As per UGC guidelines an electronic bar code is provided to secure your paper

International Journal for Modern Trends in Science and Technology
Volume 11, Issue 08, pages 13-24.
ISSN: 2455-3778 online
Available online at: http://www.ijmtst.com/vol11issue08.html
DOI: https://doi.org/10.5281/zenodo.16647033

Environmental Impact Assessment of Four Lanning of Nagpur-Katol Section of NH-353J

Vaishnavi R. Sontakke[1], Rohit P. Deshmukh[2], Dilip L. Budhlani[2]

[1]*Research Scholar, Civil Engineering Department, Swaminarayan Siddhanta Institute of Technology, Nagpur, India.*
[2]*Assistant Professor, Civil Engineering Department, Swaminarayan Siddhanta Institute of Technology, Nagpur, India.*

To Cite this Article
Vaishnavi R. Sontakke, Rohit P. Deshmukh & Dilip L. Budhlani (2025). Environmental Impact Assessment of Four Lanning of Nagpur-Katol Section of NH-353J. International Journal for Modern Trends in Science and Technology, 11(08), 13-24. https://doi.org/10.5281/zenodo.16647033

Article Info
Received: 03 July 2025; Accepted: 25 July 2025.; Published: 31 July 2025.

KEYWORDS

Environmental Impact Assessment (EIA), Environmental Management Plan (EMP), National Highway NH-353J, NHAI, MoRTH.

ABSTRACT

This study presents a critical environmental impact assessment (EIA) of the four-laning of the Nagpur-Katol section of National Highway NH-353J. The project is significant for regional connectivity and economic development; however, it also poses potential environmental threats including land degradation, loss of biodiversity, air and noise pollution, and social displacement. The study follows the guidelines outlined in the EIA Notification 2006 by MoEF&CC and the MoRTH Environmental Guidelines. Baseline environmental data has been collected and analyzed for air, water, noise, soil, and biological environment. Environmental impact prediction has been done using qualitative and quantitative methods, and mitigation measures have been proposed to minimize adverse impacts. The study concludes with the preparation of an Environmental Management Plan (EMP) and a monitoring framework to ensure sustainable construction and operation phases.

1. INTRODUCTION

According to the Environmental Impact Assessment Guidance Manual for Highways, 2010, the Environmental Impact Assessment (EIA) serves as a vital planning instrument that has been widely recognized as a fundamental component of sound and informed decision-making in developmental projects. EIA plays a crucial role in ensuring that environmental considerations are integrated into the planning and implementation phases of infrastructure development, particularly in highway construction. Its principal objective is to assign due importance to environmental aspects by predicting and assessing the potential environmental impacts that may arise from the proposed project activities before any irreversible actions are taken. This pre-emptive approach ensures that the environment is not an afterthought but an essential factor in decision-making. Through systematic identification, assessment, and characterization of the significant environmental effects, EIA provides essential information to both the public and the authorities. This process empowers stakeholders by fostering transparency and participation, thereby enabling the formation of an informed viewpoint regarding the environmental sustainability and acceptability of the proposed developmental activity. Additionally, it sets forth recommendations and mitigation measures that are necessary to minimize adverse effects on the environment. Hence, EIA not only facilitates environmentally responsible project planning but also strengthens the legal and institutional framework for sustainable development by emphasizing the need for protective strategies and adaptive management. The expansion of NH-353J is expected to bring significant benefits, including improved traffic flow, reduced congestion, and enhanced safety. However, the environmental concerns associated with road construction are multifaceted. The clearing of vegetation, displacement of wildlife, alteration of natural drainage patterns, and increased levels of air and noise pollution are some of the potential risks. Additionally, the socio-economic implications, such as displacement of local communities and changes in land use patterns, need to be addressed. These concerns underscore the importance of conducting a detailed EIA that considers the long-term ecological and social impacts of the project, ensuring that appropriate mitigation strategies are incorporated into the project design and execution. The significance of the four-laning project for the region's economic growth cannot be overstated, yet it is equally important to balance development with environmental preservation. By focusing on the specific environmental challenges posed by the Nagpur-Katol section, this study aims to provide a roadmap for achieving sustainable infrastructure growth. Through the implementation of effective mitigation measures, such as controlling dust emissions, managing construction waste, preserving natural habitats, and ensuring proper drainage systems, the project can minimize its environmental footprint. Furthermore, the Environmental Management Plan (EMP) will play a critical role in monitoring and managing ongoing environmental risks throughout the project lifecycle, ensuring that potential impacts are addressed in a timely and effective manner.

2. LITERATURE REVIEW

Fernandez et al. (2000) describe the use of an Integrated Landscape Ecological Approach to evaluate the environmental impact of a proposed highway traversing a highly sensitive habitat of the critically endangered Iberian Lynx (Lynx pardinus). This methodology aids in avoiding common errors in decision-making by promoting a deeper understanding of the ecological constraints associated with the project. The paper illustrates how, within the framework of an Environmental Impact Assessment (EIA) for a highway project passing through a sensitive ecological zone, the Integrated Landscape Ecological Analysis (ILA) enables a thorough evaluation and prediction of the target species' ecological behavior. This approach facilitates a comparative assessment of different alignment alternatives without the influence of preconceived notions about "less harmful" options. The highway project in question was planned for short-term construction (2000–2001) and aimed to connect Lisbon, the capital of Portugal, with Algarve, the southern region of the country. The EIA specifically focused on the section of the proposed highway that would cross a mountainous chain separating Algarve from the rest of Portugal. This segment was intended to be situated approximately 50 km east of the existing main access route, which currently follows a valley aligned with a natural geological fault and is shared with a railway corridor.

