WILDLIFE CONSERVATION PLAN

(along with mitigation & Management Plan below Transmission Line & Animal Passage Plan)

For

Proposed 765 KV D/C Transmission Line

From Lakadiya - Ahmedabad Segment Passing through Wild Ass Sanctuary (WAS)



Submitted by

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FOREWARD

Wild Ass Sanctuary (WAS), one of the vast Protected Areas (PAs) of Gujarat, encompassing substantial portion of Little Rann of Kachchh (LRK) constitutes a unique landscape. Its seasonal wetland-cum-saline desert characteristics and numerous bets (islands) of varying extent imparts uniqueness to this landscape. The landscape is not only outstanding from the view-point of geomorphology, but it is exceptional from the angle of biodiversity too. A plethora of a large number of resident, migratory and resident-migratory birds inhabit the Sanctuary during one or the other season. They include several threatened species as per IUCN Red List and/or Wildlife (Protection) Act, 1972. The Sanctuary has acquired international fame for its flagship species, viz. Indian Wild Ass (*Equus hemionus khur*). Its rising population reflects effective management of the Sanctuary. Besides birds and Indian Wild Ass, the Sanctuary is inhabited by a plethora of other vertebrates (especially, reptiles and mammals) and invertebrates as also numerous grasses, herbs, shrubs and trees.

Any major infrastructural development activity having a potential of imposing impact on ecology and biodiversity of such an exceptional area cannot be considered without mitigation and conservation plan. The proposed 765 kV double circuit overhead transmission line, which will pass through a 14.9 km stretch of the Wild Ass Sanctuary (WAS) and its 67-meter Right of Way (RoW), has the potential to affect the one or the other aspect of WAS's biodiversity if implemented without planning mitigation-cum-conservation measures. Therefore, it is essential to address the likely challenges posed by this development to biodiversity within impact area and its environs and ensure that its implementation does not compromise the integrity of the Sanctuary's ecosystems.

This mitigation-cum-conservation plan aims to outline specific measures to minimize and manage any likely impacts on ecosystem and biodiversity (flora and fauna) of WAS, safeguard the habitats of the Sanctuary's wildlife, and strives to see that this infrastructure project aligns with sustainable practices.

While the infrastructural development is a necessity for enhancing connectivity and supporting regional growth, it is equally critical that it does not undermine the environmental and biodiversity values that make the Wild Ass Sanctuary a unique and vital ecological resource. Therefore, this plan outlines the necessary steps to balance development with the preservation of this extraordinary landscape.

S. C. Srivastav IFS (Retd)

Executive Summary

Mitigation-cum-Conservation Plan for the Proposed 765 kV Overhead Transmission Line through Wild Ass Sanctuary

Purpose of the Mitigation-cum-Conservation Plan

The Mitigation-cum-Conservation Plan has been prepared to address the environmental and ecological impacts of the proposed 765 kV Double Circuit Transmission Line passing through the Wild Ass Sanctuary (WAS) in Gujarat. The project involves a 14.9 km stretch within the sanctuary and aims to balance the imperative of renewable energy infrastructure development with the conservation of biodiversity. This plan delineates strategies for mitigating potential adverse effects, preserving wildlife habitats, and ensuring compliance with regulatory frameworks. The ultimate goal is to establish a harmonious coexistence between infrastructure development and wildlife conservation through scientifically informed actions.

This plan also underscores the necessity for a structured approach to address biodiversity concerns while fostering development. By incorporating a blend of preventive, mitigative, and compensatory measures, it ensures that the integrity of the sanctuary's ecosystem remains intact. The plan serves as a model for similar projects in sensitive ecological regions.

About the PowerGrid Project

The Power Grid Corporation of India Limited (POWERGRID), a premier entity under the Ministry of Power, is spearheading the Lakadiya-Ahmedabad Transmission Line project. This initiative is part of India’s ambitious target of achieving 500 GW of renewable energy capacity by 2030. The project facilitates power evacuation from the 30 GW renewable energy hub in Khavda, Gujarat. The Lakadiya-Ahmedabad Transmission Line plays a critical role in linking renewable energy hubs to national grids, thereby addressing energy demands sustainably. The project’s alignment has been carefully selected to minimize its ecological footprint while ensuring technical and operational efficiency. This dual focus on environmental sensitivity and infrastructure robustness defines POWERGRID’s approach to development.

The specific stretch within the WAS encompasses 99.912 hectares, with 31 transmission towers planned. The project also includes a conservation fund to implement the mitigation plan, underscoring POWERGRID’s commitment to environmental stewardship and sustainable development. The length of the transmission line that would pass through the Wild Ass Sanctuary is 14.9 km and it has Right of Way (RoW) of 67 m.

Salient Features of the Project

1. **Transmission Line Details:**
    - Length: 184.1 km (14.9 km in WAS)
    - Voltage: 765 kV Double Circuit
    - Right of Way: 67 meters
2. **Project Cost:** INR 723.55 crore (Wildlife Area Cost: INR 58.61 crore)
3. **Alignment:** Designed to minimize intrusion into sensitive wildlife habitats, adhering to national guidelines for linear infrastructure projects.
4. **Significance:** The project is pivotal for achieving India's renewable energy goals while ensuring minimal disruption to biodiversity in the Wild Ass Sanctuary.

Baseline Status of Flora and Fauna

The field survey covered habitats such as saline mudflats, grasslands, agricultural fields, and salt pans within a 1 km buffer on either side of the proposed line. This comprehensive survey forms the foundation for targeted conservation strategies. Drone-based aerial surveys supplemented ground-based assessments, providing valuable insights into habitat use and species distribution.

The field assessment identified a diverse array of species:

- **Mammals:** 10 species including the Indian Wild Ass (*Equus hemionus khur*), an endemic and endangered species critical to the sanctuary's identity.
- **Birds:** 85 species, including the Greater Flamingo (*Phoenicopterus roseus*) and Dalmatian Pelican (*Pelecanus crispus*), which are emblematic of the area's rich avian diversity.
- **Reptiles:** 6 species recorded, showcasing the ecological range of the sanctuary's fauna.
- **Flora:** Extensive vegetation, including native herbs, grasses, and scrublands crucial for wildlife sustenance and ecological balance. During the field investigations, a total of 45 species of plants were recorded that included grasses, herbs, shrubs and trees. Halophytes, hydrophytes and mesophytes were recorded.

Potential Impact Identification and Mitigation Measures

Potential Impacts:

- Habitat fragmentation and loss

- Risks to avian species from collision and electrocution
- Disturbance to wildlife movement corridors
- Vegetation clearing and soil erosion
- Habitat fragmentation and loss
- Disturbance to wildlife movement corridors
- Vegetation clearing and soil erosion

It may be noted that these are only likely impacts and they are indicated on the basis of relevant literature studies. Filed-assessment has indicated that not all of them may be applicable to the project area (especially impact area of the transmission line) lying in Wild Ass Sanctuary.

Mitigation Measures:

- Installation of bird diverters to prevent avian collisions
- Mounting bird guards on transmission lines to prevent electrocution of birds intending to perch on the transmission line
- Restricted vegetation clearance
- Noise and disturbance reduction during construction
- Wetland and mudflat protection measures

Specific mitigation measures can be understood from the table given in the section of financial allocation.

The project adopts a layered mitigation strategy, integrating immediate corrective measures with long-term conservation planning. This includes rigorous monitoring protocols to ensure the sustained effectiveness of implemented measures.

Conservation Interventions

The Gujarat Forest Department will oversee habitat restoration and species-specific conservation efforts:

Compensatory Afforestation: Planting native species to offset vegetation loss and enhance ecological resilience.

Habitat Improvement:

- Restoration of grasslands and wetlands to support biodiversity
- Management of invasive species like *Prosopis juliflora* to prevent ecosystem degradation
- Creation of artificial waterbodies to support wildlife species inhabiting the area.

Awareness and Ecotourism: Initiatives to engage local communities in conservation and promote sustainable livelihoods. Educational programs will foster a sense of stewardship among stakeholders.

Research and Monitoring: Establishing a dedicated fund for ongoing research to track biodiversity changes and inform adaptive management.

Animal Passage Plan Below the Transmission Line

The proposed 14.9 km long 765 kV Double Circuit overhead transmission line that would passing through Wild Ass Sanctuary (WAS) is configured to maintain minimum 18 metres (approx. 60 ft) of ground clearance. With regards to the passage/movement of wild mammalian species below the transmission line, it is understood based on field assessment that no wild (or even domestic) mammal that exists in the Wild Ass Sanctuary would have height even one seventh of this ground clearance (i.e., over 2.5 m). This is because, maximum height of the tallest wild mammal, viz. Nilgai can be as tall as 1.7m. The flagship mammal, viz. Indian Wild Ass is known to have maximum height of 1.4 m. Some other mammals that were recorded in the field assessment area (including the transmission line's impact area) included Wild/Feral Pig, Jackal and Indian Fox. These mammals have very low height at shoulder (i.e., fox-0.35m, jackal-0.45m and wild/feral pig-1.1 m). Thus, there is no possibility of hindrance to the movement of such wild mammals below the transmission line. Thus, if minimum ground clearance of 18m at mid span would be maintained for the proposed transmission line passing through a portion of WAS, it would be sufficient for safe and unhindered passage/movement of mammalian species. It will neither cause hindrance to the movement nor will it cause electrocution. To ensure the safety of mammals (and reptiles) that may attempt to climb tower structures (such as cats and monkeys), Anti-Climbing Devices (ACDs) will be installed at the four corner gates of each tower. The gates will include two opening and two non-opening sections, all enclosed with barbed wire and appropriate accessories, designed to prevent animals from climbing the tower structure. During the construction phase, all excavated pits shall be securely barricaded and

fenced to prevent accidental falls of passing/moving wild (and domestic) mammals, as well as certain reptiles that are in movement. Birds flying below 18 meters are not directly at risk of hitting the transmission lines. However, for the low-flying birds, other ground-based elements of the transmission infrastructure (e.g., towers, pylons, or other structures) should not become obstacles, If there is any low-lying structure or equipment within this area, effectively and innovatively marking them would be necessary. To ensure that transmission towers and associated structures are not used by birds as perches, anti-perching devices or bird deterrents on the lower sections of the towers and associated structures would be necessary to prevent birds from roosting or resting on them.

Conservation Plan Below the Transmission Line

The RoW area in the WAS will be required to be restored post-construction of the proposed transmission line. The restoration activities shall include plantation of native dwarf species in RoW growing in sanctuary area. The species to be planted shall are carefully selected using transmission line configuration and habitat characteristics. Planting low-height native flora that can survive and thrive in saline soil and arid climatic condition should be selected for planting them under the lines. Shrub/scrub (barring *Prosopis juliflora*), herbs and grasses mentioned earlier (under Baseline Vegetation Status of the area in Proposed RoW) should be preferred. Following species may be used for restoration below the transmission line: *Salvadora spp., Tamarix* sp., *Prosopis cineraria, Acacia spp., Balanites sp., Capparis decidua, Suaeda nudiflora, Cressa cretica, Aeluropus lagopoides* etc.

