossing and dung found during survey suggesting elephant movement
11	293/25A - 293/29	22.72427	85.79537	Rubberized level crossings with Distributed Acoustic Sensing (DAS) early warning system/ slope modification	Flat surface area with either side agricultural fields

**H = Height, W = Width*

3.7. Stretches and mitigation measures suggested in Chaibasa Forest Division

Table 8: Suggested mitigation measures in sensitive elephant crossing zones in Chaibasa Forest division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	363/8 - 363/10	22.16753	85.62347	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track to facilitate elephant movement through the underpass
2	342/33A - 342/35A	22.30663	85.73813	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track up to 800 - 1000 m from the underpass opening
3	337/9A - 337/11A	22.35255	85.75596	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track starting from Talaburu Railway Station to the underpass opening
4	300/31	22.65528	5.80769	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track is necessary from the underpass opening

**H = Height, W = Width*

Figure 4: Existing mitigation measures need modification like barricading from the side of the overpass along the along railway track and placement of light/sound barriers

Figure 5: Existing major bridge which requires landscape modification like habitat restoration, plantation and water availability for elephant movement under bridge

Figure 6: Existing culverts need structural modifications for elephant underpass

3.8. Stretches and mitigation measures suggested in Ramgarh Forest Division

Table 9: Suggested mitigation measures in sensitive elephant crossing zones in Ramgarh Forest division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	377/23 - 378/1	23.48888	85.74108	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track up to 1000 m is necessary from the underpass opening
2	374/7 - 374/6	23.50365	85.76817	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track to facilitate elephant movement through the mitigation structure

**H = Height, W = Width*

3.9. Stretches and mitigation measures suggested in Bokaro Forest Division

Table 10: Suggested mitigation measures in sensitive elephant crossing zones in Bokaro Forest division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	67/9 - 67/10	23.79192	85.65295	Existing major bridge	Habitat restoration and modification is suggested along the structure to enhance elephant movement
2	71/9 - 71/27	23.76775	85.63661	Underpass 6 m (H) x 30 m (W)	Barricading either side of the railway track to facilitate elephant movement through the mitigation structure

**H = Height, W = Width*

3.10. Stretches and mitigation measures suggested in Hazaribagh Forest Division (East)

Table 11: Suggested mitigation measures in sensitive elephant crossing zones in Hazaribagh Forest Division (East)

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	350/10	24.20410	85.85416	Underpass 6 m (H) x 30 m (W)	The mitigation structure should facilitate elephant movement and the existing barricading wall along the railway track should make a funnel effect
2	338/19	24.12636	85.91884	Underpass 6 m (H) x 30 m (W)	

**H = Height, W = Width*

3.11. Stretches and mitigation measures suggested in Koderma Forest Division

Table 12: Suggested mitigation measures in sensitive elephant crossing zones in Koderma Forest Division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	364/20 – 364/22	24.29437	85.7599	Existing major bridge	The existing wall barricade along the railway track will help elephants cross under the bridge
2	368/6 – 368/7	24.31360	85.73202	Underpass 6 m (H) x 30 m (W)	
3	380/28 – 381/1	24.35969	85.61779	Overpass	
4	11/23 – 11/27	24.46315	85.62157	Underpass 6 m (H) x 30 m (W)	Barricading existing elephant crossing paths and funnelling their movement towards the underpass for crossing
5	12/13 – 12/15	24.35415	85.46854	Rubberised level crossings with Distributed Acoustic Sensing (DAS) early warning system and slope modification	

**H = Height, W = Width*

3.12. Stretches and mitigation measures suggested in Latehar Forest Division

Table 13: Suggested mitigation measures in sensitive elephant crossing zones in the Latehar Forest Division

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
1	21/5A – 21/5B	23.82480	84.81904	Overpass	There is a metal road running parallel to the railway track. Therefore, the mitigation structure should be on the railway track and the road
2		23.83486	84.83588	Existing major bridge	The existing structure acts as an underpass for elephant movement. Any debris or construction material should be cleared to give open passage for elephant movement
3		23.83756	84.84064	Existing major bridge	The existing structure acts as an underpass for elephant movement. Any debris or construction material should be cleared to give open passage for elephant movement