Kuitunen et al. (2007) discussed the comparison of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) outcomes using the Rapid Impact Assessment Matrix (RIAM) method. A variety of techniques have been developed to support impact assessment processes, including scoping, checklists, matrices, qualitative and quantitative models, literature reviews, and decision-support systems. RIAM, originally designed to evaluate alternative procedures within a single project, was utilized in this study to compare the environmental and social impacts of multiple projects, plans, and programs within the same geographical area. The RIAM method evaluates impacts based on five distinct criteria. In this study, these criteria were applied to the most significant impacts identified in the assessed cases. Each impact was scored based on both its environmental and social consequences. The results demonstrated that RIAM is a useful tool for the comparison and ranking of diverse and unrelated projects, plans, programs, and policies—enabling an objective evaluation of their positive or negative impacts. One of the primary goals of EIA is to anticipate and assess the significant environmental consequences of proposed projects before implementation, thereby supporting informed decision-making and sustainable development.

Tullos et al. (2008) analyzed the Environmental Impact Assessment (EIA) process of the Three Gorges Project (TGP) in China, using it as a case study to evaluate the feedback loop between EIA, scientific research, and policymaking. The study investigated whether identifiable patterns exist between the number of scientific publications related to environmental impacts. The paper highlights the need for institutional changes to improve the connection between scientific research and policymaking, aiming to enhance the environmental sustainability of large-scale infrastructure projects such as dams. While large dams provide numerous societal benefits—such as water storage, hydropower, and flood control—they also pose significant and often irreversible environmental impacts. As global pressures from climate change, increasing risks of floods and droughts, and rising energy demand continue to grow, a surge in the development of new large dams is expected. However, the authors emphasize that without comprehensive and science-informed assessments of potential impacts, such projects risk causing long-term environmental degradation.

Villarroya et al. (2012) discussed the importance of integrating avoidance, minimization, and compensation techniques collectively within the Environmental Impact Assessment (EIA) process to effectively reduce the ecological impacts caused by development projects. The primary goal of EIA is to enhance the sustainability of environmentally regulated projects by identifying significant environmental impacts and recommending appropriate mitigation measures. The authors emphasized the need for new conceptual frameworks and innovative practices in EIA to foster more sustainable project outcomes. Beyond the development of new approaches, they advocate for the formulation of practical strategies that can be applied across real-world EIA processes. In Spain, avoidance and minimization of ecological impacts are already well embedded in the mindset and daily practices of EIA professionals. However, the authors note that ecological compensation is often overlooked or inadequately addressed. The central role of ecological evaluation, particularly in relation to residual impacts, tends to go unnoticed by the general public and is often weak or absent in official EIA documentation. A review of 72 Records of Decision (RODs) for road and railway projects in Spain revealed a consistent pattern: while EIA reports frequently prioritize avoidance and minimization, they pay limited attention to ecological compensation. Moreover, the evaluation of residual impacts, which should serve as the basis for compensation, was found to be insufficiently addressed—if at all—in one of the primaries legally binding and publicly accessible sources for EIA decision-making in Spain.

Sharma et al. (2005) discussed the salient features of the revised Environmental Impact Assessment (EIA) procedures and guidelines, with a specific focus on roads and highways, comparing them to the earlier May 1994 EIA Notification. In the revised notification, the extensive list of 32 project types in the pre-1994 version was restructured into 8 main categories and subcategories, organized based on the pollution potential thresholds of the projects. Road and highway projects are specifically listed under Category 7(f) and are categorized into Category A or B1, based on defined screening thresholds in the revised 2006 EIA Notification. All road and highway projects classified as Category A or B1 must undergo public consultation, as mandated in the revised procedures, to ensure transparency and address public concerns.

Chopra et al. (2011) emphasized the importance of Environmental Impact Assessment (EIA) in ensuring the sustainable development of highway projects, using a case study of a 20-kilometer-long vital road link. The study assessed the existing environmental conditions at the project site and examined the potential impacts of the proposed development. Parameters evaluated included socio-economic, biological, air (dust), water, noise, ecological, soil, and cultural factors. Using existing data and the matrix method for impact evaluation, the study quantified total environmental impact and identified appropriate mitigation and enhancement measures to be implemented during both the construction and operation phases. Although the project posed certain major environmental concerns, the overall conclusion was that it would be environmentally beneficial if mitigation strategies were properly executed. The study also identified broader challenges in the effectiveness of the EIA process, noting that its limitations arise not just from technical or methodological shortcomings but also from procedural inefficiencies. A significant issue highlighted was the lack of meaningful public participation, which the authors recommend should be strictly incorporated and continuously monitored.