Important measures to be adopted by the User Agency (Project Proponent) based on MoEFCC's guidelines [mentioned in the minutes of the 79th Meeting of the Standing Committee of National Board for Wild Life (Source: Letter F.No. WL-6/88/2024-WL dated 23rd August 2024)]:

1. The User Agency shall not violate any provision of the Wildlife (Protection) Act, 1972.
2. The User Agency shall not harm or destroy wildlife habitat and flora and fauna of the Sanctuary.
3. The User Agency shall not use the area for any work other than the work permitted.
4. The User Agency shall not establish temporary or permanent labour camps in the Sanctuary.
5. The User Agency or its contractor shall not create any fire places inside the Sanctuary
6. The User Agency shall make it sure that all the material required for the work shall be prepared outside the Sanctuary.
7. The User Agency shall carry out work in the Sanctuary only in the day time from 8 am to 6 pm.
8. Approval under Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980, wherever required, shall be obtained by User Agency for the use of forest land.

9. The User Agency shall deposit NPV for the use of land of Protected Area as per the existing rates before initiating any work on the land.
10. The User Agency shall restore the land in its original form after completion of the work.

Financial Allocation

The financial outlay worked out for the Conservation Plan shall be deposited to Forest Department by the user agency (project proponent) for the implementation of the Plan by the Forest Department. The approved amount for this purpose shall be deposited by the user agency in the account as per the demand raised by the concerned officials of the Forest Department.

Conservation measures proposed for the project area to be implemented by the Forest Department at the cost borne by the User Agency along with financial outlay is given below

	Conservation Activity	**Amount (Rs. in lakhs)**
A	**Habitat Improvement & Restoration**	
i.	*Prosopis juliflora* control (Uprooting & Pruning)	30
ii.	Restoration/improvement of existing wetlands	15
iii.	Native Plant Nurseries	10
iv.	Management measures for area below the transmission line in WAS (plantation of low-height native plants at suitable locations)	25
v.	Construction of water holes/havadas for supporting drinking water needs of wild ass and other wild mammals	15
vi.	Van talavdies	10
vii.	Sagar pala/Aad bandh	20
viii.	Mounds (with stone pitching) serving as dual purpose as refuge for Wild Ass and other mammals during monsoon inundation and resting/roosting spots for birds (Especially, large waterbirds)	20

ix.	Development of grass plot	25
x.	Wolf Breeding Centre	25
B	**Support Conservation & Awareness Activities**	
i.	Wildlife Rescue Centre (Equipped with Vehicles, Manpower, Instruments etc.)	30
ii.	Watch towers for wild animal observation	25
iii	Utility Vans	20
iii.	Sensitisation/Awareness Activities	15
iv.	Staff training	15
v.	Research/Monitoring	10
vi.	Nature education camp sites (strengthening)	15
C.	**Support to ecotourism promotion activities and Infrastructure**	
i.	Ecotourism facilities (Physical)	**25**
ii.	Eco-guide training for selected youth from local communities	**10**
iii.	Improvement in tourism infrastructure (interpretation/information centres at ecotourism sites and waste management arrangements)	**30**
	Grand Total (Rs. In lakhs)	**390**

The User Agency will also be taking care of various mitigation measures. The cost for each of these measures / activities will be borne by itself. The summary is given below:

No.	**Mitigation Activity**	**Amount (Rs. In Lakhs)**
I.	**Safety Measures for Birds and Other Wildlife (Mammalian, Reptilian)**	

a)	Mounting multiple Bird Diverters along the length of the transmission line (14.9 km) within the Sanctuary area to divert the flying birds away from the transmission line and to prevent their collision with the transmission line. Bird diverters can be mounted at 30-60m interval.	Based on Actual Costs to be Incurred

b)	Placing multiple 'Bird Guards' to safeguard birds (that may land on transmission line) from electrocution, and affixing 'Anti-Climbing Devices' (ACDs) for the protection of mammals and reptiles.	Based on Actual Costs to be Incurred
II.	**Regulatory Compliances for Vegetation Loss**	
a)	**Compensatory Afforestation:** As per MoEFCC letter FP/GJ/TRANS/434476/2023, 69.5597 hectares (0.69559 sq.km) of forest land is proposed for diversion for the 765 kV D/C Lakadiya-Ahmedabad Transmission Line in Gujarat. Under the Forest Conservation Act (FCA), compensatory afforestation is required over twice the diverted area, totalling 1.39 sq.km. For the Wild Ass Sanctuary, a 14.9 km stretch of the line passes through, affecting 1 sq.km. Typically, compensatory afforestation would cover twice this area, i.e., 2 sq.km. However, given the total afforestation requirement of 1.391194 sq.km, the area in the sanctuary will need afforestation over about 0.199 sq.km to ensure ecological restoration.	Based on Actual Cost to be borne by the User Agency. (Compensatory afforestation scheme over degraded forest land on twice area (with respect to extent of Impact Area) shall be prepared and implemented by Forest Dept. as a part of forest diversion proposal under FCA at the cost borne by the User Agency. CA scheme amount shall be deposited by the User Agency as a part of FCA compliance.
b)	**Low-Height Native Plantation:** The User Agency shall carry out the plantation of native low-height plant species, some of which have medicinal properties, along the Right of Way (RoW) under the transmission line, as per the approved scheme by the Forest Department under the Forest Conservation Act (FCA), if applicable, at the Agency's expense. Existing low-height plant species in the Wild Ass Sanctuary (WAS) include *Tamarix, Suaeda, Cressa, Aeluropus*, and *Salvadora*, among others, many of which possess medicinal properties. Additionally, species such as Gugal (Commiphora wightii) may also be considered for plantation.	As per the Actuals by the User Agency. Plantation of low-height (dwarf species; preferably those having medicinal properties) in the RoW of diverted land below transmission line shall be prepared and implemented by Forest Department as a part of forest diversion proposal under FCA at the cost borne by the User Agency. The Plantation Scheme amount shall be deposited by the User Agency as a part of FCA compliances.

c)	**Ecological Compensation:** The company (User Agency) shall deposit the monetary value assigned to the long-term ecological impact of land diversion (i.e., Net Present Value of NPV) for the diversion of Forest and Sanctuary areas, as per the prevailing norms and rates under the Forest Conservation Act (FCA).	Based on Actual Cost to be borne by the User Agency. (NPV shall be calculated by the Forest Dept. as a part of forest diversion proposal under FCA and the amount shall be deposited by the company (User Agency) as a part of FCA compliances.

The Mitigation-cum-Conservation Plan ensures that the Lakadiya-Ahmedabad Transmission Line project that partly falls in Wild Ass Sanctuary (WAS) for 14.9 km through aligns with biodiversity conservation goals. By integrating robust and practical mitigation strategies suggested in the Plan, this plan seeks to preserve the biodiversity of the Wild Ass Sanctuary while facilitating renewable energy infrastructure development. It reflects a balanced approach to progress, demonstrating how infrastructure projects can coexist with robust conservation efforts. This plan serves as a blueprint for future initiatives in ecologically sensitive regions.

डेटा वर्गीकरण : प्रतिबंधित/RESTRICTED

Wildlife Mitigation & Conservation Plan for Proposed 765 KV Double Circuit Transmission Line of Lakadiya-Ahmedabad Segment Passing through Wild Ass Sanctuary (WAS)

A Mitigation-cum-Conservation Plan



Submitted to

पावरग्रिड

Power Grid Corporation, India

Submitted by:
M/s. Khavda-II-B Transmission Limited

Prepared by

SEED Foundation, Gandhinagar

CONTENTS

Chapter No.	Chapter Title & Section Heading	Page No.
	Executive Summary	i
1	**The User Agency (POWERGRID) and its 765kV Transmission Line Project in Wild Ass Sanctuary (WAS)**	**1**
	1.1 Introduction to the User Agency-Power Grid Corporation of India Limited (POWERGRID)	
	1.1.1 Mandate and Responsibility	
	1.1.2 Infrastructure and Expansion	
	1.1.3 Technological Advancements and Initiatives	
	1.1.4 Financial Performance and Corporate Governance	
	1.1.5 Sustainability and Social Impact	
	1.2 About the Project of 765 kV Transmission Infrastructure to Evacuate Power from KREP & its Scope	
	1.2.1 Project Description	
	1.2.2 Scope of the Project	
	1.3 Salient features of Lakadiya-Ahmedabad Transmission Line Scheme	
	1.4 Technique of erecting overhead transmission line	
	1.4.1 Clearing and Grading	
	1.4.2 Foundation Excavation	
	1.4.3 Foundation Installation and Setting	
	1.4.4 Pylon Assembly and Erection	
	1.4.5 Stringing Preparation	
	1.4.6 Conductor Stringing	
	1.4.7 Tensioning and Clamping	
	1.4.8 Insulator Installation	
	1.4.9 Joint Inspection and Testing	
	1.4.10 Crossings (Roads, Water Bodies)	
	1.4.11 Restoration	
2	**Environment Impact Assessment**	**10**
	2.1 Environment Impacts of Linear Structures-Background	
	2.1.1 Prevention	
	2.1.2 Reduction/Realignment	
	2.1.3 Restoration	
	2.1.4 Mitigation	
	2.2 Wildlife (wild flora-fauna) Investigation in the Project Study Area (i.e. Impact Area and 1 km buffer on each side of transmission line) in WAS for Impact Assessment	
	2.2.1 Wild Ass Sanctuary (WAS) in which the 765 kV Transmission Line is located	

Chapter No.	Chapter Title & Section Heading	Page No.
	2.2.1.1 Location and Area of the Wild Ass Sanctuary (WAS)	
	2.2.1.2 Constitution	
	2.2.1.3 Wetland Characteristic of Little Rann Encompassed by Wild Ass Sanctuary	
	2.2.1.4 Major Habitats besides Wetland	
	2.2.1.5 Importance of the Sanctuary	
	2.2.1.6 Salt Zone of Morbi district	
	2.2.2 Objectives	
	2.2.3 Methodology	
	2.2.4 Findings of the field survey-based Wildlife Investigations	
	2.2.4.1 Fauna	
	2.2.4.2 Flora	
	2.3 Identification of Potential Impacts for Developing Mitigation Measures based on Field Assessment	
3	**Mitigation Measures-_Identification and Implementation by the Power Grid Corporation**	**78**
	3.1 Introduction to Basic Terms Pertaining to Mitigation	
	3.1.1 Mitigation	
	3.1.2 Mitigation goals	
	3.1.3 Mitigation action	
	3.1.4 Mitigation action plan	
	3.2 Mitigation Measures to be Implemented by Power Grid Corporation	
	3.2.1 Wetland and Mudflat Protection	
	3.2.2 Measures for Safety of Wildlife and Their Movements	
	3.2.2.1 Avoidance of Disruption in Wildlife Corridors	
	3.2.2.2 Minimum/Restricted Tree-removal(cutting)	
	3.2.2.3 Disturbance Reduction during Construction Phase of the Transmission Line	
	3.2.2.4 Physical Risk Reduction for Mammals and Reptiles during Construction & Operation Phases	
	3.2.2.5 Bird Safety Measures	
4	**Conservation Measures to be Implemented by Gujarat Forest Department**	**88**
	4.1 Introduction	
	4.1.1 Compensatory Afforestation	
	4.2.2 Habitat Improvement	
	4.2.2.1 Establishing Native Herb and Grass Cover for Habitat Restoration	