No.	Chainage	Latitude	Longitude	Mitigation Type*	Remarks
4		23.84661	84.87263	Existing major bridge	The existing structure acts as an underpass for elephant movement. Any debris or construction material should be cleared to give open passage for elephant movement
5	02/06	23.68023	84.77234	Signage	
6	180/27	23.67278	84.78252	Existing major bridge	The existing structure acts as an underpass for elephant movement. Any debris or construction material should be cleared to give open passage for elephant movement
7	174/24 – 174/22	23.65508	84.83620	Underpass 6 m (H) x 30 m (W)	Barricading existing elephant crossing paths and funnelling their movement towards the underpass for crossing
8	23.65815	84.86662		Underpass 6 m (H) x 30 m (W)	
9	167/21 – 167/19	23.65854	84.90145	Underpass 6 m (H) x 30 m (W)	

**H = Height, W = Width*

04. General recommendations for all sites

The following blanket recommendations are to be implemented across all sites:

1. Distributed Acoustic Sensing (DAS) – based Intrusion Detection Systems (IDS) are to be implemented on all sensitive stretches on priority. Further all level crossings and ramps should incorporate the DAS IDS system as well.
2. Sign boards on the sensitive stretches should be erected to alert loco pilots, along with indications of specific wildlife-crossing zones.
3. Goods trains should be scheduled for the daytime as much as possible or during the time period when the activity of the wildlife species especially elephants is at its minimum.
4. For construction of structural mitigation measures (underpasses, overpasses, level crossings and ramps), the WII report on specifications of mitigation measures should be referred.

5. Regular clearing of vegetation till at least 30 m on either side of the railway tracks is to be done to increase visibility for both loco pilots and elephants. The frequency and responsibility of carrying out pruning may be decided mutually by both parties.

6. Strict restriction and fines on disposal of garbage, especially food items, from operating trains on railway tracks in sensitive stretches and railway stations near them should be imposed.

7. Joint teams of railways and forest department personnel should be formed for all critical stretches. The team would be responsible for joint patrolling on the track of elephant presence, coordination and information sharing, and regular cleaning of railway tracks. This can be achieved by creating WhatsApp groups for each region comprising of senior officials and frontline staff of the railways and forest department.

8. There should be regular cooperation and exchange of information between forest department and railways staff. Regular sensitization workshops for railway staff, especially loco pilots and ground staff should be conducted.

9. Most railway tracks in the surveyed areas are in the process of getting electrified. Adequate measures (insulation and proofing of all electric infrastructure) should be taken to avoid incidents of electrocution of wildlife because of the railway electric infrastructure.

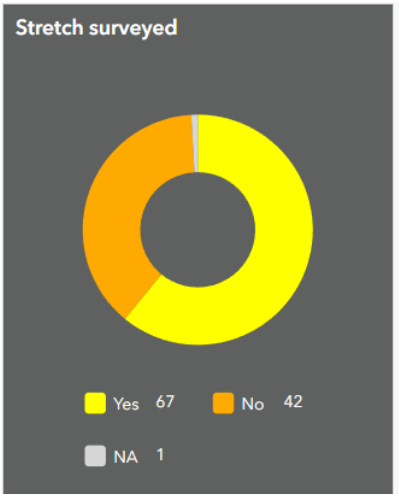
10. To discourage use of wildlife-friendly ramps and level crossings by people and vehicles, concrete barrier poles and/or other barriers should be built that are high enough to block passage of 2 and 4-wheelers, but low enough to allow elephants to pass.