The study titled "Environmental Impact Assessment of Six Laning through NH-4" by **Sagar M. Gawande and Prashant A. Kadu (2013)** in the International Journal of Scientific & Engineering Research explores the environmental consequences of highway expansion projects, specifically the proposed six-laning of a 130-kilometer stretch of National Highway 4 (NH-4) from Pune to Bangalore. This paper highlights the importance of the Environmental Impact Assessment (EIA) as a critical tool in evaluating both the positive and negative impacts of such infrastructure development projects on the physical, biological, and socio-economic environment. The authors stress that EIA is an essential process for minimizing environmental degradation by incorporating alternative designs, modifications, and remedial measures. The methodology employed in the study involves assessing key environmental parameters such as air quality, water quality, soil characteristics, noise levels, and ecological health. Through the collection and analysis of samples from the project site, including air, water, and soil, the study examines the current state of these environmental components and how they might be affected by the proposed six-laning project. The paper provides a comprehensive analysis of the socio-economic and biological impacts of highway expansion, noting that road development can lead to significant ecological damage, habitat disturbance, and loss of flora and fauna. However, the authors argue that the expansion of NH-4 is necessary for accommodating the growing traffic volume, particularly since the current two-lane highway is insufficient for handling existing traffic flows. Gawande and Kadu (2013) emphasize the importance of mitigating environmental impacts during different stages of the project, suggesting several mitigation measures. For instance, they recommend air quality management through dust control and vehicular emission standards, water conservation strategies, soil stabilization techniques, and noise reduction methods. Additionally, the report underscores the need for public awareness and engagement in the EIA process to ensure that the concerns of local communities are addressed. The case study of NH-4 serves as a relevant example of how EIAs can guide the sustainable development of highway projects in India. The research demonstrates that while road infrastructure is crucial for economic growth, it must be planned and executed in a manner that balances development objectives with environmental conservation. By addressing environmental and social challenges early in the project design phase, EIAs can help minimize long-term negative effects and promote more sustainable infrastructure development. The significance of this study lies in its holistic approach to understanding the impact of highway expansion on diverse environmental and socio-economic parameters. It provides valuable insights for policymakers, engineers, and environmental planners, demonstrating that the success of large-scale infrastructure projects is not only measured in terms of economic output but also in how well environmental and social factors are integrated into the decision-making process.

3. PROPOSED METHODOLOGY

3.1 STUDY AREA AND PROJECT DESCRIPTION

National Highway 353J (NH 353J) is a four-lane highway in Maharashtra, India, a spur road of National Highway 53, connecting Nagpur Outer Ring Road (Fetri) to Chandur Bazar, passing through Katol, Kalmeshwar, Jalalkheda, Warud, Morshi, Achalpur, and Paratwada.

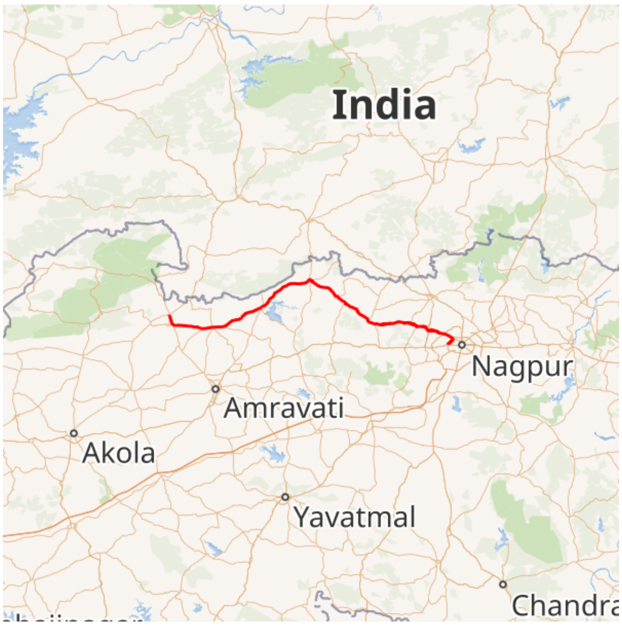

Fig.3.1: Map of National Highway 353J in red

1. Project Location: NH-353J, Nagpur-Katol Section (Length ~50 km)
2. Project Proponent: NHAI
3. Design Features: 4-lane divided carriageway, ROW, service roads
4. Environmental Sensitivity: Forest areas, agricultural land, settlements
5. Name of Project for which Forest Land is required: Rehabilitation and Up-gradation of Nagpur-Katol National Highway 353 J from existing KM 13+000 (Outer Ring Road, Nagpur) to 62+900 (Katol bypass) two/ four lane with paved shoulders in the state of Maharashtra
6. Short narrative of the proposal and Project/scheme for which the forest land is required: The proposed Project is starting from Junction with Outer Ring Road, Nagpur to New Katol by pass end NH 353 J. The total length is 49.900 KM. The alignment passes through Nagpur district of Maharashtra; via Kalmeshwar, Katol.
7. State: Maharashtra
8. Category of the Proposal: Road
9. Shape of forest land proposed to be diverted: Linear
10. Estimated cost of the Project (Rupees in lacs): 135000
11. Area of forest land proposed for diversion (in ha.): 13.761
12. Non-forest land required for this project (in ha.): 0
13. Total period for which the forest land is proposed to be diverted (in years): NIL

Table 3.1: Village wise breakup

S.No.	Village	Forest Land(ha.)	Non-Forest Land(ha.)
1.	Yerla	0.6	0
2.	Dahegaon	0.0113	0
3.	Amnergondi	2.64	0
4.	Borgondi	7.78	0
5.	Pardi Gotmare	0.02	0
6.	Chargaon	0.21	0
7.	Peth Budhwar	0.59	0
8.	Sonkhamb	0.06	0
9.	Methpanjra	0.59	0
10.	Tarabodi	0.82	0
11.	katol	0.43	0
	Total	13.7513	0

4. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

4.1 PROPOSED WILDLIFE MITIGATION PLAN

Proposed Wildlife Mitigation Plan for Diversion of 14.07 Ha of Forest land for Upgradation of Nagpur-Katol section of NH 353J from Km 13+00 (Outer Ring Road, Nagpur) to 62+900 (End of Katol Bypass). The National Highways Authority of India (NHAI) has proposed the upgradation of the Nagpur–Katol section of National Highway 353J to a 4-lane carriageway with paved shoulders, covering a stretch from kilometer 13+000 (Outer Ring Road, Nagpur) to kilometer 62+900 (end of Katol Bypass), with a total length of approximately 49.9 kilometers. This strategic infrastructure development aims to enhance regional connectivity by linking Katol and Kalmeshwar Tehsils of Nagpur district to Nagpur city, and further extending the connectivity to Warud Tehsil in Amravati district.

