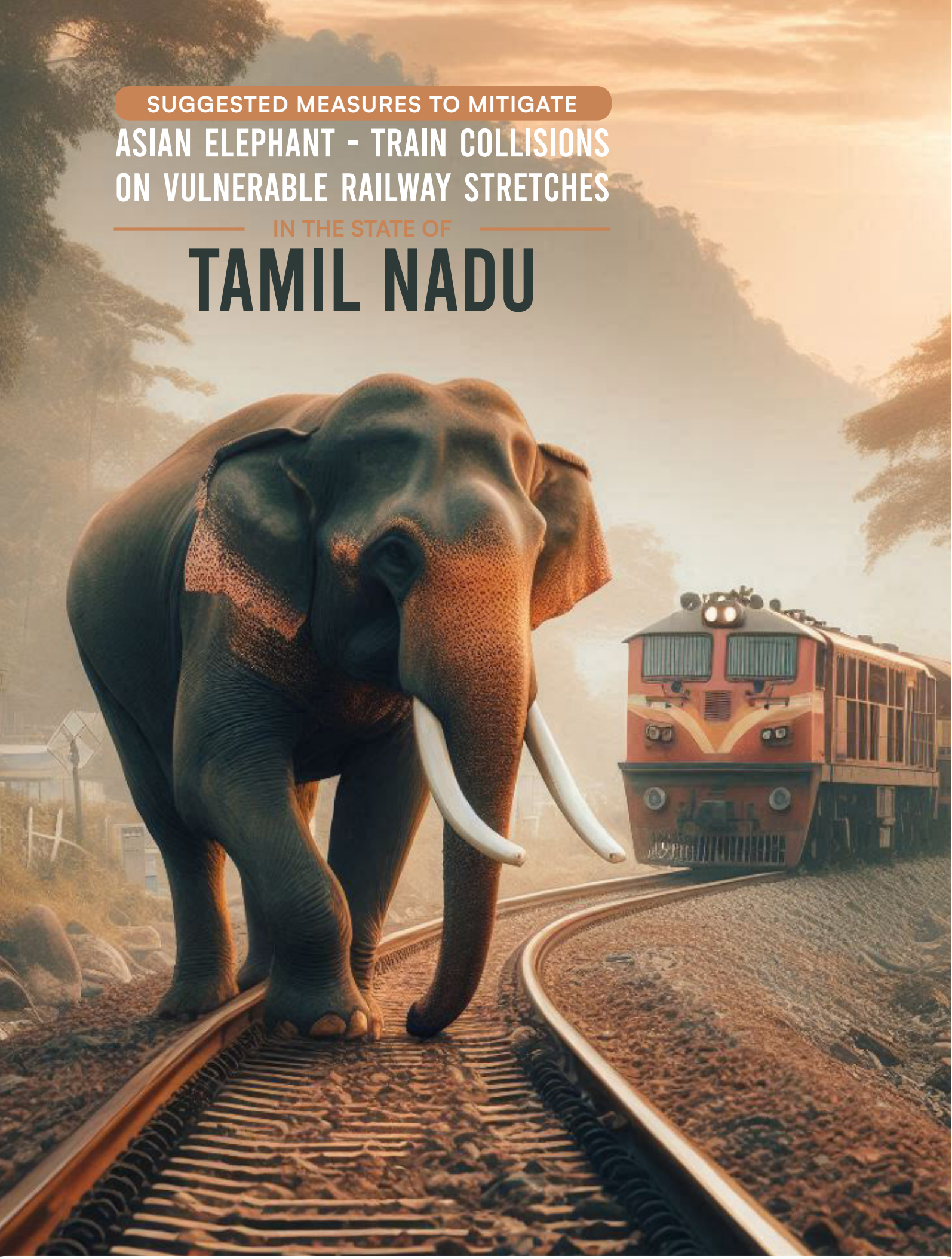
SUGGESTED MEASURES TO MITIGATE

ASIAN ELEPHANT - TRAIN COLLISIONS ON VULNERABLE RAILWAY STRETCHES

IN THE STATE OF

TAMIL NADU



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Wildlife Institute of India

AUGUST 2024

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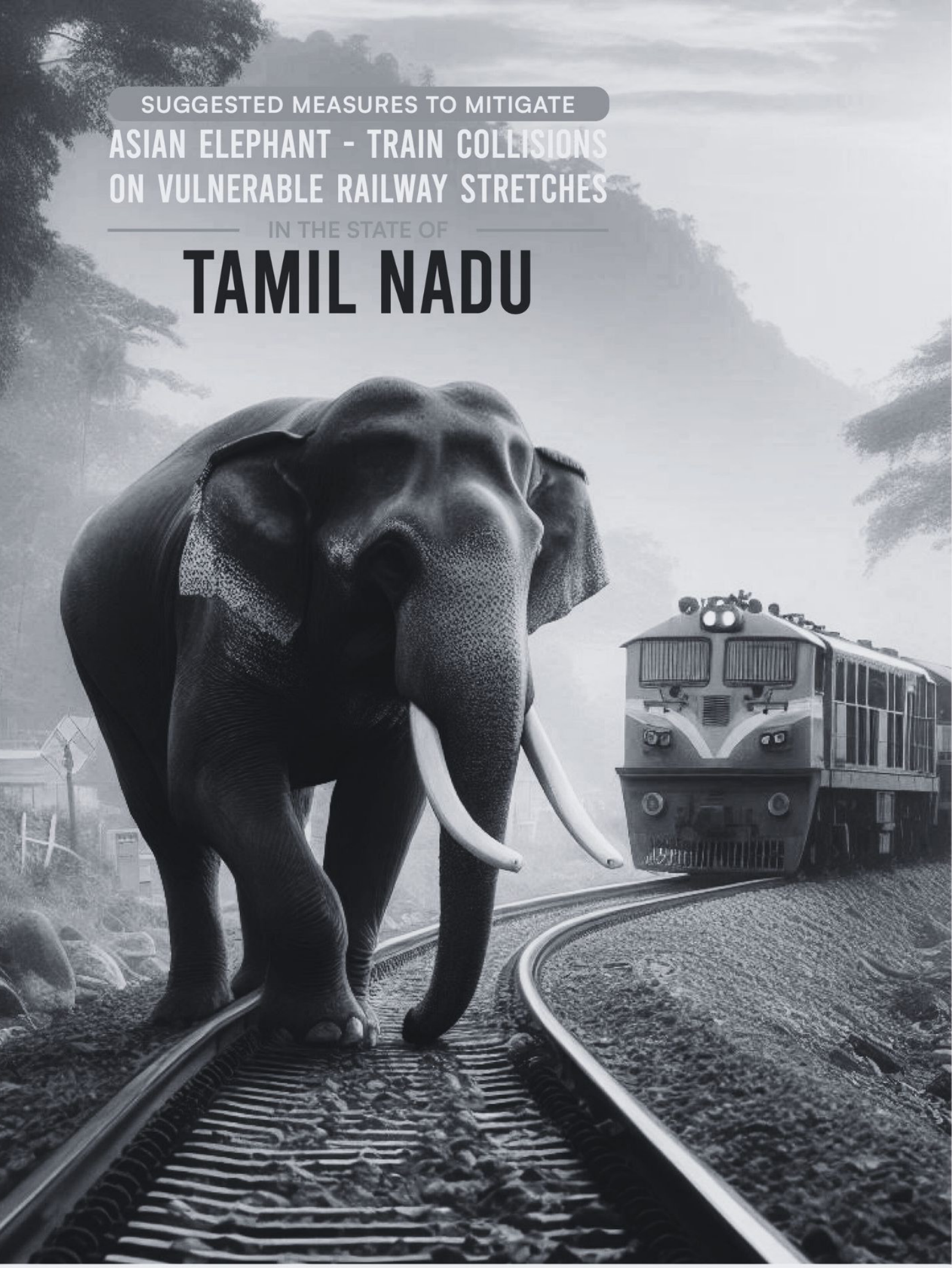

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To minimize the risk of collisions between elephants and trains, the Ministry of Environment, Forest and Climate Change and the Ministry of Railways in India have jointly undertaken several measures. These include the construction of underpasses and 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.

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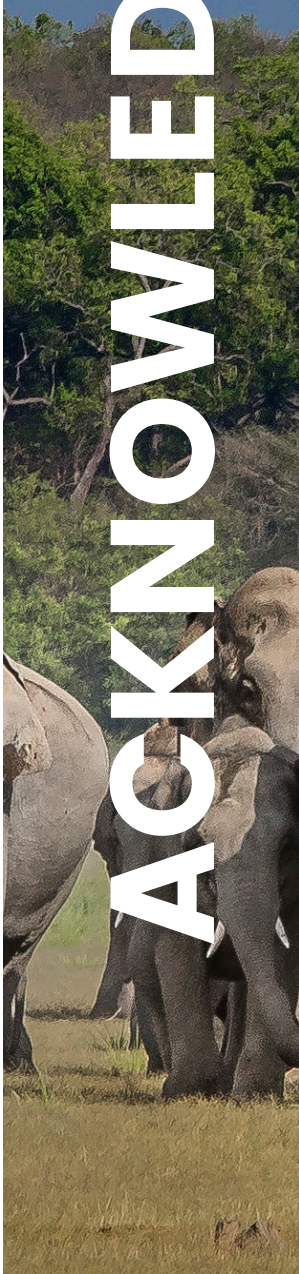

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01. Introduction

Train collisions pose a significant threat to elephants in India. Elephant movements can be disrupted, and incidents between trains and elephants can occur when railway lines cross through elephant habitats. There is ecological significance of the elephants in preserving the equilibrium of the ecosystem. In order to reduce the number of train-elephant collision events, the Ministry of Environment, Forest and Climate Change (MoEF&CC) and the Ministry of Railways convened a meeting in June 2023 to discuss potential mitigation measures that could be implemented on the railway track. In this regard, the Project Elephant Division of the MoEFCC and State Forest Departments identified 110 railway line segments across elephant reserves and elephant distribution areas outside of elephant reserves, taking into account the risks to both human and elephant lives.

Tamil Nadu, with an estimated about 2,500 elephants (approximately 10% of India's population) as of 2023, plays a vital role in national elephant conservation efforts. The state boasts two elephant reserves encompassing over 12,000 km^2 and several elephant corridors. There were 8 railway stretches identified in the Tamil Nadu state that pass through elephant habitats and are considered important for wildlife movement across the railway lines (Office Memorandum, GOI, MOEF&CC(PE), New Delhi. F.No.12-1/2029-PE (part-1), dated: 30.08.2022) (Table 1).

Table 1: The identified stretches of railway lines to survey the elephant collision risk in Tamil Nadu.