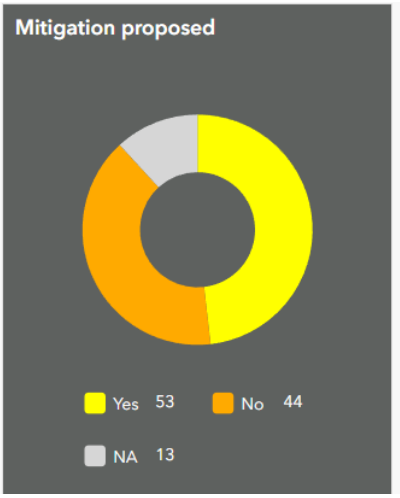
11. Incidences of elephant and wildlife injury and mortality should be documented by both parties, with complete details on GPS location, chainage, date and time of day.

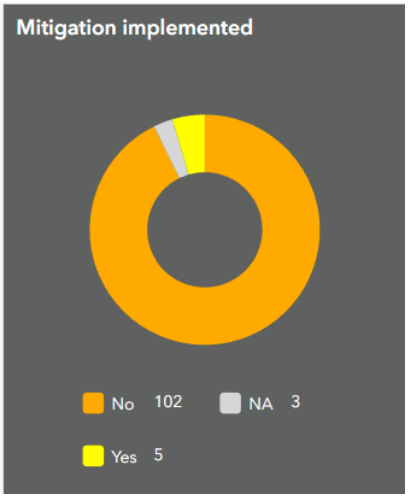
12. In the future, all metre-gauge to broad-gauge conversion projects in elephant landscapes should include comprehensive elephant mitigation plans.

13. In the future, railway stretches posing collision and barrier risks to wildlife should be identified that exist beyond elephant reserves and protected areas, such as corridors.

05. Dashboard for monitoring implementation of mitigation measures







Crossing zone details

Serial No	Name of area	State	Crossing zone width (m)	Stretch surveyed	Mitigation proposed	Mitigation implemented	Remarks	ReportLink
1	Elephant reserve	Uttarakhand	8.60	Yes	Yes	No		https://drive.google.com/file/d/1PZ2YCcHrQKnVcRywn7iyoOgDLiYQQkpe/view?usp=drive_link
2	Elephant reserve	Uttarakhand	14.30	Yes	Yes	No		-
3	Elephant reserve	Uttarakhand	28.90	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
4	Elephant reserve	Uttarakhand	4.50	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
5	Elephant reserve	Uttarakhand	21.30	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
6	Elephant distribution	Uttarakhand	5.90	Yes	No	No	Stretch falls within Kathgodam city limits	-
7	Elephant distribution	Uttarakhand	4.40	Yes	Yes	No	Surveyed by Forest Deparment	https://drive.google.com/file/d/1tFYaY4n5kYA9OhcBqeO5eqHMzqTTJWlt/view?usp=sharing
8	Elephant distribution	Uttarakhand	39.80	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
9	Elephant distribution	Uttarakhand	30.70	Yes	Yes	Yes	This stretch has been surveyed under Harrawala Project & seperately discussed with MoR	-
10	Elephant reserve	Uttar Pradesh	7.60	No	No	No		
11	Elephant distribution	Uttar Pradesh	7.60	No	No	No		
12	Elephant distribution	Uttar Pradesh	3.30	No	No	No		
13	Elephant distribution	Uttar Pradesh	10.30	No	No	No		
14	Elephant distribution	Uttar Pradesh	49.80	No	No	No		
15	Elephant distribution	Uttar Pradesh	19.00	No	No	No		

India is a megadiverse country, with only 2.4% of the world's land area, but accounts for 7-8% of all recorded species of the world, including about 91,000 species of animals and 45,500 species of plants. India is also the second-most populous country in the world with a population of over 1.3 billion people! To transport and cater to the needs of such a large population, the Indian Railway is the main artery of inland transportation in India. In 2020, it carried a total of 808.6 crore passengers! Indian Railways is also the single largest employer in India and the eighth largest in the world, employing approximately 13 Lakh people. It is the country's lifeline for large-scale traffic movement – freight and passengers. Railways are at the core of India's economic development and make it possible to conduct many activities like business, sightseeing, and pilgrimage along with the transportation of goods over longer distances. In fact, the Indian Railways is among the world's largest rail networks and runs thousands of trains daily. To cater to India's fast-growing economy, the railway sector has envisaged Vision 2024 to achieve targets of 2024 MT freight loading by 2024. The railway also aims to electrify the entire network.