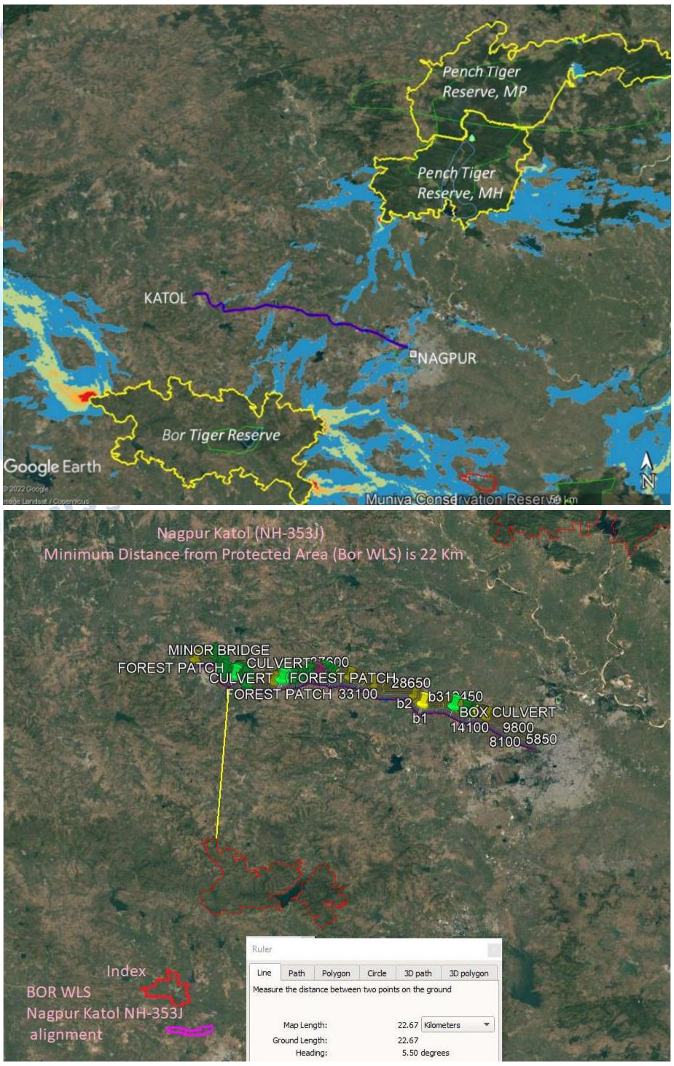

Fig.4.1: Proposed alignment for four-laning of the National Highway 353J passing through the Pench – Bor tiger corridor in the Vidarbha Landscape, Maharashtra

With the recorded traffic volume reaching 21,794 vehicles per day as of November 2020, the current 2-lane configuration is insufficient to accommodate the growing traffic demand, thereby necessitating the expansion to a 4-lane configuration to ensure smooth and efficient vehicular movement. Importantly, while the alignment of the proposed road does not intersect any designated protected areas and the required forest clearance permissions have been duly obtained, the alignment does traverse through the Pench-Bor tiger corridor, which is part of the Eastern Vidarbha Landscape. This ecologically sensitive corridor comprises both designated forest areas and scattered forest patches embedded within an agricultural matrix, raising the need for careful environmental consideration and mitigation strategies to minimize potential impacts on wildlife movement and habitat connectivity.

4.1.1 Projected impacts of the highway up-gradation

The proposed upgradation of National Highway 353J, which spans a length of 59.8 kilometers, traverses through a landscape composed of fragmented forest patches interwoven with agricultural areas and human settlements. This mosaic of land use forms an ecologically significant corridor that facilitates connectivity between the Pench and Bor Tiger Reserves in Maharashtra. Despite the seemingly fragmented nature of the project site, this corridor remains vital for the movement and genetic exchange of wildlife, especially apex predators such as tigers, and a variety of associated fauna. However, the expansion of the highway to a wider, 4-lane configuration poses a serious threat to this ecological linkage. The widened road, along with the anticipated increase in vehicular traffic, especially high-speed traffic, is expected to intensify negative impacts on local biodiversity. Numerous studies have documented that such infrastructural developments can result in increased wildlife mortality due to vehicle collisions, affecting not only large mammals like tigers and leopards but also smaller fauna including birds, amphibians, reptiles, and small mammals (Jackson 2000; Saxena et al. 2020; Dennehy et al. 2021). The physical presence of a wide, fast-moving road network acts as a significant barrier to wildlife movement, thereby fragmenting habitats and restricting access to essential resources. Furthermore, the constant noise and disturbance from vehicular activity are known to adversely influence the behavior, distribution, and population dynamics of sensitive species such as herpetofauna, small mammals, and avifauna (Roedenbeck & Voser 2008; Rao & Koli 2017). As traffic intensity rises, so does the probability of wildlife-vehicle collisions, posing a dual threat—disrupting wildlife ecology and endangering human lives (Rico et al. 2007; van der Ree et al. 2011; Shilling et al. 2020; Taylor & Goldingay 2010; Diaz-Varela et al. 2011; Kučas & Balčiauskas 2021). Therefore, the ecological implications of this highway upgradation demand comprehensive mitigation planning, including wildlife crossing structures, fencing, and speed regulation measures, to ensure a balance between developmental needs and conservation priorities.