Chapter No.	Chapter Title & Section Heading	Page No.
	4.2.2.2 Creation of Artificial Wetlands for Habitat Improvement	
	4.2.2.3_Shelterbelt Development for Wildlife in Open Landscapes	
	4.2.2.4 Invasive Species (mainly *P. juliflora*) Management	
	4.2.2.5 Wildlife Monitoring and Research	
	4.2.3 Awareness, Education and Ecotourism Activities by Forest Department	
5	**Implementation, Monitoring and Evaluation of Mitigation-cum-Conservation Measure Plan**	**101**
	5.1 Implementation of Mitigation Plan	
	5.1.1 Implementation of regulatory compliances	
	5.1.2 Implementation of wildlife mitigation measures by project proponent	
	5.1.3 Implementation of wildlife mitigation measures by Forest Department	
	5.2 Monitoring and evaluation responsibility	
	5.2.1 Monitoring Programme for Wildlife Mitigation Measures	
	5.2.1.1 Monitoring Methodology	
	5.2.2 Adaptive Management Approach	
	5.2.3 Specific Monitoring Activities	
	5.3 Conservation Measures Monitoring Programme	
	5.4 Evaluation and Reporting	
	5.5 Integration with Regional Initiatives	
6	**Financial Outlay**	**107**
	References	**114**
	Annexure I: Geographical points of the finalized demarcation of the proposed 765 KV D/C overhead transmission line passing through WAS **Annexure II:** Animal Passage Plan for the Area Below Transmission Line **Annexure III:** Management Plan For the Area Below Transmission Line	**115-123**

LIST OF TABLES

Table No.	Titles	Page No.
1.1	Details of 765 kV D/C Lakadiya-Ahmedabad Transmission Line	6
2.1	Extent (area in hectare) of Land Use/Cover (LULC)categories in the buffer area	22
2.2	Checklist of the bird species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS)	44
2.3	Checklist of the mammalian species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS)	59
2.4	Checklist of common reptile species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS)	62
2.5	Checklist of the plant species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS)	67
2.6a	Envisioned potential impacts of transmission line erection project	73
2.6b	Envisioned potential impacts of transmission line erection project	75
6.1	Mitigation Measures proposed for the Project Area	107
6.2	Conservation measures proposed for the project area to be implemented by the Forest Department at the cost borne by the User Agency along with financial outlay	110
6.3	Proposed year-wise financial outlay schedule for conservation measures in the Project Area	112

LIST OF FIGURES

Fig. no.	Titles	Page No.
2.1	Transmission line's alternative routes (shown in different colours like cyan, magenta, green, reddish brown etc.) out of which one shown with magenta colour has been finalized	12
2.2	Typical landscape of Wild Ass Sanctuary characterized by predominance of dry saline flats of Little Rann of Kachchh	15
2.3	Glimpses of seasonal inundation of the saline flats of Little Rann in Wild Ass Sanctuary-An important waterbird habitat	16
2.4a	Lakadiya-Ahmedabad Overhead Transmission Line and its Environs with Observation Points used for Flora-Fauna Field Survey.	20
2.4b	A proposed 765 KV Double Circuit Transmission Line (19.4 km) passing through Wild Ass Sanctuary	21
2.4c	1 km buffer on each side of the proposed 765 kV D/C transmission line passing through a portion of Wild Ass Sanctuary for 14.9km	23
2.5	Distribution of the sampling localities (1-5) in proposed overhead transmission line passing through Wild Ass Sanctuary	33
2.6a	Drone image of inundated mudflat of LRK near Khirai Village, WAS	34
2.6b	Drone image of Herb-Grass-Scrub covered land near Haripar Village	35
2.6c	Salt-work area in LRK towards Haripar (Point 3), WAS-a drone image	36
2.6d	Salt-work area in LRK towards Shikarpur (Point 4), WAS-a drone image	36
2.6e	Drone image of barren land-cum-Castor cultivation area of Shikarpur area, WAS	37
2.7a	Inundated Mudflat of LRK in WAS	38
2.7b	Dry Mudflat of LRK in WAS	38
2.7c	Salt-work (Salt-pan) area in LRK, WAS	38
2.7d	Pond with marshy vegetation in WAS	38
2.7e	Herb cover, WAS	39
2.7f	Scrub cover, WAS	39
2.7g	Castor cultivation, WAS	39
2.7h	Coriander cultivation, WAS	39
2.8	Drone utilised in the present study	40
2.9	White-throated Kingfisher	43
2.10	Red-naped Ibis	43
2.11	Glimpses of birds in different habitats encountered during field assessment for transmission line mitigation plan study in WAS	53
2.12	A Great White Pelican (Juvenile)	54
2.13	A pair of *Numenius* sp.	54
2.14	Drone image showing presence of pelicans and storks	57

2.15	Some small mammals and a reptile	58
2.16a	A flock of Indian Wild Ass in WAS near Khirai village	60
2.16b	Resting Indian Wild Asses in WAS near Khirai village	60
2.17a	A drone image (dated 28-10-'24) indicating 9 Wild Asses in the frame	61
2.17b	A drone image (dated 28-10-'24) indicating occurrence of juvenile Wild Ass	61
18	Marshy Emergent Vegetation	63
19	*Dichrostachys cinerea* – An uncommon shrub in the area	63
2.20	Glimpses of plants of different habits recorded during field assessment	64
2.21	*Tamarix troupii*-A native shrub species which can adapt well to saline soil condition	65
2.22	Dense growth of an exotic invasive shrub-*Prosopis juliflora*	66
2.23	*Cressa cretica* –A common halophyte in WAS	69
2.24	*Phragmites karka* – a common emergent hydrophyte in the area	69
3.1a	Different types of markers used as bird diverters for transmission lines	83
3.1b	Indicative illustration of a bird diverter on transmission line	83
3.2	Diverter installation indicative designs (Source: WII, 2018)	83
3.3	Indicative design & configuration of bird markers to be installed to reduce bird collision on transmission line passing through selected WLS/ forest stretch	85

Chapter-1

The Project Implementer (POWERGRID) and its 765kV Transmission Line Project in Wild Ass Sanctuary (WAS)

1.1 Introduction to the Project Implementer-Power Grid Corporation of India Limited (POWERGRID)

Power Grid Corporation of India Limited (POWERGRID) is a premier central public sector enterprise under the Ministry of Power, Government of India. POWERGRID has cemented its role as a backbone of India's power infrastructure, enabling nationwide electricity transmission and supporting the country's growing energy demands. Established in 1989 and headquartered in Gurugram, Haryana, POWERGRID is responsible for the majority of India's electric power transmission, facilitating the movement of electricity from generation points to distribution networks, where it reaches end-users. With an expansive national footprint, POWERGRID plays a critical role in maintaining the stability and reliability of the country's power grid, ensuring that power generated in one region can be transmitted seamlessly to others. With a vision of achieving sustainable and reliable power transmission, POWERGRID remains focused on enhancing grid resilience, embracing green energy integration, and expanding its cross-border connectivity, making it a vital player in India's journey toward becoming a global energy leader.

1.1.1 Mandate and Responsibilities

POWERGRID's primary mandate is to develop and manage India's national power transmission network, operating a range of high-voltage lines spanning the length and breadth of the country. It is tasked with planning, coordinating, and ensuring efficient energy transmission in India. Additionally, POWERGRID is responsible for inter-regional power transmission, which involves connecting different regions to balance supply and

demand effectively. This capability is particularly vital as India strives for 24/7 electricity access across urban and rural areas.

1.1.2 Infrastructure and Expansion

POWERGRID boasts one of the largest transmission networks in the world, with thousands of kilometers of transmission lines and substations across India. It operates at multiple voltage levels, from 132 kV up to the ultra-high voltage (UHV) level of 800 kV, and includes a robust network of substations that ensure stable and efficient power flow. As of recent reports, POWERGRID's network covers over 173,000 circuit kilometers and has more than 250 substations, underscoring its pivotal role in supporting India's growing energy needs.

The corporation is also actively involved in strengthening cross-border electricity transmission networks. India has successfully established interconnections with neighboring countries, including Nepal, Bhutan, and Bangladesh, which facilitate power trade and contribute to regional energy security. Through these initiatives, POWERGRID supports both India’s and its neighbors’ development by enhancing energy reliability and access.

1.1.3 Technological Advancements and Initiatives

POWERGRID emphasizes advanced technology adoption and innovation to improve grid efficiency and resilience. It has invested in Smart Grid technologies, such as real-time monitoring systems, digital substations, and automated control systems that enhance grid stability. Furthermore, POWERGRID’s commitment to renewable energy integration is noteworthy; it is continuously working on grid solutions to accommodate renewable energy from solar and wind sources, which are inherently variable, into the mainstream power grid.

1.1.4 Financial Performance and Corporate Governance

As a listed company, POWERGRID operates with a high degree of financial transparency and corporate governance. It has consistently shown strong financial performance, with healthy revenue and profit growth attributed to its critical role in India's power sector and its efficient operational model. Its stocks are listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE), making it one of the more sought-after public sector units for investors.

1.1.5 Sustainability and Social Impact

POWERGRID is committed to sustainable practices and corporate social responsibility (CSR). It undertakes various CSR initiatives, focusing on community welfare, education, health, and rural development. The corporation has also adopted eco-friendly practices within its projects to minimize environmental impact, such as using environmentally sensitive areas and adopting best practices in project planning.

1.2 About the Project of 765 kV Transmission Infrastructure to evacuate power from KREP and its Scope

1.2.1 Project Description

Government of India has set a target of reaching 500 GW of installed capacity from renewable energy sources by the year 2030. In order to achieve the target, various Solar, Wind, Wind- Solar Hybrid policies have been enunciated by Central and State Governments.

Gujarat state has also been on the forefront in planning and implementing renewable energy projects. For development of large-scale renewable energy projects, the state of Gujarat has issued a policy for allotment of revenue waste land to the park developers for the purpose of raising Renewable Energy (RE) Generation Park to develop 30 GW (planned expansion to 42 GW) Wind- Solar Hybrid Park in Khavda

region (in area bordering India and Pakistan), Kutch district of Gujarat. The development of renewable park in Khavda region is a prestigious & ambitious National project of Government of India for development of renewable energy to meet the 500 GW target by 2030.

30 GW renewable energy power to be generated at Hybrid RE park at Khavda shall be evacuated through 10 to 12 High Voltage transmission lines of (400 kV, 500 kV, 765 kV) in phase manner as mentioned below:

Phase	**Gigawatt**	**Route of the transmission line**
I	3	Khavda RE. Park to Bhuj
II	4.5	Khavda RE. Park to **Lakadiya, to Ahmedabad,** Navsari
III	7	Khavda RE. Park to Lakadiya to Halvad to Vataman to Navsari
IV	7	Khavda RE. Park to Lakadiya to Navsari to Nagpur
V	8.5	Khavda RE. Park to Lakadiya to Surat to Olpad to Navsari

While promoting such transmission projects, the richness of the area in terms of wildlife has to remain undisturbed. Looking into the development of transmission system for evacuation of renewable energy from Khavda RE Park, **it is proposed to develop a conservation fund wherein the budget acquired can be deposited and such a mechanism can bring to facilitate the operation of such fund for implementation of conservation plan.**

Considering that approximately 10 to 12 high-voltage transmission lines (400 kV, 500 kV, 765 kV) are planned to be constructed in a phased manner, some degree of disturbance to wildlife is inevitable. To mitigate this impact, dedicated efforts must be undertaken, supported by the effective utilization of conservation funds.

In future all such budget can be deposited in this conservation fund and efforts can be made to use this fund for various conservation and mitigation measures.