Recognized as economic, energy-efficient, and environment-friendly relative to other means of transport such as roads and air, the expansion and upgrading of railways is seen as an important measure in supporting development through large-scale movement of people and goods. However, railway construction and operation has its ecological effects, and a range of impacts on wildlife and habitats have also been documented. Several of India's passenger

and freight trains crisscross through some of the country's most sensitive wildlife habitats, particularly protected areas and corridors that are home to critically endangered tigers and elephants, amongst other animals. The extensive network of our Railways cuts through several of these forested landscapes, compromising the connectivity of the landscape and resulting in a barrier effect.

To reduce the impact of railways on our wildlife, it is important to come together and develop measures that can protect India's rich biodiversity and also help to develop a system that is more sustainable and effective in minimizing mortalities and reducing barrier effects across the railways tracks passing through sensitive habitats in India

Project Elephant Division of MoEF&CC in coordination with Ministry of Railways and Wildlife Institute of India has identified sensitive stretches which need prioritization for mitigation planning. The portal is developed to monitor the progress of implementation of mitigation measures from the beginning. The process involves joint surveys of the identified stretches by officials of the Forest Department, Railways and Wildlife Institute of India, recommendation of mitigation measures and implementation of the mitigation measures. The mitigation proposed on the stretches surveyed by various team has been upload on the dashboard. The dashboard can be accessed at Railway Crossing Zones Dashboard (arcgis.com)

The purpose of the dashboard is to monitor the implementation of the mitigation measures on the surveyed stretches. The officers are requested to update the information on the dashboard developed for the purpose. In case of any issues please reach us at projectelephant.moef@gmail.com or elephantcell@wii.gov.in

05. List of State Forest Department and Indian Railways officials consulted during the survey

Jharkhand Forest Department Staff:

Latehar Forest Division

Alok Tigga, *Sub-beat Officer, Chandwa Range*

Sumit Kumar Gupta, *Sub-beat Officer, Chandwa Range*

Sunil Kachhap, *Sub-beat Officer, Chandwa Range*

Jamshedpur Forest Division

Kalyan Prasad Mahto, *IC Forest, Chakulia Range Office*

Anup Kumar Bera, *Sub-beat Officer, Chakulia Range Office*

Biplab Kumar, *Sub-beat Officer, Chakulia Range Office*

Hazaribagh Forest Division

Vidya Bhushan, *Forester-In-Charge*

Anshu Kumar, *Forester-In-Charge, Bagodar Range*

Deb Chand Mahato, *Sub-beat Officer*

Prabhat K. Lakra, *Sub-beat Officer*

Saraikela Forest Division

Rana Pratap, *Forester, Chandil Range*

D.N. Tudu, *Forester-In-Charge*

Saraikela Range

Amit Kumar Patnayak, *Forest Guard, Kharsawan Range*

Koderma Forest Division

Ravinder Kumar, *RFO, Domchach Range*

Rahul Kumar, *Sub-beat Officer, Gajhandi Range*

Hiraman Oraon, *Sub-beat Officer, Koderma Range*

Abhimanyu Kumar, *Sub-beat Officer, Domchach Range*

Ram Babu Kumar, *Gajhandi Range*

Saranda-Kolhan Forest Division

Ram Nandan Ram, *RFO, Koina-Manoharpur Range*

Shanar Bhagat, *RFO, Saitbar Range*

Chaibasa Forest Division

Jitendra Prasad Singh, *RFO, Noamundi Range*

Richard Mathew Soren, *Sub-beat Officer, Chaibasa Range*

Ekka Bablu Lakra, *Sub-beat Officer, Chaibasa Range*

Ramgarh Forest Division

Shailender Kumar, *Sub-beat Officer, Mandu Range*

Nilesh Chandra Poddar, *Sub-beat Officer, Mandu Range*

Bokaro Forest Division

Dheeraj Kumar, *Sub-beat Officer, Tenughat Range*

Indian Railways

Sunil Kumar, *Assistant Operation Manager (Control), Kharagpur Division, SE Railway*