4.1.2 Proposed Mitigation Measures

A comprehensive review of the proposed mitigation measures was undertaken, utilizing data derived from radio-telemetry studies on tiger movement corridors within the Vidarbha Landscape, as documented by Habib et al. (2021). This review focused on evaluating the alignment of highway segments that intersect with identified tiger corridors, forest patches demarcated in the study, and continuous forest tracts situated adjacent to the proposed road. Based on this spatial analysis, the dimensions and specifications of the mitigation structures—such as underpasses, box culverts, and minor bridges—were revised to enhance their ecological effectiveness, particularly in relation to their proximity to critical wildlife movement paths and forested zones. These revisions, along with specific recommendations, are detailed in the project documentation, with changes highlighted in green in Table 4.1 for ease of reference. It is important to note that for the highway section prior to chainage km 37.125, detailed structural specifications for the forest patches were not explicitly provided in the project documents. Therefore, information from the provided KML file was utilized to infer and suggest appropriate mitigation structures for this stretch. For effective wildlife permeability, all minor bridges along the alignment are recommended to maintain a minimum vertical clearance of 5 meters. Similarly, all box culverts situated within forest patches should adhere to a minimum dimension of 5 meters by 5 meters to facilitate the safe passage of a variety of faunal species, from large mammals to smaller vertebrates. Additionally, some box culverts located adjacent to forested areas—although not explicitly identified in the KML file—have also undergone dimensional modifications to serve as potential wildlife crossing points. It should also be noted that certain structures identified during the review process were classified with the remark "not a mitigation structure." These refer to culverts or bridges that, due to their location or context, are unlikely to function effectively as wildlife crossings. As such, they are not proposed to be included in the final mitigation plan. The overall aim of these recommendations and design revisions is to ensure that ecological connectivity is preserved and enhanced, minimizing the long-term impact of highway expansion on the Pench-Bor tiger corridor and associated biodiversity.

Table 4.1: Mitigation measures proposed by NHAI for proposed upgradation of NH 353J, and revised recommended dimensions for maintaining the connectivity of the Pench-Bor tiger corridor in the Vidarbha Landscape, Maharashtra

SN	Location (Km)	Earlier Proposed Structure as per Forest Proposal	Earlier Proposed Span/ Opening (m)	Modified Structure considering Wildlife crossing	Modified Span/ Opening (m)	Recommended Structure Dimensions (m)	Remarks
1	17.100	Box Culvert	Span- 2 x 2m, Height- 2m				No structure found in KML; Not a mitigation structure
2	37.125	Box Culvert	Width- 2m; Height 2m	Box Culvert	Width- 2m; Height 2m		Not a mitigation structure
3	37.262	Culvert	1.2 m	Culvert	1.2 m		Not a mitigation structure
4	37.592	Culvert	1.2 m	Culvert	1.2 m	5 x 5	Recommended
5	37.890	Culvert	-		Span: 2 x 1.5 x 1.5	5 x 5	Recommended
6	38.400	Minor Bridge	Width- 8m; Height 2m	Minor Bridge	Width- 12m x 3no. = 36m; Height 4.5m	Width: 36, Height: 5	Recommended
7	-	Culvert	-				
8	39.066	Minor Bridge	Width- 12m; Height 4m	Minor Bridge	Width- 12m; Height 4m		Recommended
9	39.150	Culvert	-		1 x 2 x 2	5 x 5	Recommended; Move to Ch. 39.065
10	39.425	Box Culvert	Width- 2m; Height 2m	Box Culvert	Width- 2m; Height 2m		Not a mitigation structure
11	39.750	Box Culvert	Width- 2m; Height 2m	Box Culvert	Width- 2m; Height 2m		Not a mitigation structure
12	40.000	Culvert	-			5 x 5	Dimensions of proposed structure have not been provided
13	40.320	Culvert	-			5 x 5	Dimensions of proposed structure
14	40.460	Culvert	2 x 1.2 m	Minor Bridge	Width – 12 m x 2 no. = 24 m; Height 4.5 m		Recommended
15	40.633	Box Culvert	Width – 2 m; Height 2 m	Box Culvert	Width – 2 m; Height 2 m	5 x 5	Recommended

SN	Location (Km)	Earlier Proposed Structure as per Forest Proposal	Earlier Proposed Span/ Opening (m)	Modified Structure considering Wildlife crossing	Modified Span/ Opening (m)	Recommended Structure Dimensions (m)	Remarks
16	40.925	Box Culvert	Width – 2 m; Height 2 m	Box Culvert	Width – 2 m; Height 2 m	5 x 5	Recommended
17	41.200	Minor Bridge	Width 8 m; Height 5 m	Minor Bridge	Width 8 m; Height 5 m		Recommended
18	41.570	Culvert	1.2 m	Culvert	1.2 m		Not a mitigation structure
19	41.910	Culvert	2 x 1.2 m	Culvert	2 x 1.2 m	5 x 5	Recommended
20	42.267	Culvert	Width – 2 m; Height 2 m	Culvert	Width – 2 m; Height 2 m	5 x 5	Recommended
21	42.560	Culvert	Span: 2 x 1.5			5 x 5	Recommended
22	42.700	Minor Bridge	Width 24 m; Height 5 m	Minor Bridge	Width 24 m; Height 5 m		Recommended
23	43.150	Culvert	-			5 x 5	Recommended
24	43.452	Minor Bridge	Width 16 m; Height 5 m	Minor Bridge	Width 16 m; Height 5 m		Recommended
25	43.670	Culvert	1.2 m		1.2 m	5 x 5	Recommended
26	44.000	Box Culvert	Width – 2 m; Height 2 m	Box Culvert	Width – 2 m; Height 2 m	Width: 10; Height: 5	Merge culverts on chainage 43960 and 44000
27	45.100	Underpass	Width – 12 m; Height 4.5 m	Underpass	Width – 12 m; Height 4.5 m		Not a mitigation structure
28	45.200	Box Culvert	Width – 2 m; Height 2 m	Box Culvert	Width – 2 m; Height 2 m		Not a mitigation structure
29	45.670	Culvert	1.2 m	Culvert	1.2 m	5 x 5	Recommended
30	46.000	Minor Bridge	Width – 2 x 12; Height – 4 m	Minor Bridge	Width – 2 x 12; Height – 4 m	Width: 2 x 12, Height: 5	Recommended
31	46.200	Underpass	Width – 12m; Height – 4.5 m	Underpass	Width – 12m; Height – 4.5 m		Not a mitigation structure
32	46.300	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not a mitigation structure
33	46.550	Box Culvert	1 x 2 x 2				Not a mitigation structure
34	46.840	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not on KML; Not a mitigation structure
35	47.250	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not a mitigation structure
36	47.570	Minor Bridge	Width – 2 x 12.5; Height – 3.5 m	Minor Bridge	Width – 2 x 12.5; Height – 3.5 m		Recommended with height 5 m
37	47.800	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not a mitigation structure
38	48.185	Culvert	1.2 m	Culvert	1.2 m		Not a mitigation structure
39	48.737	Minor Bridge	Width – 2 x 12.5; Height – 3 m	Minor Bridge	Width – 2 x 12.5; Height – 3 m		Not a mitigation structure
40	48.850	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not a mitigation structure
41	49.365	Culvert	2 x 1.2 m		2 x 1.2 m		Not a mitigation structure
42	49.700	Culvert	1 m		1 m		No structure in