1.2.2 Scope of the Project

To evacuate power from the Khavda Renewable Energy Park (KREP) and distribute it across India, a robust transmission network is being developed, spearheaded by **Power Grid Corporation of India Limited (PGCIL)**. Its major transmission segments are as follows:

- **Khavda to Lakadiya (765 kV)**: This segment forms the primary evacuation corridor.
- **Lakadiya to Ahmedabad (765 kV)**: Connects the energy park to Gujarat's load centers and national grid.
- **Lakadiya to Vadodara (765 kV)**: Facilitates power distribution to southern and central India.

Powergrid Khavda II Transmission Line (a wholly owned subsidiary company of Power Grid Corporation of India Ltd. has proposed to construct 765 kV Double Circuit Lakadia-to-Ahmedabad transmission line of about 184 km for the evacuation of Solar & wind energy generated through the renewable source of energy at Khavda to Lakadia under phase II of power evacuation scheme. This document entails both mitigation and conservation plan for the area below transmission line that passes across Wild Ass Sanctuary (Little Rann of Kachchh) for the distance of 14.912 km. It covers wildlife sanctuary area of about 1 sq,km.

1.3 Salient features of Lakadia-Ahmedabad Transmission Line Scheme

Details of Lakadiya-Ahmedabad Transmission Line scheme is given in Table 1.1

Table 1.1 Details of 765 kV D/C Lakadiya-Ahmedabad Transmission Line

1	**Name of Company**	**POWERGRID KHAVADA II TRANMISSION LINE** [A wholly owned subsidiary company of POWER GRID CORPORATION OF INDIA LIMITED (Govt of India Enterprise)] "Transmission scheme for evacuation of 4.5GW RE injection at Khavda PS under Phase-II Part –B" through Tariff Based competitive bidding
2	**Name of line**	765 KV D/C LAKADIYA-AHMEDABAD TRANMISSION LINE
3	**Importance of Project**	765 KV Double Circuit Lakadiya PS-Ahmedabad Transmission line is utmost important to evacuate the power from 30 GW Khavada Renewable Energy Zone. This project is also important for the target of Zero carbon emission of Government of India. This Project enhances the availability of clean energy for the people of and increase the availability of electrical power for local people and Gujarat State.
4	**Right of Way of line (RoW)**	67 M
5	**Total Line length**	184.106 KM
6	**Total KM in Wild life Area**	14.912 KM
7	**Total area in Wild life**	99.912 ha
8	**Name of village in Wildlife area**	Rann of Kutch, Sikarpur, Vardusar, Khikhli, Ghatila, Hariper
9	**Total tower in Wild life area**	31 Nos.
10	**Total cost of Project**	723,54,83,171/-
11	**Cost of Wild life area (14.912 KM)**	58,60,51,106/-

Source: Power Grid Corporation

1.4 Technique of erecting overhead transmission line

1.4.1 Clearing and Grading

- Objective: Prepare the site for construction.
- Activities:
  - Clear vegetation, debris, and any obstructions along the transmission line route.
  - Level the ground to ensure a stable and uniform base for foundation work.

1.4.2 Foundation Excavation

- Objective: Create a stable base for the pylons.
- Activities:
  - Dig foundation pits according to the design specifications.
  - Consider soil conditions, depth requirements, and load-bearing capacity.

1.4.3 Foundation Installation and Setting

- Objective: Provide structural support to the pylons.
- Activities:
  - Install concrete or steel foundations based on soil and design considerations.
  - Reinforce with materials like rebar, as necessary.
  - Allow the foundation to cure for optimal strength.

1.4.4 Pylon Assembly and Erection

- Objective: Assemble and install the transmission line pylons.
- Activities:
  - Prefabricate or partially assemble pylons on-site or off-site.
  - Use cranes or gin poles to erect the pylons onto their foundations.
  - Ensure proper alignment and secure all connections.

1.4.5 Stringing Preparation

- Objective: Prepare for the installation of conductors (wires).
- Activities:
  - Install stringing rollers or pulleys on the pylons.
  - Verify that all tools and equipment are ready for stringing.

1.4.6 Conductor Stringing

- Objective: Install the transmission conductors between pylons.
- Activities:
  - Use pulling and tensioning equipment to lay the conductors along the prepared route.
  - Ensure minimal sag and no damage to the conductors during the process.

1.4.7 Tensioning and Clamping

- Objective: Secure conductors to achieve the required tension.
- Activities:
  - Adjust the tension of the conductors to design specifications.
  - Clamp the conductors at anchor points and intermediate pylons.

1.4.8 Insulator Installation

- Objective: Prevent electrical leakage and support the conductors.
- Activities:
  - Attach insulators to pylons at designed points.
  - Securely connect conductors to the insulators.

1.4.9 Joint Inspection and Testing

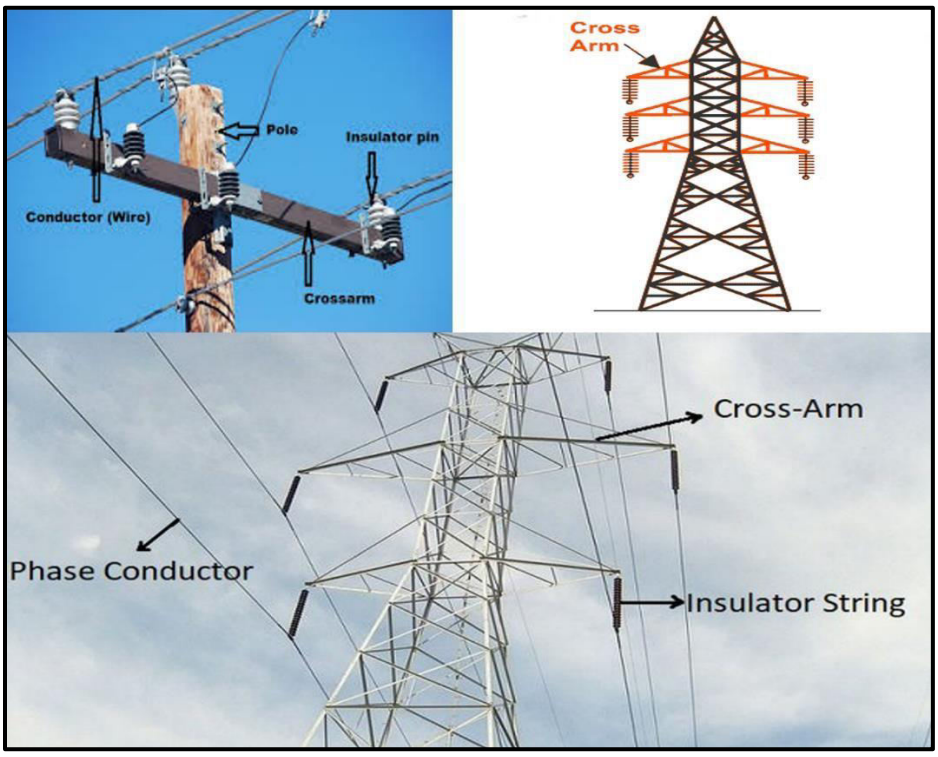
- Objective: Ensure the system's integrity and readiness.
- Activities:
  - Inspect all joints, pylons, and installations for defects or misalignments.
  - Conduct electrical and mechanical tests on conductors and insulators.

1.4.10 Crossings (Roads, Water Bodies)

- Objective: Safely navigate obstacles along the route.
- Activities:
  - Use specialized equipment and techniques like scaffolding or floating platforms.
  - Coordinate with local authorities for road closures or permits if required.

1.4.11 Restoration

- Objective: Restore the environment and minimize impact.
- Activities:
  - Restore the areas affected by construction, such as filling excavated pits and reseeding vegetation.
  - Ensure the site is safe and free of hazards for wild flora-fauna local and communities.



(Source:www.electricaldesks.com)

Chapter-2

Environment Impact Assessment

2.1 Environment Impacts of Linear Structures-A Background

Linear infrastructure, such as transmission lines, can exert significant ecological impacts and to avoid/reduce/mitigate them, targeted strategies are required. Such man-made structures in natural landscapes are known to impose adverse impact on habitats of flora and fauna (wildlife) through fragmentation, habitat alteration (e.g. through clearance/alteration of natural elements like vegetation cover) and by creating barriers against home range or territorial movements of wild mammals and/or dispersal movement of herpetofauna. The animals that use flight as their mode of transportation (e.g. birds, bats) face direct risks of collision with conductors and/or electrocution. Such hazards can severely affect their diversity and/or populations. Addressing these challenges demands careful assessment and planning to minimize harm to biodiversity.

The above-mentioned aspects have constituted the basis in developing this particular report comprising wildlife mitigation measures and conservation plan for the proposed 765 kV DC overhead transmission line project. The proposed transmission line would be passing over the length of 14.9 km across small portion of Wild Ass Sanctuary (Little Rann)'s wilderness-cum-salt manufacture area falling in Maliya taluka. The impacts to be assessed encompass an area of 99.999 hectare (approx. 1 sq. km) falling in Maliya Wildlife Division, Gujarat Forest Department.

In accordance with the draft guidelines issued by the National Board for Wildlife and MoEF & CC in 2011(titled *Guidelines for Linear Infrastructure Intrusions in Natural Areas: Roads and Powerlines),* a hierarchical approach has been adopted for the proposed 765 kV DC transmission line project. This approach prioritizes 'Prevention,' 'Realignment,' 'Restoration,' and 'Mitigation'.

2.1.1 Prevention:

As much as possible, efforts have to be made to avoid active wildlife areas in the Protected Area, viz. Wild Ass Sanctuary. An extensive analysis of alternative routes needs to be performed and it has been done for this project. Based on it, the most optimal alignment has to be selected that has minimal intrusion into the sanctuary area (Fig. 2.1). For the present project (Lakadiya-Ahmedabad transmission line passing through a portion of Wild Ass Sanctuary falling in Maliya taluka)

2.1.2 Reduction/Realignment:

The finalized route should strike a balance between environmental sensitivity and technical feasibility. Multiple alternatives have to beevaluated to determine the most viable alignment for the 765 kV D/C Lakadia-Ahmedabad line including its segment passing through Wild Ass Sanctuary. The selected alignment should prioritize minimizing intrusion into wildlife sanctuary areas while accommodating existing infrastructure and project requirements (Map-X). The finalised route includes a diversion of 99.912 hectares, within the protected area of the Wild Ass Sanctuary, under the Maliya Division. It is desirable that the alignment follows the outer boundary of the main sanctuaryso that it is unlikely to cause significant adverse impacts on critical wildlife or avifauna habitats. The same is implemented in the project.

2.1.3 Restoration:

Following construction (i.e. in post-construction stage), the diverted sanctuary areas will have to be ecologically restored under the supervision of the respective forest division. Restoration efforts will have to prioritize the use of native, diverse species that align with the region's natural vegetation. Particular attention will have to be given to preserving the integrity of the soil, landscape, and existing vegetation, ensuring minimal disturbance throughout the restoration process.