Sl No.	Length (km)	Start Latitude	Start Longitude	End Latitude	End Longitude	District
1	3	10.868581	76.83481	10.87713	76.85952	Coimbatore
2	5.3	10.899215	76.90627	10.9003	76.92634	Coimbatore
3	14.4	11.341931	76.79704	11.33747	76.69662	Coimbatore
4	14.8	11.177097	76.96344	11.04576	76.95146	Coimbatore
5	90.3	11.222887	76.96948	11.40675	76.69662	Coimbatore, the Nilgiris
6	9	12.624218	78.39531	12.57676	78.44251	Tirupattur
7	14	12.595113	78.57493	12.68973	78.63589	Tirupattur
8	6.9	12.630446	78.428	12.58328	78.47487	Tirupattur

02. Field Survey

A joint survey by the WII and Forest department was carried out at the identified stretches from 20th March 2024 to 27th March 2024, where local railway officers joined wherever possible. During the survey, records of the presence of the wildlife and topographic features of such sites were taken. Sites where elephant activity has been reported or where records of elephant deaths or injuries exist were deemed vulnerable to collisions between wildlife and trains. After careful consideration and inspection, mitigation measures were taken at each of these locations. Most of the stretches were walked on foot (Fig. 1), except the ones where it was ascertained through discussion with the forest and railway officials that the identified railway line stretch does not cross through forest habitat and it was located in the middle of human habitation.

Figure 1: Field survey along the Connoor – Mettupalayam railway line.

The identified stretches in Tamil Nadu could be grouped into three major clusters- 1) the southern Coimbatore district, 2) The Nilgiris and Mettupalayam Forest range in Coimbatore district, 3) Tirupattur district. While 8 stretches were initially identified, an on-ground visit revealed that a few of the stretches fall completely into human habitation, and there were no reports of elephant movement. The stretch from Coimbatore to Karmadi in Coimbatore district, Vaniyambadi to Jolarpet and Patchur to Mallanuru (eastern track) in Tirupattur district did not have any elephant movement and did not require any mitigation structure. In Coimbatore, two tracks, Ettimadai – Walayar and Madukkarai – Ettimadai, were surveyed. A few stretches on the Mettupalayam to Ooty track in Coimbatore and the Nilgiris districts were overlapping and this was surveyed as a single track from Kallar to Ooty. In Tirupattur district, only one track, Patchur to Mallanuru (western track) passing through Kothur reserve forest, was surveyed.

* 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.

03. Site-Specific Findings & Mitigation Measures

3.1. Ettimadai - Walayar

This railway line connects Coimbatore to Palakkad in Kerala and has heavy traffic of over 150 trains per day, including high-speed trains and local passenger trains (Fig. 2). The 3 km stretch in the Madukkarai forest range close to Walayar station in Kerala is crucial from an elephant conservation perspective. Madukkarai forest area is used by migrating elephants whose ranges are spread largely across Kerala. The railway line in this stretch is looped separately with upward and downward routes (Fig. 3). The route from Coimbatore to Palakkad crosses (northern track) from the middle of the forest and bisects a crucial migration route used by these elephants. The route from Palakkad to Coimbatore (southern track) has little forest around it but is surrounded by banana and coconut plantations. There have been elephant death reports as recent as 2022, where 3 elephant death incidents occurred on the track.

The Tamil Nadu Forest Department and Railway Department have taken proactive measures to thwart such incidents from happening on this track. The northern track has 2 elephant underpasses and 3 level crossing ramps within a 3 km stretch. The forest department reported regular use of the underpasses and ramps. Apart from the elephant, signs of wild dogs, gaur, sambar, and wild boar were found at the mitigation structures. In addition, an AI-based elephant monitoring system has been installed on both lines (Fig. 4). A control room is established to monitor the elephant movement close to the railway tracks 24 hr. Any sighting close to the tracks immediately triggers an alarm to the running trains.

While the existing structures are sufficient in number, the level crossing ramps have an unsuitable design (Fig. 5). The railway track is above ground, and ramps are built on either side. The track, however, is filled with ballast, which is known to slow down elephant movement and increase the risk of collision. To ease the elephant crossing, the track should be levelled using modern design and materials such as rubberised filling (Table 2).

The AI-monitoring system is promising. In the test run from December 2023 to January 2024, 130 alert warnings were generated by the system, out of which 119 incidents involved elephants coming close to the track. The system also alerted about the presence of Indian gaur and leopard. Currently, the warning is generated when animals are within 20m of the track. This could be improved by widening the alert range to 50 meters so that the train loco pilot has ample time to react. The AI system could be replicated at other sites in India with a high risk of elephant-train collision.