							KML
43	49.785	Culvert	3 x 0.9 m		3 x 0.9 m	5 x 5	No structure in KML
44	50.400	Culvert	3 x 0.9 m		3 x 0.9 m		Not a mitigation structure
45	50.645	Box Culvert	Width – 2 m; Height – 2 m	Box Culvert	Width – 2 m; Height – 2 m		Not a mitigation structure

SN	Location (Km)	Earlier Proposed Structure as per Forest Proposal	Earlier Proposed Span/ Opening (m)	Modified Structure considering Wildlife crossing	Modified Span/ Opening (m)	Recommended Structure Dimensions (m)	Remarks
46	51.225	Culvert	-	Culvert	-		Not a mitigation structure
47	51.785	Minor Bridge	Width 30 m; Height 10 m	Minor Bridge	Width 30 m; Height 10 m		Recommended
48	50.900	Flyover	Width – 30 m; Height 5.5 m	Flyover	Width – 30 m; Height 5.5 m		Not a mitigation structure
49	51.685	Underpasses	Width – 12 m; Height 4.5 m	Underpasses	Width – 12 m; Height 4.5 m		Not a mitigation structure
50	52.025	Box Culvert	Width – 2 m; Height 2 m	52.025	Box Culvert		Not a mitigation structure
51	52.475	ROB/Flyover	Width – 98 m; Height 13 m	ROB/Flyover	Width – 98 m; Height 13 m		Not a mitigation structure
52	53.150	Culvert	-	Culvert	-	5 x 5	Recommended
53	53.800	Culvert	-	Culvert	-	5 x 5	No details provided; Recommended
54	54.075	Minor Bridge	Width 12 m; Height 6 m	Minor Bridge	Width – 2 no. x 6 m + 1 no. x 12 m = 24 m; Height 6 m		Recommended
55	54.162	Underpasses	Width – 12 m; Height 4.5 m	Underpasses	Width – 12 m; Height 4.5 m		Not a mitigation structure
56	54.370	Culvert	-	Deleted	-		
57	54.590	Culvert	-	Deleted	-		Realignment recommended
58	54.800	Box Culvert	Width – 2 m; Height 2 m	Deleted	-		
59	54+995	-	-	Animal Overpass	50 m wide		
60	NA	-	-	Minor Bridge	Width – 20 m; Height 4.5 m		
61	55.120	Culvert	-	Culvert	-		

SN	Location (Km)	Earlier Proposed Structure as per Forest Proposal	Earlier Proposed Span/ Opening (m)	Modified Structure considering Wildlife crossing	Modified Span/ Opening (m)	Recommended Structure Dimensions (m)	Remarks
62	55.400	Underpasses	Width – 12 m; Height 4.5 m	Underpasses	Width – 12 m; Height 4.5 m		Not a mitigation structure
63	56.130	Culvert	1.2	-	-	5 x 5	Recommended
64	56.300	-	-	Underpass	Width – 12 m × 2 no.; Height – 4.5 m		Recommended with height 5 m
65	56.872	Culvert	1.2	-	-	5 x 5	Recommended
66	57.200	Culvert	-	Culvert	-	5 x 5	No details provided

67	57.408	Minor Bridge	Width 15 m; Height 8 m	Minor Bridge	Width 15 m; Height 8 m		Recommended
68	57.540	Minor Bridge	Width 12 m; Height 8 m	Minor Bridge	Width 12 m; Height 8 m		Recommended
69	57.600	Minor Bridge	Width 15 m; Height 8 m	Minor Bridge	Width 15 m; Height 8 m		Recommended
70	57.730	Culvert	-	-	-	5 x 5	Recommended
71	58.100	Culvert	-	-	-	5 x 5	Recommended
72	58.230	Underpasses	Width – 12 m; Height 4.5 m	-	-		Not a mitigation structure
73	58.907	Minor Bridge	Width 15 m; Height 5 m	-	-		Recommended
74	59.620	Flyover	Width – 60 m; Height 12 m	-	-		Not a mitigation structure

4.1.3 Realignment of NH 353J between ch. 54.075 and 55.800

The proposed alignment between chainages 54.100 and 55.550 bisects an intact patch of scrub forest. Therefore, realignment of this section is recommended such that the highway goes around the patch and not through it (Fig. 4.2). Two additional box culverts are recommended on the realigned stretch, each measuring 20 x 5 m (Table 4.2).