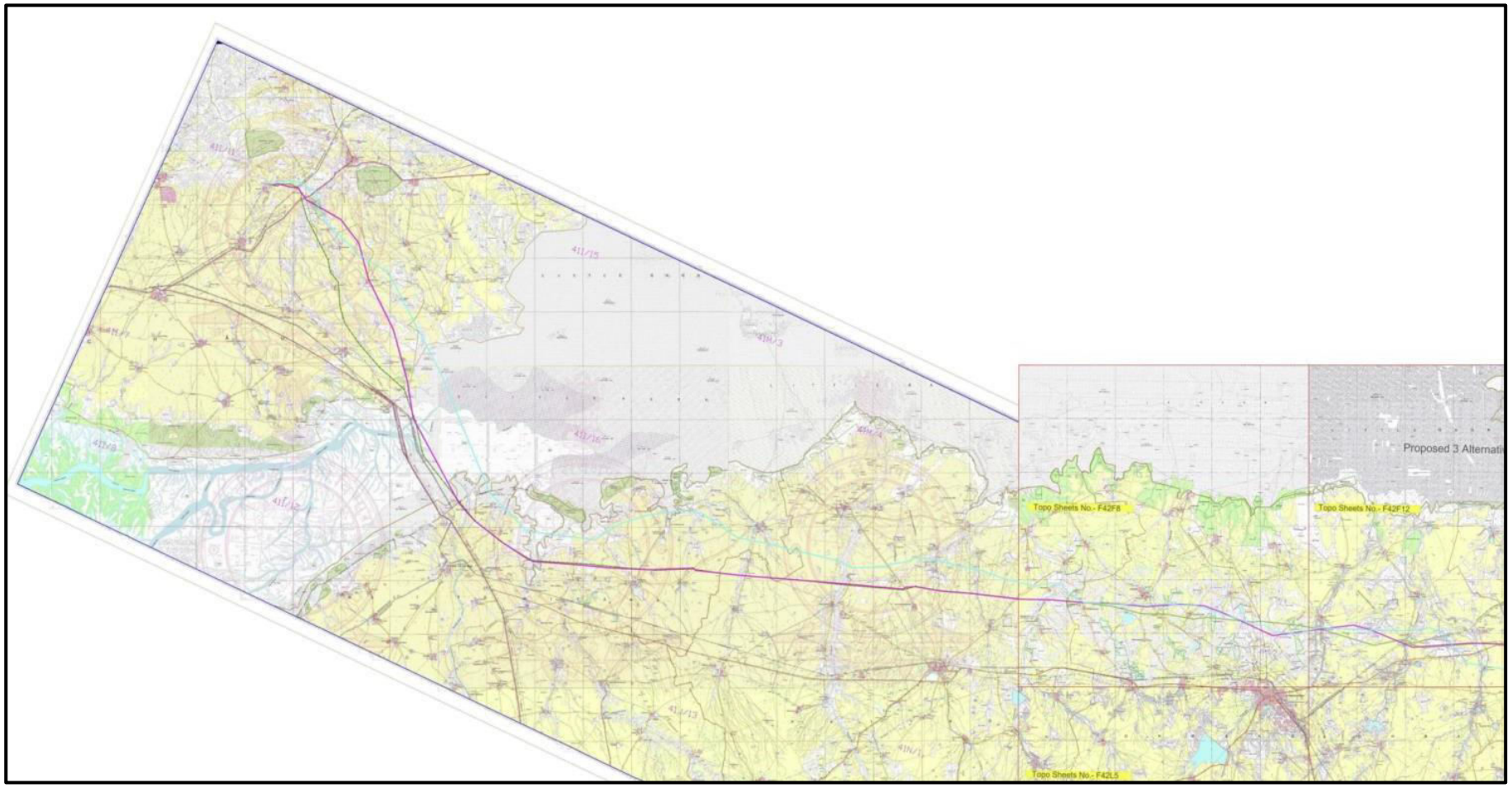


Fig 2.1. Transmission line's alternative routes (shown in different colours like cyan, magenta, green, reddish brown etc.) out of which one shown with magenta colour has been finalized

2.1.4 Mitigation:

For identification of the mitigation measures, identification of the impacts of the proposed project on the area's biodiversity (flora and fauna) is essential. Moreover, to identify the impacts on the biodiversity, field-survey based studies have to be carried out to evaluate (i) which flora and fauna exist in the area likely to be impacted , and (ii) which might be the potential impacts of the transmission line on the biodiversity (flora-fauna) in that area Field surveys to collect baseline data is very much essential as based on analysis of the base line data, identification anticipated impact on flora and fauna of the project area and identification of the mitigation measures will be possible. These points are taken into consideration for development of mitigation measures and conservation plan for the Power Grid Corporation's project of Lakadiya-Ahmedabad overhead transmission line passing for 14.9 km through Wild Ass Sanctuary. It may be noted that the entire work of baseline data collection (methodology and findings including comprehensive checks-lists of flora and fauna) for the transmission line project of Power Grid Corporation is comprehensively provided in section 2.3. In the subsequent section, scientifically informed mitigation measures have been developed to effectively reduce these impacts.

2.2 Wildlife (wild flora-fauna) Investigation in the Project Study Area (i.e. Impact Area and 1 km buffer on each side of transmission line) in WAS for Impact Assessment

2.2.1 Wild Ass Sanctuary (WAS) in which the 765 kV Transmission Line is located

The Wild Ass Sanctuary is a unique landscape of salt flats and seasonal wetlands, spanning 4953 km^2. It was established in 1973 under sections 20 and 21 of the Gujarat Wild Animals and Wild Birds Protection Act, 1963 to protect the endangered Indian Wild Ass (*Equus heminous khur*) (Parmar et al., 2014). The area is a vital eco-tone between marine and terrestrial ecosystems, with saline mudflats, islands, and a rich biodiversity. It is home to diverse communities, including salt workers, livestock herders, and fishermen, who rely on its resources. Beyond its stunning salt plains, it holds rich historical significance, with folklore of Vacchra Dada and tales of King Siddhraj Jaisinh navigating

the Rann by boat, including the story of Nanda Bet. Its climate has shaped both the region's ecology and the development of local civilizations.

2.2.1.1 Location and Area of the Wild Ass Sanctuary (WAS)

The Wild Ass Sanctuary is situated between latitudes 22°55'N and 24°35'N, and longitudes 70°30'E and 71°45'E, covering a total distance of over 4953 km^2 which makes it one of the vast sanctuaries in the country. It includes 3569 km^2 area of Little Rann of Kachchh, 580 km^2 of reserved and unclassed forest area and 804 km^2 of the government barren land lying on the periphery of the sanctuary. It is situated partly within the Kachchh biotic province (3A) of the Indian Desert Bio-geographic zone (3) and partly in the Gujarat-Rajwada biotic province (4B) of the Semi-Arid bio-geographic zone (4). One of its most striking characteristics is the salt-encrusted mudflats and Bets (islands) (Singh et al. 1999). It is spread over Patan, Surendranagar and Morbi districts of the Saurashtra region, as well as Banaskantha in North Gujarat and Kachchh district in Kachchh region with majority of the sanctuary falling under Kachchh District.

2.2.1.2 Constitution

The Wild Ass Sanctuary spans across four forest divisions and five revenue districts, covering areas in Surendranagar, Morbi, Patan, Kachchh (East), and Banaskantha. It comprises of reserved and unclassed forests, as well as coastal ranges such as Dhrangadhara, Halvad, Bhachau, Adesar, Santalpur, Vav, Radhanpur, Sami, and Patdi. The sanctuary also encompasses the Little Rann of Kachchh and surrounding government barren lands. Shaped roughly like a triangle, its southern edge is in Malia (Morbi) and parts of Surendranagar; the eastern fringe lies in Dasada (Surendranagar), Sami, and Radhanpur (Patan); the northern apex extends into Santalpur (Patan); and the western edge covers Bhachau and Rapar (Kachchh) (Parmar et al., 2014). The Tropic of Cancer passes through the Sanctuary. As settlement rights have not been completed yet, according to section 18 to 24 of Wildlife (Protection) Act 1972, Sanctuary is opened for villagers of coastal areas for grazing and salt manufacturing as per their old and existing rights. Survey and demarcation

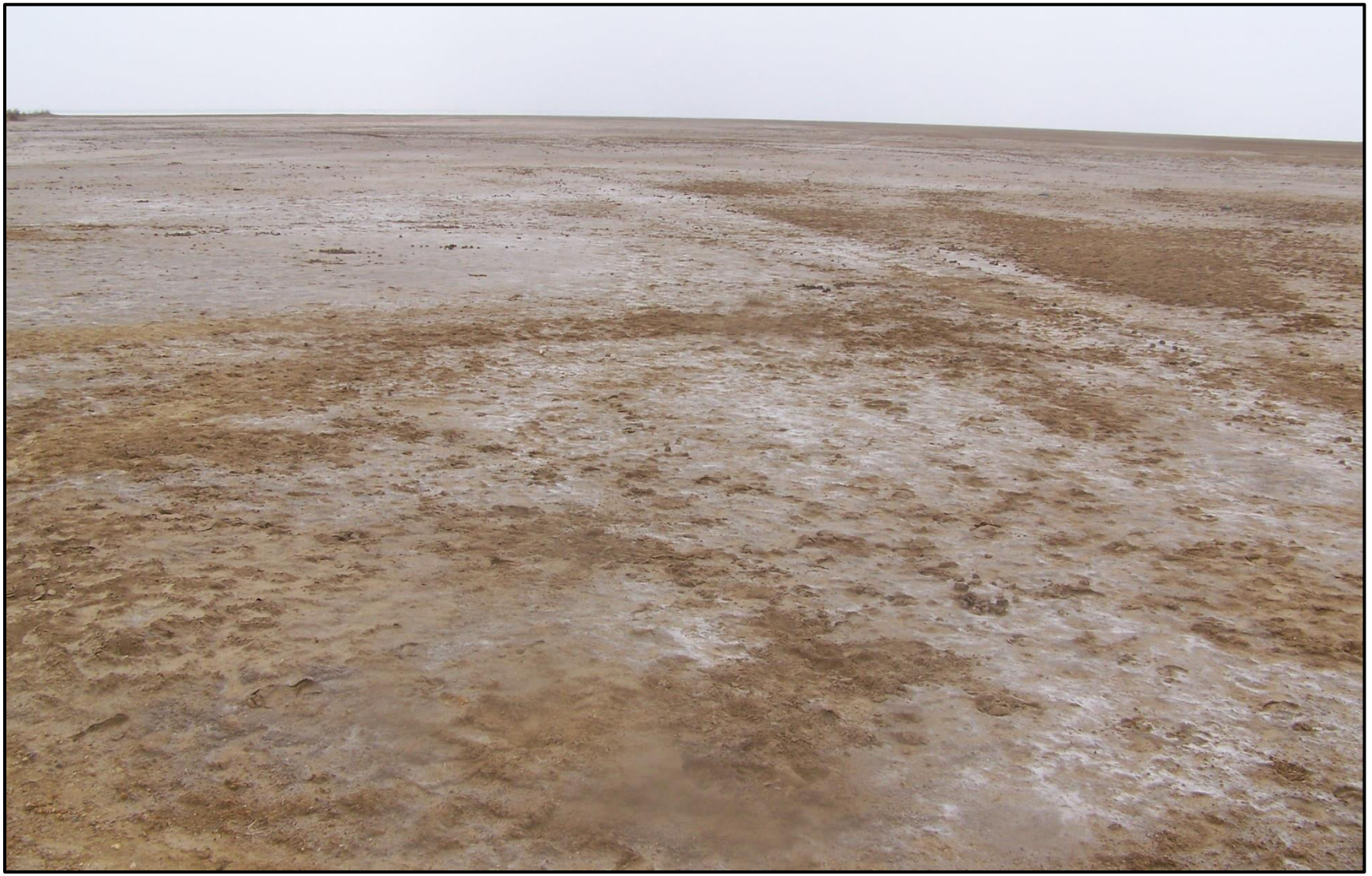


Fig. 2.2 Typical landscape of Wild Ass Sanctuary characterized by predominance of dry saline flats of Little Rann of Kachchh



Fig. 2.3 Glimpses of seasonal inundation of the saline flats of Little Rann in Wild Ass Sanctuary-An important waterbird habitat

of sanctuary has not been done so far, thus plain areas of sanctuary are easily accessible from all surroundings.