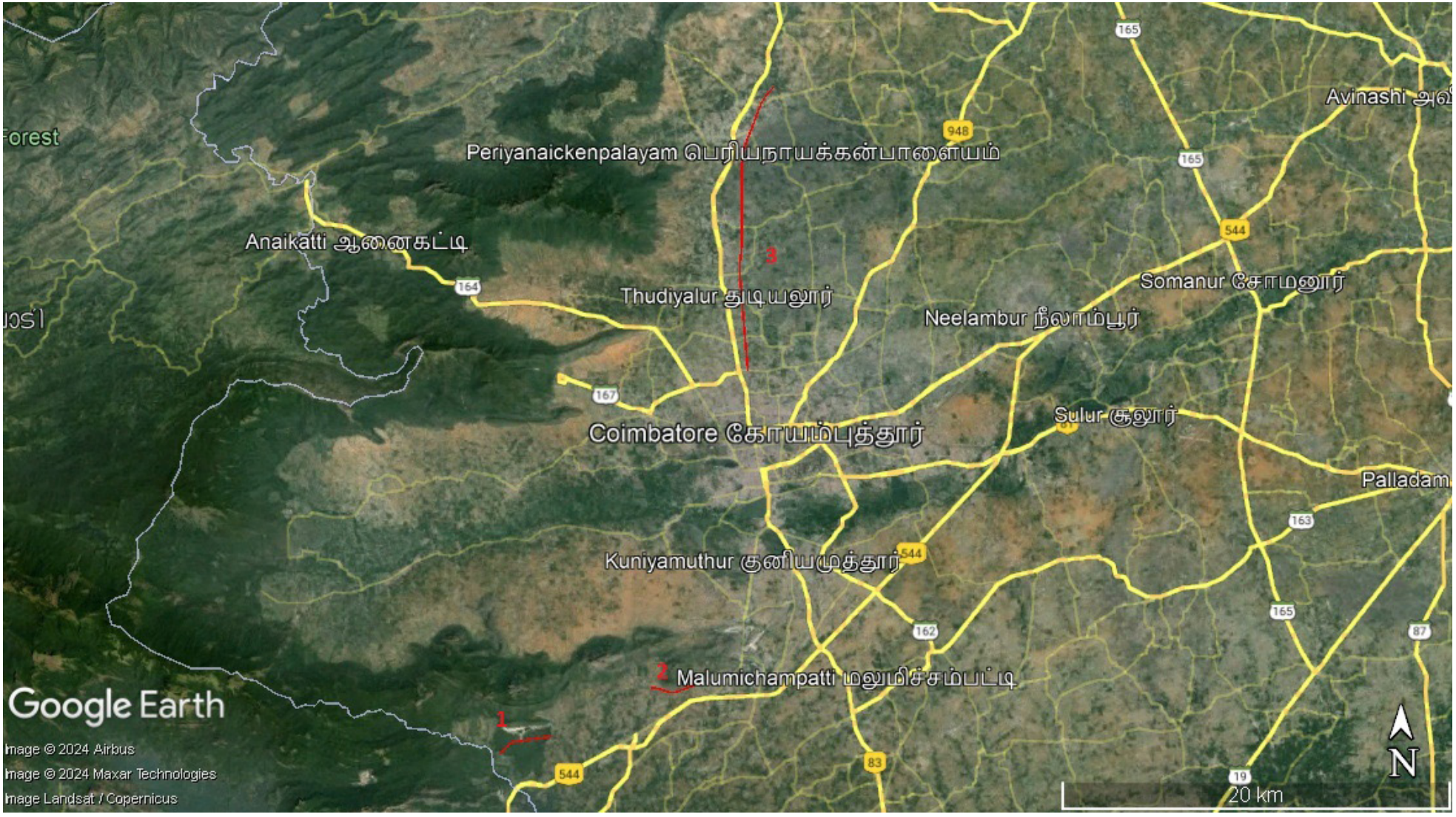


Figure 2: Surveyed railway lines in the southern part of Coimbatore district. Marked railway lines are – 1- Ettimadai – Walayar, 2- Madukkarai – Ettimadai, 3- Coimbatore – Karamadai