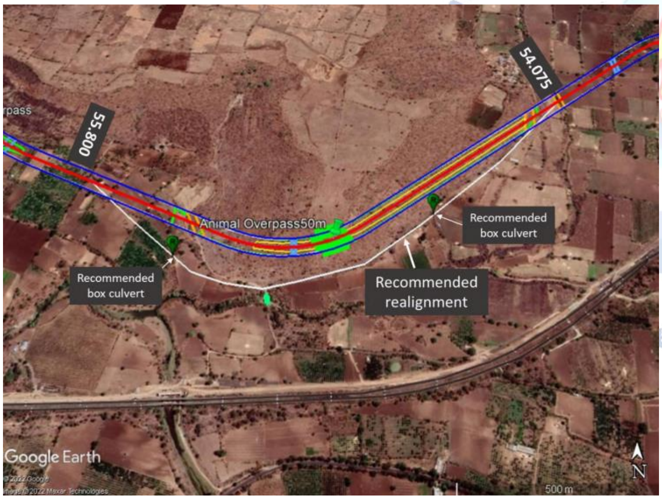

Fig.4.2: Realignment of NH 353J between chainage km. 54.075 and 55.800 to avoid fragmentation of the forest patch

Table 4.2: Details of crossing structures to be built on the realigned highway section between ch. 54.075 and 55.800.

SN	Latitude	Longitude	Dimensions (m)
1	21°15′47.93″N	78°37′29.44″E	20 × 5
2	21°15′43.19″N	78°37′2.74″E	20 × 5

5. CONCLUSION

The expansion of road infrastructure, particularly the four-laning of the Nagpur-Katol section of NH-353J, presents a complex interplay between developmental benefits and environmental costs. Road development significantly affects both the biotic and abiotic components of ecosystems by altering population dynamics of flora and fauna, disrupting the natural flow of materials and nutrients, modifying landforms and hydrological patterns, and introducing invasive species and pollutants into the environment. These changes inevitably affect ecosystem services and the long-term sustainability of the region. This critical study highlights that while the economic and connectivity benefits of highway expansion are evident, the comprehensive environmental impact—especially concerning air quality, soil degradation, water pollution, habitat fragmentation, and human health risks—remains insufficiently evaluated. Additionally, the socio-economic conditions of the communities residing along the highway corridor demand closer scrutiny, as they are directly exposed to both the opportunities and adverse impacts arising from such infrastructure projects.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

References

[1] Abdel Ghany, U., Wahab, R.A., 2013. Optimization of cement kiln dust usage for removing different metals from synthetic raw water. Journal of American. Science 9(12), 784–793.

[2] Achadu OJ, Goler EE, Ayejuyo OO, Olaoye OO and Ochimana IO. Assessment of heavy metals (Pb, Cd, Zn and Cu) concentrations in soils along a major highway in Wukari, North-Eastern Nigeria. Journal of Biodiversity and Environmental Sciences, 6(2): 1-7 (2015)

[3] Aryan, Y., Dikshit, A. K., & Shinde, A. M. (2024). Assessment of environmental impacts and reduction opportunities for road infrastructures in India. Transportation Research Part D: Transport and Environment. https://doi.org/10.1016/j.trd.2024.104106.

[4] AASHTO, 2004. A Policy on Geometric Design of Highways and Streets, Green Book. American Association of State Highway and Transportation Officials.

[5] American Association of State Highway and Transportation Officials (AASHTO). A Policy on Geometric Design of Highways and Streets. Washington, DC. 2004.

[6] Ashok Kumar, Dhananjay A.S, Agarwal Alkesh, Badage Ganesh, Chavan Bhagatsinh, Devkar Anil, Kadam Shubham, (2015). "Up Gradation of Geometric Design of Sh-131(Ch. 9.35km-15.575km) Using MX Road Software-A Case Study", International Journal of Civil Engineering and Technology, Volume 6, Issue 6.

[7] Asian Development Bank (1993), Content and format of Environmental impact assessment (EIA).

[8] Bai J, Cui B, Wang Q, Gao H and Ding Q. Assessment of heavy metal contamination of roadside soils in Southwest China. Stochastic Environmental Research and Risk Assessment, 23(3): 341-347 (2009)

[9] Chaudhary, A., & Akhtar, A. (2024). A novel approach for environmental impact assessment of road construction projects in India. Environmental Impact Assessment Review, 107477. https://doi.org/10.1016/j.eiar.2024.107477.

[10] Chopra T., Aggrawal M. and Chowdhry P. (2011), Analyzing Strategic Issues Of Environmental Impact Assessment For Highway Projects With A Case Study Of Indian National Highway, Presented in ICPT, 2011.

[11] Devaraj Hanumappa and Parthasarathy Ramachandran, "Cellular Automata Model for Mixed Traffic Flow with Lane Changing Behavior" https://www.hindawi.com/journals/mse/2021/9142790.

[12] Dennehy E, Llaneza L, López-Bao JV. 2021. Contrasting wolf responses to different paved roads and traffic volume levels. Biodiversity and Conservation 30:3133–3150. Springer Science and Business Media B.V. Available from https://link.springer.com/article/10.1007/s10531-021-02239-y (accessed November 16, 2021).

[13] Diaz-Varela ER, Vazquez-Gonzalez I, Marey-Pérez MF, Álvarez-López CJ. 2011. Assessing methods of mitigating wildlife-vehicle collisions by accident characterization and spatial analysis. Transportation Research Part D: Transport and Environment 16:281–287. Elsevier Ltd.

[14] Dr. S. S. Jain, P. K. Singh,Dr. M Parida, "Road Safety Audit For Four Lane National Highways", International Conference on Road Safety and Simulation, September 14-16, 2011, Indianapolis, USA.