2.2.1.3 Wetland Characteristic of Little Rann Encompassed by Wild Ass Sanctuary

The Little Rann of Kachchh was initially situated in a tectonic depression. During the Mesozoic era, it, along with the Greater Rann, was part of the Arabian Sea. However, a geological shift eventually cut off this connection, and over time, the area transformed into a seasonal marshy salt desert. During the monsoon season, the region is inundated with water, forming a wetland. In contrast, during the summer, the water evaporates, leaving behind a vast expanse of dry, white, salty land.

The Rann of Kachchh is a unique landscape, primarily consisting of flat, low-lying plains with occasional elevated areas (Bets) and fringes. While largely arid, parts of the region transform into seasonal wetlands, especially in the northern and western sections connecting the Great and Little Ranns. Areas near Pachchham and Sanchor also experience flooding. What distinguishes this wetland is its mix of saline water from the sea and freshwater from rainfall and small streams, creating a distinctive and dynamic ecosystem.

The Rann of Kachchh is primarily inundated by freshwater from rivers like Banas, Saraswati, and Rupen, along with tidal waters from the Gulf of Kachchh. While tidal influence persists even after freshwater dries up, freshwater runoff from seasonal streams plays a larger role in flooding the region (Singh et al., 1999).

Different areas in the Rann show varying wetland characteristics, with some sites receiving only freshwater and others a mix of both freshwater and tidal water. However, freshwater flow has reduced over time due to factors like the NW-SE fault limiting river flow and the damming of rivers like Banas at Dantivada. This reduction in freshwater flow is further exacerbated by the configuration of wide buried channels along the central exits of the Little Rann, which extend from the mainland in the NE to the head of the Gulf of

Kachchh in the SW. Satellite imagery has identified these channels (Merh and Kalik, 1996), and this has been one of the reasons for the reduction in the fresh water flow into the Little Rann.

2.2.1.4 Major Habitats besides Wetland

The region is dominated by vast salt flats, particularly within the Little Rann of Kachchh (LRK), which are seasonally flooded and form a crucial part of the area's unique ecosystem. Along the periphery of the Rann, grasslands provide grazing grounds for herbivores and livestock. The wetland, which forms during the monsoon, attracts a variety of migratory birds and supports diverse aquatic flora and fauna. Human activities surrounding the Little Rann, such as agriculture, salt production, pastoralism, settlement development, and tourism, have significantly altered the landscape. These modifications transform natural habitats into agricultural fields, salt pans, grazing areas, villages, and tourism infrastructure, placing pressure on the local ecosystems. As such, sustainable management practices are essential to ensure a balance between development and conservation.

2.2.1.5 Importance of the Sanctuary

The Little Rann of Kachchh (LRK) is India's second-largest protected area, home to unique biodiversity, including endemic species (Parmar et al., 2014). Its landscape shifts from a saline desert in summer to a seasonal wetland during monsoons. This mosaic of freshwater and tidal waters supports diverse aquatic life. The LRK acts as a critical watershed, regulating floods and connecting the Gulf of Kachchh to the Gulf of Khambhat. It is a key spawning ground for prawns and fish, and a vital stopover for migratory birds, especially flamingos. Recognized as a Wetland of National Importance and an Important Bird Area (IBA). Little Rann of Kachchh wetland qualifies number of Ramsar criteria to be declared it as Ramsar Site under Ramsar Convention. Additionally, it is a

popular tourist destination known for bird watching and the Rannotsav festival, and plays a significant socioeconomic role with its indigenous Kachchhhi Maldharis, salt pan workers, and fishermen. Additionally, the report prepared by the CEE for proposing the biosphere reserve in the area covering 6385.2 km^2 of the Little Rann and 47 villages around the periphery has been accepted in 2009 and the LRK is a biosphere reserve along with GRK constitute Kachchh Biosphere Reserve.

2.2.1.6 Salt Zone of Morbi district

The saltworks in Morbi district are located in the southwest portion of the Wild Ass Sanctuary (WAS), covering an area of 5,974 hectares leased after the sanctuary's notification, with an additional 2,953 hectares leased prior to the notification. Major saltwork areas are concentrated southwest of the Surajbari Bridge, east of the railway bridge near Surajbari (north of Hajipur village), and north of Venasar village (Parmar et al., 2014).

The region around Surajbari Bridge and Bagasra, in the southwest part of the sanctuary, is heavily impacted by salt manufacturing activities. Salt works had been established in some areas as early as 1984. Wildlife, including the Wild Ass, is rarely sighted in this southern creek area, the area is less significant for wildlife. The area of the present project is situated in WAS.

2.2.1.7 The Project Area in Wild Ass Sanctuary

Lakadiya-Ahmedabad overhead transmission line has total length of 184 km (Fig.2.4a). A portion of it having a length of 14.9 km passing through Wild Ass Sanctuary (Fig. 2.4b). It covers wildlife area of 99.912 ha (approx. 1 sq.km) as per the details provided in Table 1.1.

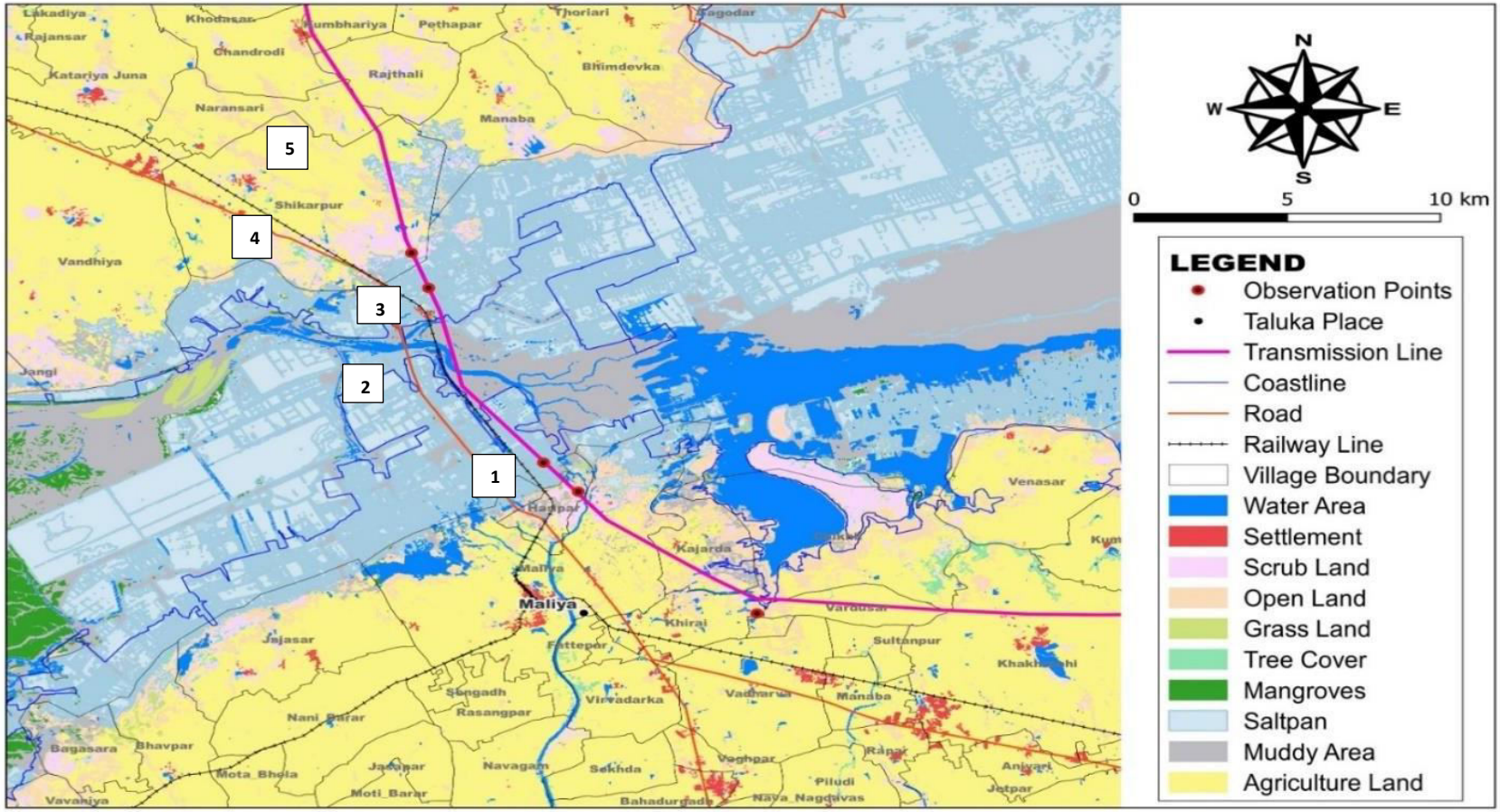


Fig.2.4a. Lakadiya-Ahmedabad Overhead Transmission Line and its Environs with Observation Points used for Flora-Fauna Field Survey.

Note: 1: Khirai observation pt. (23° 5'36.70"N, 70°49'43.81"E); 2. Haripar herb-grass-scrub land o.pt. (23° 9'6.25"N, 70°45'41.84"E); 3: LRK salt-work area o.pt. towards Haripar, Maliya (23° 8'25.96"N, 70°46'21.20"E), 4: LRK salt-work area o.pt. towards Shikarpur, Bhachau (23°13'7.20"N, 70°43'33.03"E); 5. Shikarpur castor cultivation-cum-barren land o.pt.(23°13'55.44"N, 70°43'14.10"E)