Rahul Kumar, *JE/P.Way/DVM, Kharagpur Division, SE Railway*

Subodh Kumar Singh, *Chief Divisional Transportation Inspector, Ghatsila, Kharagpur Division, SE Railway*

J. C. Das, *OC, RPF, Ghatsila, Kharagpur Division, SE Railway*

B. Pashwan, *Senior Section Engineer/P.Way, Muri, S.E. Railway*

R.K. Singh, *Senior Section Engineer/Works, Sini – KKP, S.E. Railway*

Kamlesh K. Singh, *ADEN/West/CKP, S.E. Railway*

K. Shrinivas, *SSE/Workline/CKP, S.E. Railway*

Ranjeet Singh, *Senior Section Engineer (Works), Chaibasa-Chakradharpur Division, S.E. Railway*

Giridhar Kumar, *SSE (Special), S.E. Railway*

Dilip Kumar, *Assistant Divisional Engineer, Dhanbad Division, S.E. Railway*

06. References

Project Elephant, MoEF&CC, Government of India (2023), Elephant Corridors of India 2023 (Edition – 1/2023).

WII, (2024). General Guidelines for Suggesting Mitigation Measures on Existing Railway Tracks Through Elephant Habitats in India.

APPENDIX 1

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

GENERAL GUIDELINES

FOR SUGGESTING MITIGATION MEASURES ON EXISTING RAILWAY TRACKS THROUGH ELEPHANT HABITATS IN INDIA

MAY 2023

General Guidelines for Suggesting Mitigation Mesaurs on Railways Tracks through Elephant Habitats in India

Railway lines passing through elephant habitats can alter movement patterns and cause collisions of elephants with trains. Considering the threats to both elephant and human life, WII in consultation with Project Elephant Division of MoEFCC and State Forest Departments has identified 105 stretches of railway lines cutting through elephant reserves and elephant distribution beyond elephant reserves. Subsequently, the Ministry of Environment, Forests and Climate Change (MoEF&CC) and the Ministry of Railways (MoR) in a joint meeting directed that surveys by the railway officials, respective state forest department officers, and WII should be conducted within these stretches. The objectives of the joint field surveys would be to identify specific elephant crossing zones on these stretches and to suggest site-specific mitigation measures based on the location and the extent of these crossing zones.

In the case of existing railway lines, designing and locating structural mitigation measures for wildlife are confounded by several factors. Most critical among these is the limitation of the track height i.e., the height of the railway track with respect to surrounding terrain, making it difficult to allocate the minimum underpass height of 6 m required for animal underpasses in elephant landscapes. Additionally, excavating the ground under the track to achieve the prescribed height makes structures vulnerable to damage by rainwater, and also renders the structures unusable by wildlife. Thus, the choice of mitigation measures on existing railway lines has to be based on multiple factors that include wildlife, landscape as well as railway track design considerations. However, in the case of new railway lines, allocating adequate height to the railway tracks to incorporate wildlife mitigation measures along the line should be ensured.

In light of these factors, the following general pointers are prescribed to guide the Railway and Forest Officials in designing and choosing between different structural mitigation measures in the identified critical elephant zones intersected by railway lines. The choice of mitigation measures can be based on landscape, topography, railway track height, and other logistics.

1. Level crossings

The coarse ballast used on railway tracks is unsuitable for movement by wildlife, particularly elephants. For this reason, level crossings for elephants built using suitable material (soil, cement) and with smooth gradient can help ease movement across the railway track at grade. Level crossings are ideally located where the surrounding land is at level (flat) with the railway track and coincides with a known/identified elephant crossing area. Rubberized level crossings[1] (Fig. 1) may also be used in place of cement and soil.