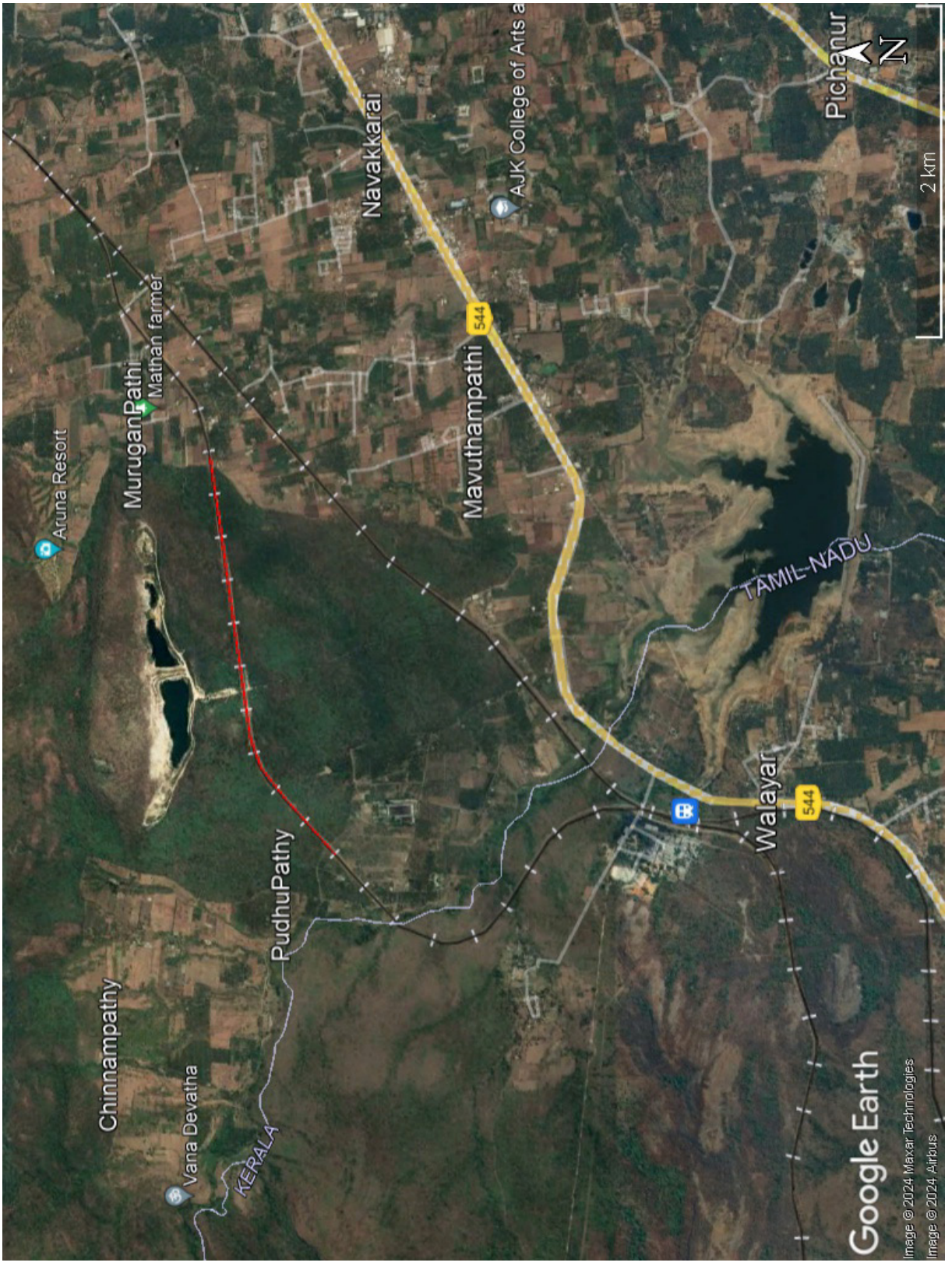


Figure 3: Ettimadai – Walayar railway track. The northern track is a crucial elephant corridor.

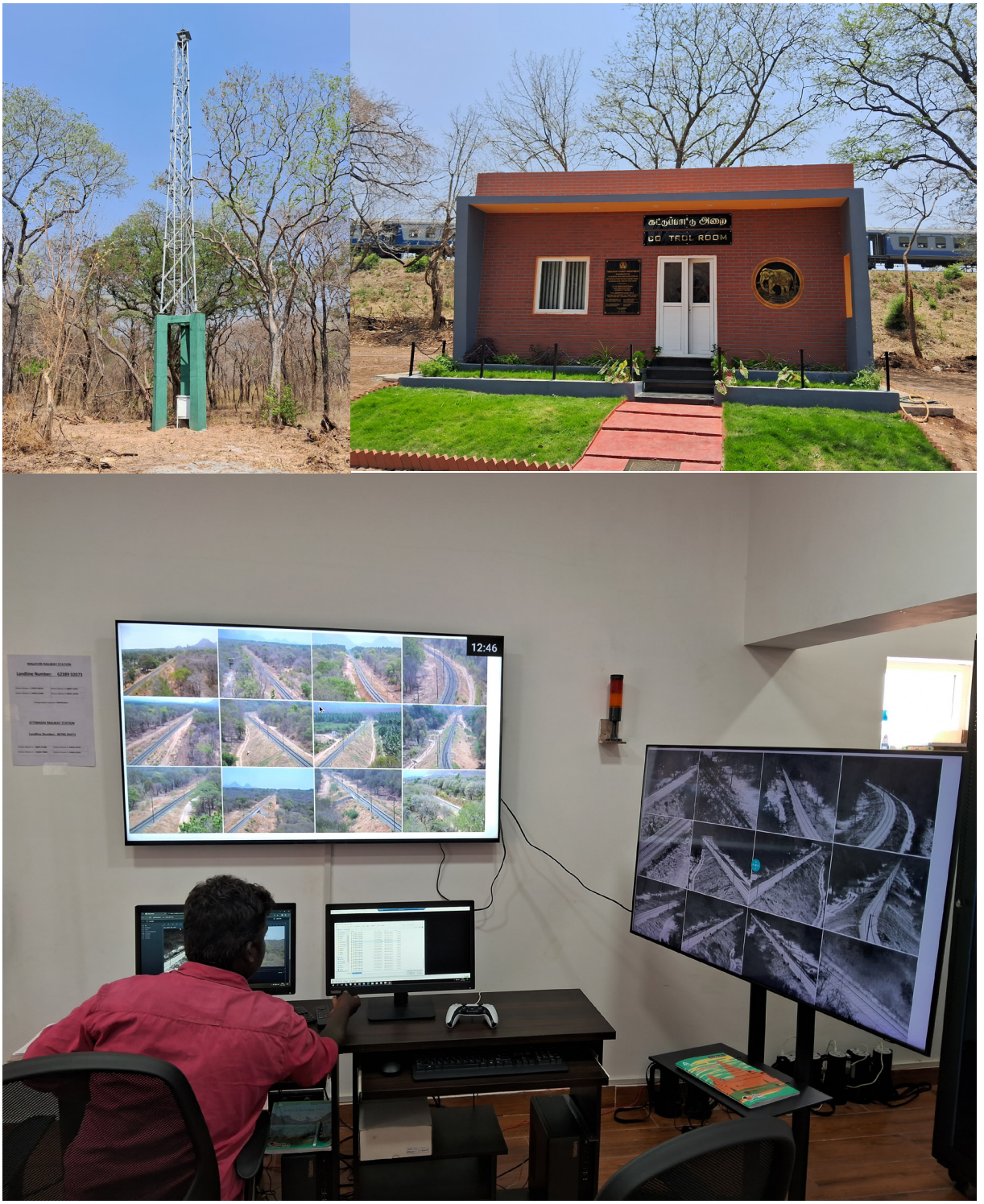


Figure 4: AI-based elephant monitoring and alert system on railway tracks in Madukkarai Forest Range. Top left- cameras are installed on towers close to the railway line; Top right- the control room; Bottom- Continuous monitoring in action.

Table 2: Existing mitigation structures on the Ettimadai – Walayar stretch with additional suggestions to upgrade the level crossing

S. No.	Chainage	Existing mitigation structure	Suggestions	Latitude	Longitude
1	505/A500	Underpass (10 m x 18 m)	-	10°52'31.05"N	76°51'8.09"E
2	506/4	Level crossing	Upgradation to rubberised ramp required at the crossing	10°52'27.3"N	76°50'36.1"E
3	506/8	Underpass (10 m x 18 m) under construction	-	10°52'19.8"N	76°50'19.0"E
4	506A/100	Level crossing	Upgradation to rubberised ramp required at the crossing, repairing required	10°52'16.7"N	76°50'16.1"E
5	506 A/9	Level crossing	Upgradation to rubberised ramp required at the crossing, repairing required	10°52'11.7"N	76°50'11.0"E

Figure 5: Mitigation structures in Madukkarai Forest range. Left – Underpass of 10 x 18 m dimension; the structure requires installation of light and sound barriers on both sides. Right – level crossing ramp, the structure requires upgradation to make a rubberized level crossing on the track.