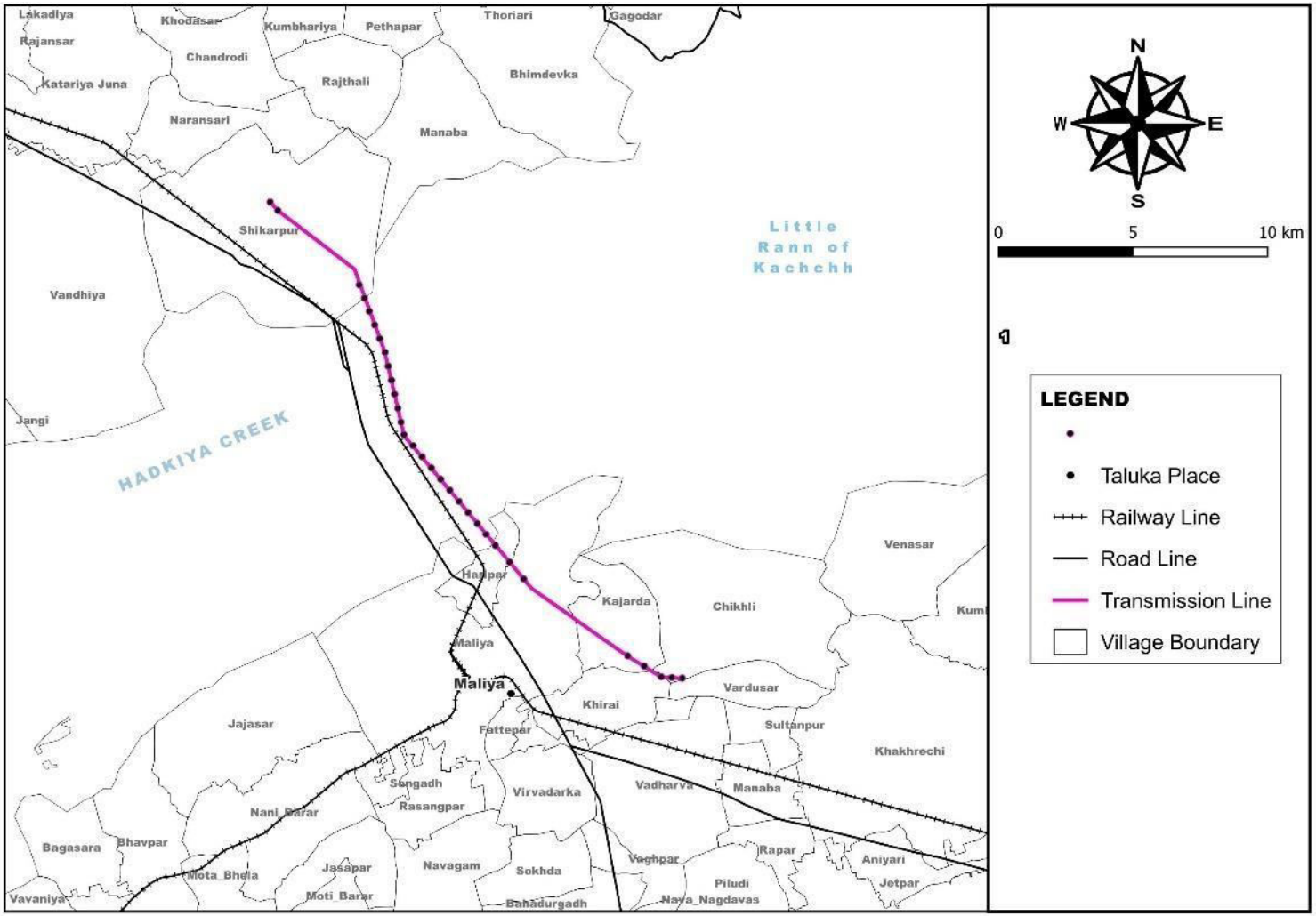


Fig. 2.4b A proposed 765 KV Double Circuit Transmission Line (19.4 km) passing through Wild Ass Sanctuary (Note: Geographical coordinates of points falling on this proposed line are given in Annexure-1)

Overall, this project area is situated near Surajbari bridge and covers the land area of Khirai, Haripar, Shikarpur, Vardusar and Ghatila villages and portion of Little Rann that is heavily occupied with salt-works. 1 km on each the side of the transmission line has been considered as a buffer for understanding land use-land cover (Fig.2.2c, Table 2.1).

The area of each of the land use/cover categories encompassed by this buffer has been determined and given in Table 2.1. The field-work for flora and fauna assessment was focused on five observation points (shown in Figs. 2.2a, 2.3) falling in the land of Khirai (23° 5' 36.70"N, 70° 49' 43.81"E), Haripar (23° 9' 6.25"N, 70° 45' 41.84"E) and Shikarpur (23° 13' 55.44"N, 70° 43' 14.10"E) villages, LRK salt-work area o.pt. towards Haripar, Maliya (23° 8' 25.96"N, 70° 46' 21.20"E), 4: LRK salt-work area o.pt. towards Shikarpur, Bhachau (23° 13' 7.20"N, 70° 43' 33.03"E).

Table 2.1 Extent (area in hectare) of Land Use/Cover (LULC)categories in the buffer area (shown in Fig.2.2c)

Sr.No.	LULC Classes	Area (Ha)
1	Waterbody	282.69
2	Settlement	33.03
3	Scrub land	312.21
4	Open Land	573.54
5	Grass Land	31.08
6	Tree Cover	12.04
7	Mangroves	0.45
8	Saltpans	2078.64
9	Muddy Area	544.68
10	Agriculture land	1495.83
Total Area		**5364.19**

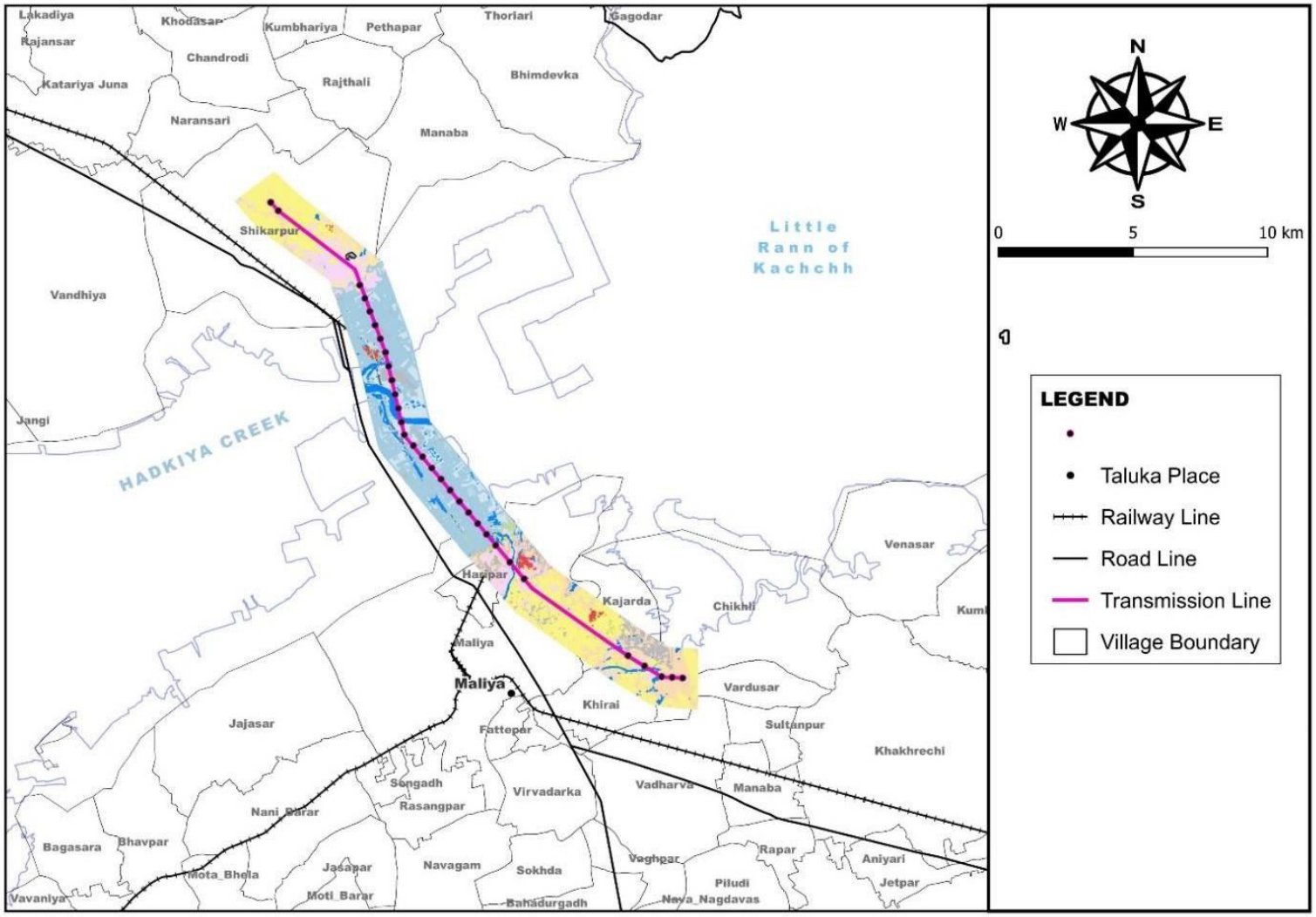


Fig. 2.4c. 1 km buffer on each side of the proposed 765 kV D/C transmission line passing through a portion of Wild Ass Sanctuary for 14.9 km.

PowerGrid Corporation, India under section 29 of Wildlife (Protection) Act, 1972, has obtained approval of Lakadiya-Ahmedabad Overhead Transmission Line project through portion of Wild Ass Sanctuary (WAS) in/adjacent to Khirai and Haripar villages of Maliya-Miana taluka of Morbi district and Shikarpur village of Bhachau taluka of Kachchh district. As per the details provided by local officials of PowerGrid Corporation office at Halvad, the length of the overhead transmission line passing across the WAS is 14.912 km covering 99.912 ha wildlife area.

2.2.2 Objectives

The main objective of the field investigation was to have a baseline data on fauna and flora of the Project-relevant portions of Wild Ass Sanctuary so that any short-term or long-term and direct or indirect ecological impacts during construction and operating phases of erecting the overhead transmission line can be anticipated and mitigation measures can be recommended.

The specific objectives of conducting field study and survey in the project area are given as below.

1. To assess the wildlife/biodiversity within the Sanctuary area using primary and secondary data for Lakadiya-Ahmedabad overhead transmission line project passing through the Wild Ass Sanctuary, Little Rann of Kachchh (LRK).
2. To find out environmental and ecological impacts of implementation of the PowerGrid Corporation's overhead transmission line project in the study area covering Wild Ass Sanctuary area (WAS) falling in/adjacent to Maliya town and Khirai-Haripar-Shikarpur villages.
3. To provide comprehensive mitigation measures based on the environmental and ecological impacts predicted/understood as an outcome of data analysis and its interpretation.

4. To capture aerial imagery using drone to record and document the habitats and wildlife like Indian Wild Ass and waterfowl which occur in herd or congregation and to attempt having estimation of their abundance (numbers) using the imagery.

2.2.3 Methodology

The baseline data necessary for the impact assessment followed by mitigation -cum-conservation planning was carried out in two phases in the form of flora-fauna rapid field surveys in the area of Wild Ass Sanctuary (WAS) through which Lakadiya-Ahmedabad overhead transmission line would be passing. The field assessment was carried out in two phases for covering two different seasons. To understand post-monsoon season scenario, the field visit was conducted in the last week of October, 2024. Furthermore, to understand the winter season scenario, the field visit was undertaken in mid-November, 2024. A total of 48 man-hours were spent for rapid field surveys.

2.2.3.1 Field surveys for wildlife (flora-fauna) inventorying

Conventionally, field surveys for flora and fauna baseline data collection are conducted using a sampling-based approach. For areas such as forests, deserts, wetlands, or Protected Areas (PAs), it is a conventional practice to sample **0.1% to 1.0%** of the total area, depending on habitat heterogeneity and the study's objectives. These areas are typically polygonal (i.e. enclosed and expansive in shape), making it relatively straightforward to determine the proportion of the area to be sampled. In contrast, a transmission line is a **linear structure**, which presents a unique challenge. When conducting flora and fauna baseline data collection as part of an Environmental Impact Assessment (EIA) for a transmission line project, it becomes difficult to define the "total area" in relation to which the "sampling area" should be determined. This creates a dilemma in establishing the appropriate scope and extent of the survey.