[1] Functional Specification for Rubberised Surface at Level Crossings. 2019. Ministry of Railways, Govt of India. https://rdso.indianrailways.gov.in/

Figure 1. A level crossing with a rubberised surface that can be replicated on level crossings for wildlife.

2. Ramps

At most elephant crossing locations intersected by railway lines, the elevation in track height and the additional layer of ballast makes it difficult for a large-bodied hoofed animal like an elephant to make quick decisions and move away from a railway track in the event of an approaching train, leading to elephant-train collisions. At such locations, ramps using suitable material (soil, cement) may be constructed that flattens towards the top of the track, and allow for smooth and quick movement by elephants. It is important to include a level crossing instead of ballast at the top of the ramp (near the railway track) to ensure smooth movement by elephants. The sites for construction should be based on identified animal crossing zones and suitable terrain. Ramps should be levelled with the surrounding terrain by smoothening out the slope (Fig. 2). Additionally, in areas with human presence, the ramps may be fenced to funnel elephant movement across the railway track.

The orientation of the ramps with respect to the railway track may be oblique or perpendicular, depending on the land available for flattening the ramp to a navigable slope. The width of ramps and level crossings for elephants should be at least 50 m wide. Early warning systems or wildlife sensors may be provided at these places as additional measures to detect elephant movement and to avoid collision with trains.

Figure 2. An example of a ramp built for aiding elephant movement across a railway line near Coimbatore, Tamil Nadu, India (Top) and an elephant group using a ramp constructed for ease of movement in Deepor Bheel Assam, India (Bottom).

3. Wildlife underpasses

The term wildlife underpass can be used to describe different types of structures built below the railway track to facilitate wildlife movement. These can be box culverts, viaducts, or bridges with natural drainage of different heights and widths, depending on the target wild species or community. In elephant landscapes, the minimum height of an underpass should be 6 m, with adequate width (minimum 30 m) to allow for the movement of large elephant herds (Fig. 3). However, the actual size would depend on the width of the crossing zone and feasibility of construction of underpass considering track height and curvature. Nonetheless, all efforts should be made to maintain a minimum width of 30 m. At locations where the track height is suitable, the topography of the adjacent land should be such to avoid flooding of the underpass by rainwater. Additionally, light and sound barriers should be installed above the railway track to reduce the disturbance due to train traffic on animals using underpasses.

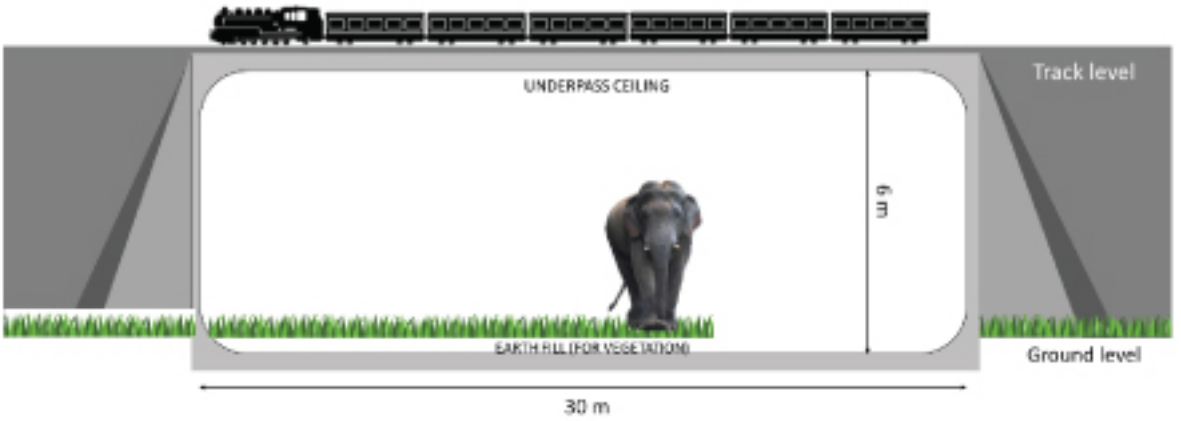


Figure 3. Graphic representation of an underpass for elephants below a railway track.