3.2. Madukkarai – Ettimadai

This stretch on the Coimbatore – Palakkad railway line passes along forest area for about 3 km (Fig. 6). However, the other side of the track is human habitation and agriculture. Elephants often cross for water and crop raiding and come into conflict. There was one report of elephant death on this track.

A metal barrier was installed to deter elephants from crossing the track. The barrier is now broken in several places and currently exists from chainage 498/9 to 498/5 (10°53'50.0"N 76°55'00.9"E) (Fig. 7). It is suggested that this barrier be repaired and maintained so that elephant movement on the track is minimised. The barrier should start close to chainage 499/7 (10°53'50.0"N 76°55'00.9"E) till chainage 498/5.

Figure 6: Madukkarai – Ettimadai stretch of the railway line.

Figure 7: The old broken barriers along the Madukkarai – Ettimadai track used to stop elephants from walking on the track and crossing into the agricultural field (Chainage 498/9).

3.3. Kallar - Ooty

The Nilgiri Mountain Railway, also known as the Ooty toy train, is a marvel of engineering that scales the steep slopes of the Nilgiri Hills (Fig. 8). This UNESCO World Heritage Site boasts a unique meter gauge track with a rack railway system. The rack, a toothed rail alongside the regular track, engages with a pinion gear on the locomotive, enabling it to climb gradients as steep as 1 in 25 (4%). This system, along with powerful steam locomotives or modern diesel engines, allows the train to navigate 16 major tunnels, 250 bridges, and 208 curves along its 46-kilometer route from Mettupalayam to Ooty (Fig. 9).

The major portion of the track is in the mountains, where elephant presence is reported from Kallar towards Ooty (Fig. 10). The train is carried by a steam engine in the stretch from Connor to Ooty while a diesel engine covers the remaining stretch. The maximum speed of the train is about 30 km per hour, while the average speed is 10 km per hour. Since the speed of the train is quite low and a number of natural underpasses exist in the form of bridges, there is no requirement to build mitigation structures on this track. This is further supported by the lack of elephant-train collision records on this track.

However, railway property damage by elephants is quite common. Therefore, electric fences need to be installed around sensitive stations, particularly Runnymede station (11°19'44.05"N, 76°48'5.01"E) (Fig. 11). At multiple places, people use old overbridges to cross the track.

Figure 8: The Nilgiri Mountain Railway is a narrow-gauge railway line. The elephant habitat starts from Kallar station, about 6 km from Mettupalayam.

Figure 9. Nilgiri mountain train has 16 major tunnels, 250 bridges, and 208 curves.

Figure 10: A female elephant with two calves was sighted close to the track on Kallar – Ooty railway line.

Figure 11: Damage by elephants at Runneymede station on the Kallar – Oory railway line.

These bridges are also used by the local wildlife. There have been incidents of animals falling from the overbridge on the track due to poor maintenance of these structures; for example, an Indian gaur died at bridge no. 41 (11°20'39.23"N, 76°51'14.19"E). These overbridges need to be maintained properly for human and animal safety by providing side railings or light and sound barriers. (Fig. 12). Elephants are reported to cross the railway track into agriculture near Satchidananda Jothi Nikethan School at bridge 13 (11°19'57.47"N, 76°53'50.26"E). This is a sensitive site for elephant-train collision as well as human-elephant conflict. An electric fence is installed at the site to deter the elephants; however, the fence needs regular repair and maintenance.

Figure 12: An Indian gaur fell from the overbridge and died at bridge no. 41 (11°20'39.23"N, 76°51'14.19"E).

3.4. Patchur – Mallanuru (western track)

This railway line connects Tirupattur in Tamil Nadu to Kuppam in Andhra Pradesh. The western track passes through Kothur Reserve Forest (Fig. 13). About 110 trains, including passenger and load vehicles, cross this track daily. The fastest trains, e.g., Vande Bharat and Shatabdi, can attain a speed of 90 km per hour.

Elephant movement is not quite frequent in this area as there is no resident population. At times a single herd of 7-8 elephants crossed into Tamil Nadu from Andhra Pradesh and stayed in Kothur and Nandibanda reserve forests. There has been an incident of electrocution of three elephants in farmland, but no incident of elephant-rail collision is reported. For safer movement of this elephant herd, a level crossing is suggested at chainage 232/8 (12°36'2.99"N, 78°24'30.11"E), where both sides of the track have a scrub forest and elephant tracks were observed (Fig. 14).

Figure 13: Surveyed railway lines in Tirupattur district. Marked railway lines are – 1- Patchur – Mallanuru (western track), 2- Patchur – Mallanuru (eastern track), 3- Vaniyambadi – Jolarpet

Figure 14: Elephant tracks were observed at chainage 232/8 (12°36'2.99"N, 78°24'30.11"E) on Patchur – Mallanuru track.

3.5. Vaniyambadi – Jolarpet

The entire track is in the middle of the agriculture and human build-up area. Yallagiri is the closest forest area (~4 km.) (Fig. 13), where a single male elephant resides and has never been seen outside of Yellagiri forest. In one isolated event, 2 male elephants moved into Tirupattur from Andhra Pradesh on 14th May 2023. These elephants were driven away by people and crossed the track a few times. Later, the animals returned to Andhra Pradesh. Given the near absence of elephants and other major wildlife species in the area, this railway line does not require specific mitigation measure.