[15] Dey, P. P., Chandra, S. and Gangopadhyay, S. (2006) "Speed Distribution Curves under Mixed Traffic Conditions', Journal of Transportation Engineering, ASCE, 132 (6), pp 475-481.

[16] Environmental Impact Assessment (2002), Course Module: UNEPs Environmental Impact Assessment Training Resources Manual, 2nd Edition.

[17] Environmental Impact Assessment of Nairobi River basin Project, Kenya (2002), United Nations Environment Programme (UNEP).

[18] Gawande, S. M., & Kadu, P. A. (2013). Environmental Impact Assessment of Six Laning through NH-4. International Journal of Scientific & Engineering Research, 4(12), 1-10.

[19] Handa, S., Aggarwal, R. K., & Bhardwaj, S. K. (2019). A Critical Review on Environmental Impact Assessment of Highway Development in the Himalayan Region. International Journal of Chemical Studies, 7(4), 28-35.

[20] IRC: 104-1988, "Guidelines for Environmental Impact Assessment of Highway Projects", Indian Roads Congress, New Delhi.

[21] IRC: SP: 88-2010. "Manual on Road Safety Audit", Indian Road Congress, New Delhi, India.

[22] IRC: SP: 73-1980. "Geometric Design Standards for Rural (non-Urban) Highways", Indian Road Congress, New Delhi, India.

[23] IRC: SP: 23-1993. "Vertical Curves for Highways". Indian Road Congress, New Delhi, India

[24] IRC: SP: 88-2010. "Manual on Road Safety Audit" Indian Road Congress, New Delhi, India.

[25] Jadhav, S., Chavan, G., Patil, S., Sanadi, S., Paravatgosavi, S., & Rabade, M. M. (2023). A Review Article on "Environmental Impact Assessment" (EIA). International Research Journal of Engineering and Technology (IRJET), 10(04), 1-6. e-ISSN: 2395-0056. p-ISSN: 2395-0072.

[26] Jackson SD. 2000. Overview of transportation impacts on wildlife movement and populations. Wildlife and highways: seeking solutions to an ecological and socioeconomic dilemma. The Wildlife Society:7–20. Available from http://www.umassextension.org/NREC/images/stories/linked_content/pdf_files/tws_ overview_ms.pdf.

[27] Kamboj, N., & Kumari, S. (2019). ENVIRONMENT IMPACT ASSESSMENT FOR HIGHWAY: A REVIEW. International Journal of Innovative Research in Science, Engineering and Technology, 8(8), 492-497.

[28] Kale, A. R., & Husain, M. F. (2020). Environmental Impact Assessment on Air Pollution during Construction of National Highway - NH-6 in Khandesh Region. International Journal of Emerging Trends in Engineering and Basic Sciences, 7(Special Issue 2), 132-137. ISSN (Online) 2349-6967.

[29] Larry, W, Canter, "Environmental Impact Assessment, McGraw-Hill series", University of Oklahoma, Norman, Oklahoma, (1999).

[30] Nandal, M. (2017). Literature Study of Environment Impact Assessment during Construction of Highways. International Journal of Enhanced Research in Science, Technology & Engineering, 6(10). ISSN: 2319-7463.

[31] Rao S, Koli VK. 2017. Edge effect of busy high traffic roads on the nest site selection of birds inside the city area: Guild response. Transportation Research Part D: Transport and Environment 51:94–101. Elsevier Ltd.

[32] Rico A, Kindlmann P, Sedláček F. 2007. Barrier effects of roads on movements of small mammals. Folia Zoologica 56:1–12.

[33] Roedenbeck IA, Voser P. 2008. Effects of roads on spatial distribution, abundance and mortality of brown hare (Lepus europaeus) in Switzerland. European Journal of Wildlife Research 54:425–437.

[34] Study of Chertalai – Thiruvananthapuram Section of NH-47 (New NH66) (from KM 379/100 to KM 551/900) [Package –KL/NH47- III] under NHDP Phase III in the State of Kerala", Preparation of Detailed Project Report (DPR) (NHAI)

[35] Suzuki K, Yabuki T and Ono Y. Roadside Rhododendron pulchrum leaves as bioindicators of heavy metal pollution in traffic areas of Okayama. Japan. Environmental Monitoring Assessment, 149:133-141 (2008)

[36] Saxena A, Chatterjee N, Rajvanshi A, Habib B. 2020. Integrating large mammal behaviour and traffic flow to determine traversability of roads with heterogeneous traffic on a Central

Indian Highway. Scientific Reports 10:18888. Available from https://doi.org/10.1038/s41598-020-75810-2.

[37] Shilling FM, Collins A, Longcore T, Vickers W. 2020. Understanding Behavioural Responses of Wildlife to Traffic to Improve Mitigation Planning. Davis.

[38] Umar, N. (2014). Environmental Impact Assessment of Extension of National Highway Number One: A Critical Study. Research Paper Geography, 4(6), 1-5. ISSN - 2249-555X.

[39] Vipinan, D., Jiji, C. K., Libu, S., Saji, V. K., & Aswathy, K. S. (2022). Environmental and Social Impact Assessment (ESIA) Of NH66. International Journal of Advances in Engineering and Management (IJAEM), 4(10), 948-954. https://www.ijaem.net

[40] Walia K, Aggarwal R. K, Bhardwaj S. K. Environment Impact Assessment of Highway Expansion – A Review. Curr World Environ 2017;12(3). DOI: http://dx.doi.org/10.12944/CWE.12.3.04

[41] Ward NI, Reeves RD and Brooks RR. Lead in soil and vegetation along a New Zealand state highway with low traffic volume. Environmental Pollution, 9: 243-251 (1975).