4. Wildlife overpasses

Wildlife overpasses are bridge-like structures built at a height across linear infrastructure (roads and railway lines) to allow wildlife to move across the gap in the habitat. Such structures are usually enhanced with natural habitat features such as native vegetation, rocks and logs. Wildlife overpasses are less confining, quieter and have ambient natural conditions of light and weather as compared to wildlife underpasses. Since wildlife overpasses are built at a height, construction of overpasses requires adequate height on either side of the road/railway line. Thus, overpasses should be built at locations with suitable height (> 7m) and topography on either side. A wildlife overpass should not be less than 30 m wide, and may be wider in case of double or triple parallel railway lines.

Overpasses should ideally be built using pre-fabricated material and installed on-site. The overburden from the construction site or excavated from other sites may be used for filling. Further a suitably thick layer of soil should be laid on top of the pre-fabricated material. Revegetation should then be carried out using native grasses and shrubs on the substrate to provide a natural movement path. Either side of the top of the

overpasses should be fenced with light and sound barriers (Fig. 4). The slope/approach of the overpass should be not more than 30 degrees at any point. If the overpass is to be constructed across two or more railway tracks, a supporting pillar/post may be provided for structural support (Fig. 5).

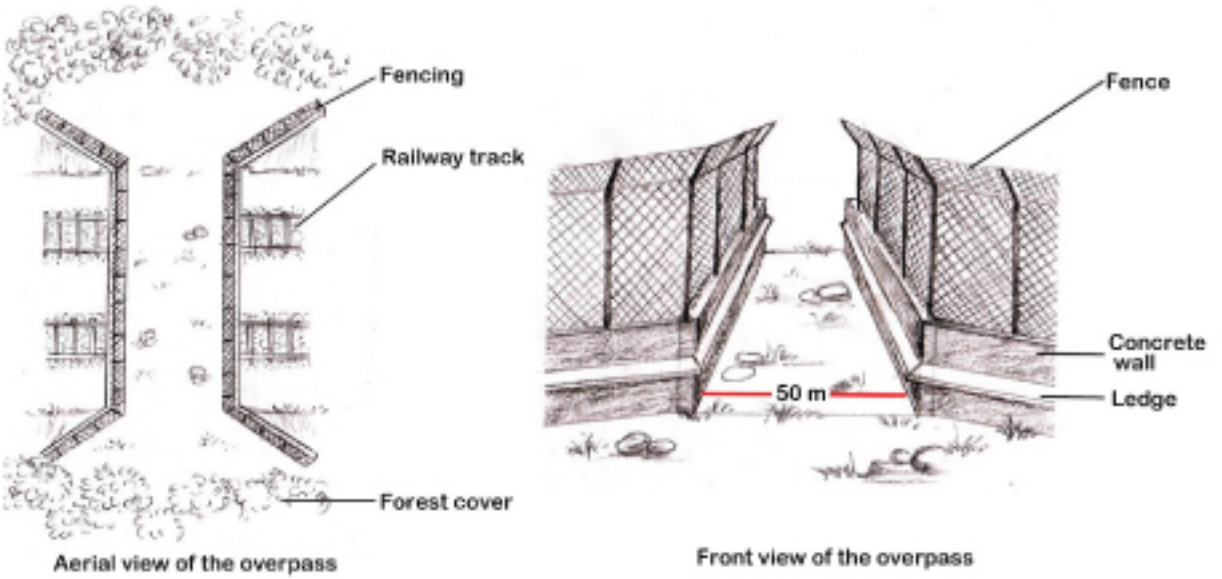


Figure 4. Aerial and front view of overpasses on railway tracks, with fencing/noise and sound barrier details.