Photographs depicting the process of construction of elephant underpass on a railway line in Tamil Nadu

04. Additional Comments

1. Loco pilots and railway officials need to be sensitized about the wildlife collision risk.

2. The train pilots should be trained to record wildlife sightings close to the track and maintain the data. Such data is valuable for suggesting and improving mitigation measures.

3. Indian gaur and Sloth bear are also high-risk species for collisions. Sloth bear scats were observed on bridges on the Nilgiris mountain railway. Railway officers specifically mentioned that sloth bears are often sighed close to the trains.

4. The majority of accidents occur at night and in the twilight. During these hours, extreme caution and strict speed control are required.

5. Garbage disposal by the passengers along the railway tracks is an attractant for wildlife, and collision risk of many of the species increases. Therefore, regular and proper disposal of food waste and garbage inside the train should be endured.

6. The AI-based alert system is a promising solution for replication elsewhere.

7. The mitigation measures infrastructure, such as level crossings, barriers, and electric fences, require regular maintenance and repair. Sustained funding for the maintenance of these constructs is of the utmost importance.

8. Tamil Nadu's major elephant populations are in the Selam, Dharmavar, and Hosur districts. Railway stretches in these districts need to be identified for collision risk assessment.

05. 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.

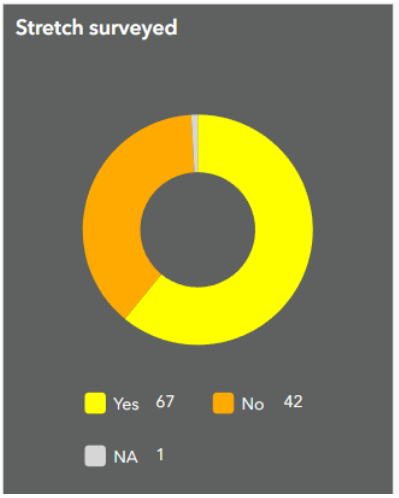
10. To discourage use of wildlife-friendly ramps and level crossings by people and vehicles, concrete barrier poles and/or other barriers should be built that are high enough to block passage of 2 and 4-wheelers, but low enough to allow elephants to pass.

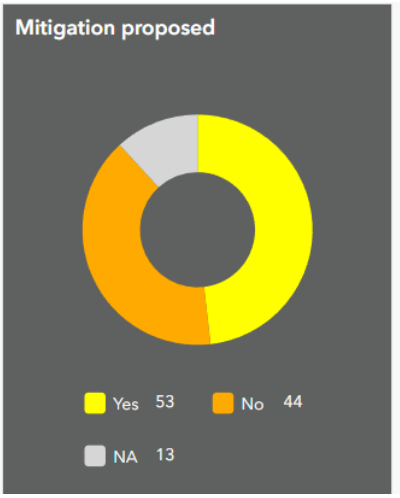
11. Incidences of elephant and wildlife injury and mortality should be documented by both parties, with complete details on GPS location, chainage, date and time of day.

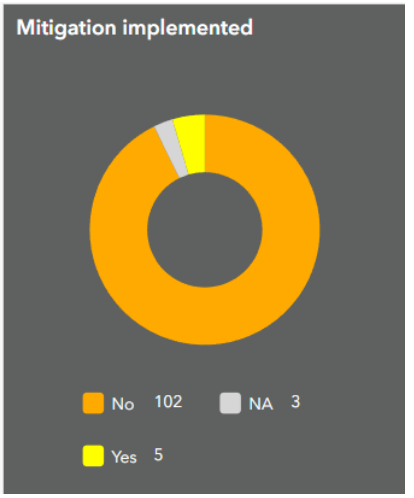
12. In the future, all metre-gauge to broad-gauge conversion projects in elephant landscapes should include comprehensive elephant mitigation plans.

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.

06. 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

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

Forest Department of Tamil Nadu:

1. Dr V. Naganathan, *Additional PCCF, Conservator of Forests (Wildlife), Tamil Nadu*
2. Mr. N. Jayaraj, *DFO, Coimbatore*
3. Mr. N. Jayaraj, *DFO, Coimbatore*
4. Dr. Naveen Murthy, *Biologist, Coimbatore*
5. Mr. Arun Kumar, *RFO, Madukkarai*
6. Mr. Joseph Stalin, *RFO, Mettupalayam*
7. Mr. S. Gowtham, *DFO, the Nilgiris*
8. Dr. Karthick Sivaraj, *Biologist, the Nilgiris*
9. Mr. M. Mahendran, *DFO, Tirupattur*
10. Mr. Radhakrishnan, *ACF, Tirupattur*

Indian Railways:

11. Mr. Rajsekhar, *JE*, *Patchur Station*

08. 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.