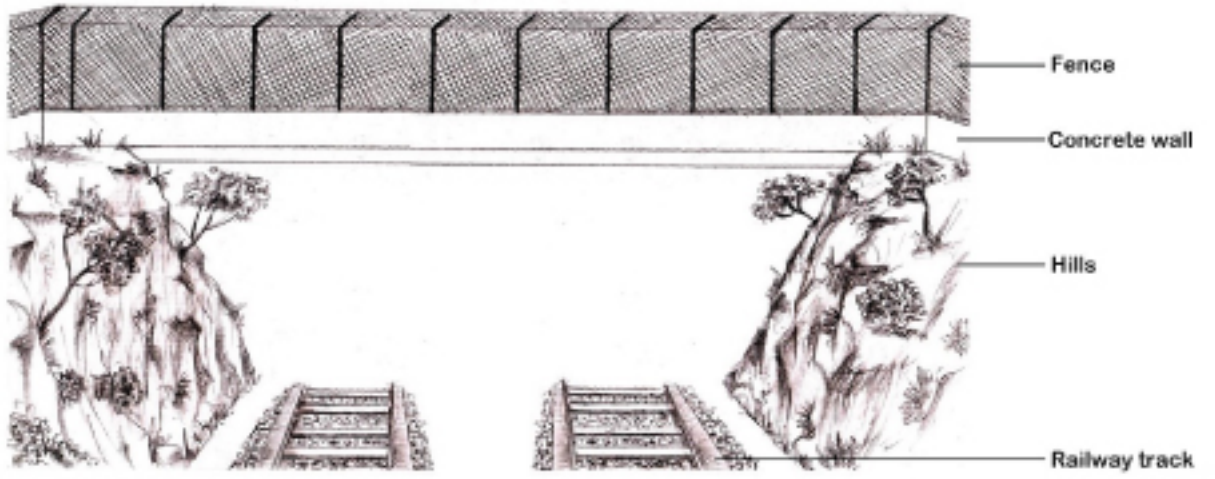


Figure 5. Lateral view of a wildlife overpass on a double-track railway line.

5. Installation of Distributed Acoustic Sensing (DAS) System

Irrespective of the type of mitigation measures to be employed across the sensitive railway stretches, all the sensitive stretches have to be installed with DAS. The system developed by railways to detect the presence and movement of the elephants along the railway tracks is basically an intrusion-based detection system based on Distributed Acoustic Sensing (DAS). A DAS monitoring interrogator converts a standard communications single-mode fiber into thousands of extremely sensitive

acoustic and vibration sensors. The Distributed Acoustic Sensor connected to one end of the fiber uses a laser to send thousands of short pulses of light along the fiber every second. A small portion of the light traveling in fiber is reflected by the process known as Rayleigh Backscatter. The concept of securing a network from malicious entities by capturing and monitoring data packets was first employed by James Anderson in 1980. Since then, researchers have developed various approaches to enhance the performance and accuracy of intrusion detection.

Vibrations from the surrounding environment will disturb the light in the fiber and will therefore be observed by the DAS interrogator. The events that are of concern are reported to the alarm server. As the data is processed in real-time, advanced algorithms can recognize the unique signatures of each type of event.

The system can show the precise location of the event, and information about what event has taken place, which means the laser pulse frequency, pulse width, and many other parameters. These parameters can be controlled, enabling the system to be tuned to the desired requirement. Integrated with machine learning and artificial intelligence, the system can differentiate even between minor variations in the scatter. The optic fiber cable running along infrastructure and other important assets can give uninterrupted and real-time feedback on activities occurring along and around them.

The recommendations of the MoEFCC committee constituted vide office order No. WL-8/28/2022-WL on 3rd January 2023 needs to be considered for the implementation of the DAS.

****

Project Elephant Division
Ministry of Environment, Forest & Climate Change
6th Floor, Jal Block,
Indira Paryavaran Bhawan,
Jor Bagh Road,
New Delhi 110003.
E-mail: projectelephant.moef@gmail.com

भारतीय वन्यजीव संस्थान
Wildlife Institute of India