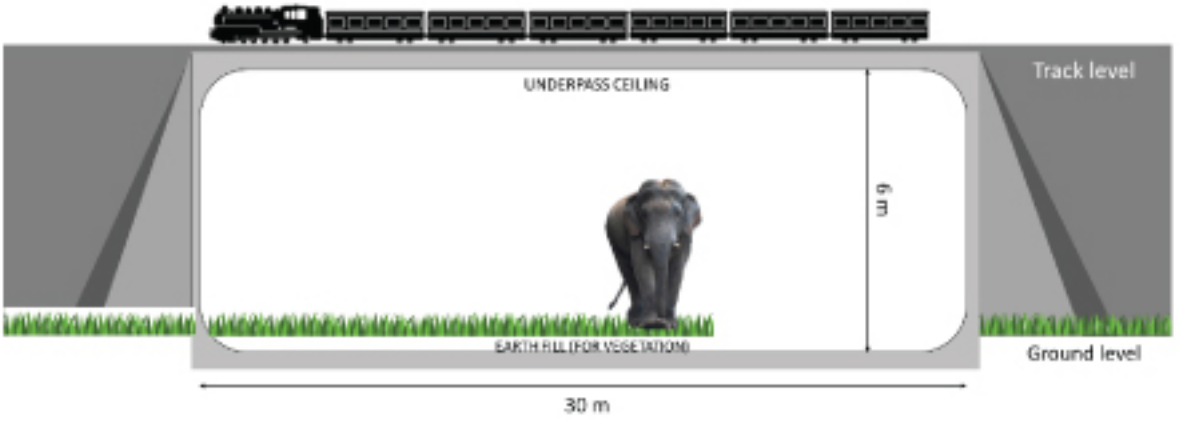


Figure 3. Graphic representation of an underpass for elephants below a railway track.

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).

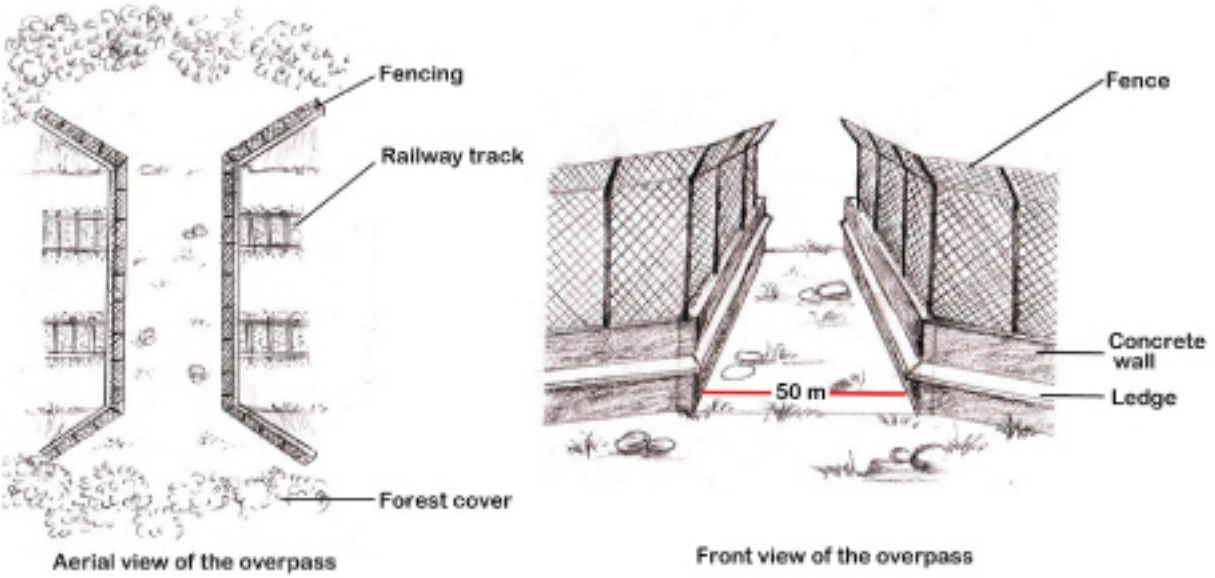


Figure 4. Aerial and front view of overpasses on railway tracks, with fencing/noise and sound barrier details.

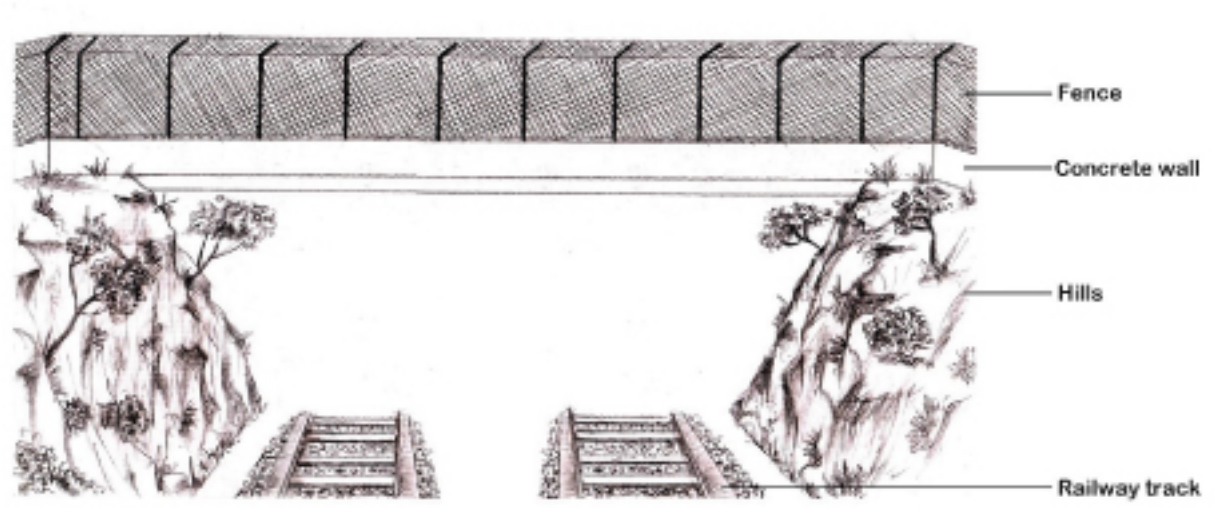


Figure 5. Lateral view of a wildlife overpass on a double-track railway line.

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.

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