In the present study for developing the Mitigation Plan for Lakadiya-Ahmedababd" transmission line passing through a portion of Wild Ass Sanctuary, it is premised that the simplest way to have "total area" for the impact assessment would be to consider a "buffer"

of an appropriate width (say, "b") along and on each side of the entire length (say, "l", which is 14.9 km in this case) of the transmission line and determining the total area through a multiplication of the length ("l) and total width (2b) of the buffer. It should be noted that the dimension "b" should be such that the "total area" (i.e., l x 2b) would cover/encompass the "Impact Area" or "Area of Influence" of the proposed transmission line. It may be noted that the **Impact Zone** is defined as the area directly affected by the project's Right of Way (RoW). It may also be noted that the **Right of Way (RoW) area** for a transmission line refers to the **corridor of land** allocated for the construction, operation, and maintenance of the transmission line and its associated infrastructure. It includes the land directly beneath the transmission line and an additional buffer area on either side, which is necessary to ensure safety, manage vegetation, and minimize interference with the line's operation. The area constituted by the length of the transmission line and width of RoW area constitutes the **direct impact zone** for environmental assessments, as it is where physical changes to the land (such as clearing vegetation, soil disturbance, or habitat loss) occur. It must, however, be considered that Indirect impacts (on biodiversity, especially fauna like birds and wide-ranging mammals like Wild Ass) may extend beyond the RoW and should be go without assessment based on project-specific factors. Thus, for assessing both direct and indirect impacts of the transmission line, wider buffer along each side of the central line of the transmission line must be consider which would encompass RoW, but will not be restricted to it

In the case of the proposed 765 KV D/C overhead transmission line passing through a portion of Wild Ass Sanctuary, the RoW is 67 m (Source: Details of 765 Kv D/C Lakadiya-Ahmedabad Tranmission Line provided by Halwad office of PowerGrid). Moreover, the length(l) of the transmission line passing through Wild Ass Sanctuary is 14.9 km as per the above-mentioned source. Therefore, Impact Area of the transmission line project is 14.9 km x 0.067 km = 0.998 sq.km or say, 1 sq.km. However, taking Impact Area of just 1 sq.km as the total area for baseline data collection on flora-fauna will be too limited as there would be several "indirect impacts" of the transmission line which would manifest beyond the width of RoW (67 m). So, in order to decide how much area should be

considered for collection of flora-fauna baseline data intensive survey of relevant literature was carried out. In other words, intensive survey of relevant literature was carried out to decide the width of the buffer on each side the transmission line for baseline data collection as it, along with the length of the transmission line, would constitute the "total area" for baseline data collection on flora-fauna.

Unfortunately, intensive literature survey has indicated that there are no standard rules to decide the width of the buffer on each side of the transmission line. Thus, in "Ecology Guidelines for Electricity Transmission Projects A Standard Approach to Ecological Impact Assessment of High Voltage Transmission Projects" by EirGrid Plc. (2020), it is mentioned that (i) "Spatial limits (or 'zones of Influence') need to be established for obtaining the necessary baseline information and a clear rationale presented"; and (ii) "the spatial extent of baseline studies should be flexible to accommodate different needs." Some other documents have indicated that the consulting agencies that conducted impact assessment for transmission line mitigation/conservation plans have considered the buffer width ranging from 200 m in hilly areas to 10 km in plain areas (Anonymous, 2022, Anonymous, 2024).

Considering all this reviewed literature indicating that there is no standardized rule to decide the buffer-width along the length of the transmission line, it was decided for the present work that the buffer width should not only take care of RoW, but considerable additional width beyond RoW to take care of a "General Condition" mentioned in the letter FP/GJ/TRANS/434476/2023 Dated 05/11/2024 addressed to ACS(Forests), Govt. of Gujarat[i.e. 1.18: No damage to the flora and fauna of the ADJOINING AREA shall be caused] and to take care of a Minute of the 79th Meeting of the Standing Committee of National Board for Wildlife circulated to All Members of Standing Committee of NBWL via letter F.No.WL-6/88/2024-WL Dated 23rd August 2024 [i.e. Minute 5. The User Agency shall not harm or destroy wildlife habitat including flora and fauna of the Sanctuary].

Considering the above-mentioned official documents and the 67m of RoW, it was decided for the present study that the buffer width on each side of the transmission line would be 1000 metres (i.e. 1 km), resulting in total 2000 m (2 km) of total buffer width

along 14.9 km long transmission line passing through a portion of the Wild Ass Sanctuary. [This buffer width would encompass the RoW of 67 m.] In turn, the total area to be considered for collection of the baseline data on flora-fauna was considered to be 14.9 x 2 = 29.8 sq.km or say 30 sq.km. As mentioned in the very beginning of this section, field surveys for flora-fauna baseline data collection are usually sampling-based and it is a conventional practice to sample flora-fauna between 0.1% and 1.0% of the total area, depending on habitat heterogeneity and study objectives. Therefore, for the present study, it was decided to consider to survey 1% of the total area for baseline data collection, i.e. 30 sq.km (derived earlier). In other words, the sampling area for flora-fauna baseline data collection was considered to be 0.3 sq.km. A total of 5 sampling sites were fixed along the transmission line each covering an area of 0.06 sq.km. totalling 0.3 sq.km. To cover 0.06 sq.km at each of the 5 sampling sites, a short transect of 300 m (i.e. less than half kilometer) was walked leishurely and on each side of it 100 m width was scanned to identify and record existing flora-fauna species. It may be noted that sampling sites for laying 300 m transects were not located at certain spatial interval. Rather, their selection was based on two criteria: 1) They should fall on/adjacent to the designated pathway of the proposed transmission line, and 2) habitat-based stratified random sampling design norms are followed. The 1st criterion was ensured by getting clear guidance from the local PowerGrid staff (basically, engineers of different categories) *in situ* as the representative staff accompanied the field-study team. In fact, at these sites, the excavation work for laying foundation of the pylons was just completed or was in progress. The 2nd criterion was ensured by confirming that a variety of habitats would be covered for sampling. Thus, the sampling site near Khirai village (23° 5'36.70"N, 70°49'43.81")E was characterized by a combination of barren-cum-inundated (shallow watered) mudflat associated with reed-dominated pond, the sampling site near Haripar village(23° 9'6.25"N, 70°45'41.84"E) was characterized by herb-and-scrub covered land associated with a pond dominated with open water area, a sampling site having coordinates 23° 8' 25.96"N N, 70°46'21.20"EE in Little Rann area was characterized by predominance of large salt-pans, a sampling site having coordinates 23°13'7.20"N, 70°43'33.03"E in Little Rann area (between Haripar and

Shikarpur, but towards Shikarpur) was characterized by smaller salt-pans and the site at Shikarpur (23°13'55.44"N, 70°43'14.10"E) was characterized by combination of agriculture land-barren area-salt-pans.

It must be noted here that entire work of field-based flora-fauna survey was based on Rapid Transect approach. This approach is justified considering that this flora-fauna survey had to be conducted only for Environment Impact Assessment for developing mitigation plan and not for any detailed biodiversity research for the area. It may also be noted that the buffer-width of 1 km on each side of the center-line of the transmission line (for determining total area for baseline data collection) was sufficient considering the following reasons:

1. Ecological homogeneity and habitat characteristics:
    - The transmission line passes through a saline desert in the Little Rann of Kachchh, which is known for its low habitat heterogeneity.
    - Most of the area experiences seasonal inundation during monsoon and post-monsoon (up to mid-winter), limiting year-round terrestrial flora and fauna diversity.
    - A 1 km buffer is sufficient to capture potential impacts on mobile species (e.g., birds, large mammals) that are most likely to interact with the transmission line.
2. Practicality and feasibility:
    - A larger/wider buffer (say, 5 km or 10 km buffer) would require surveying an unreasonably large area, which may include ecologically redundant or irrelevant zones.
    - Since the direct and indirect impacts of overhead transmission lines are generally localized, 1 km on each side is a practical and effective buffer size for baseline studies.
3. Coverage of important habitats in the project area:

- The selected buffer ensures adequate coverage of potential impacts on predominant natural and man-made habitats and important animals like the Indian Wild Ass and waterbirds,
- Beyond 1 km, the likelihood of species interacting with the transmission line diminishes, especially in homogeneous landscapes like saline deserts.

2.2.3.1.1 Assessment of fauna

(i) Avifauna assessment

The baseline data on birds was collected through "Stratified Random Survey with Randomized Walks" approach to cover different habitats and microhabitats that included open saline mudflat of Little Rann, Rann's wetlands (i.e., shallow inundation in Little Rann's mudflat area), scrubland (open and dense), Grass/Herb-covered upland, cropland, marshy wetland, salt-work areas(sal-pans). These random locations were chosen to provide inventory of bird species that are known to be associated with different habitats mentioned above. The summary of habitats covered and the locality where each habitat was available is given below:

Habitat to record bird species through stratified random walk	Locality in PowerGrid Project Area in the Wild Ass Sanctuary (WAS)
Open saline mudflat of Little Rann	Near proposed Khirai village
Marshy wetland (pond-like)	Near Khirai village, Haripar
Rann's wetland (i.e., shallow inundation in Little Rann's mudflat area)	Near Khirai village
Scrubland (open and dense)	Khirai, Haripar, Shikarpur
Grass/Herb-covered upland	Haripar
Cropland	Khirai, Haripar, Shikarpur
Salt-work areas(sal-pans)	In LRK area near Haripar, In LRK area near Shikarpur

Besides this, birds were also recorded opportunistically (and separately) during transportation from one site to the other. Birds were observed and identified using a pair of 10 x 42 binoculars. Spotting scope (20-60x80) was used for identifying waterbirds in the Rann's wetland area. For photographic records, high end point-and-shoot digital camera was used. In case of resolving dilemma regarding identification of "difficult" bird species, recognized field guides (especially one by Grimmett et al. 2020) was used. Sighted birds were recorded in pre-developed data-sheets.

(ii) Mammalian fauna assessment

Similar to birds, the baseline data on wild mammalian fauna was collected through "Stratified Random Survey with Randomized Walks" approach to cover different habitats and microhabitats. However, types of habitats that were explored/investigated for the mammals were somewhat less than that for birds owing to the ecological reasons. Thus, following habitats were covered for mammalian inventory: Open saline mudflat of Little Rann, Open scrubland and Grass/Herb-covered upland. The localities for each of these habitats were those similar to the localities summarized above for bird inventorying.

For attempting direct sightings of wild mammals, in each habitat, randomly laid 0.5km-1 km open-width transects were leisurely walked depending on the overall area of each habitat. Thus, for large habitat like Open saline mudflat of Little Rann, 1 km transect was walked, whereas for rest of the two habitats 0.5km transects were walked. Cropland (Cotton, Castor, Pigeon Pea) area was also covered as one of the mammalian habitats, but the extent of transects for this habitat was even less (depending on area of a cropland), and they were usually walked along cropland's edges. Though direct sightings were attempted using open-width transect, care was taken that a mammal is recorded only if it occurs in the relevant habitat.

It is well-known that many wild mammals are secretive and/or nocturnal and therefore, it was considered from the planning stage of the field surveys that possibilities

of direct sightings of the wild mammals would be limited and researchers will have to rely considerably on indirect evidences like foot-prints/pugmarks, droppings/scat, burrows, dens, spines etc. Therefore, besides randomly/ opportunistically searching for such indirect evidences, systematic search for the indirect evidences was also carried out along 0.5-1 km open-width transects (hereafter referred to as major transect). For this purpose, while walking along the major transects, careful search was made for the indirect evidences at regular interval (i.e. 100 m on 0.5 km transect and 250 m on 1 km transect) in the width of 5m on each side of the main walk-line. In case of confusion in species identification "Mammals of India" (Menon, V. 2014) was used. Sighted mammals were recorded in pre-developed data-sheets.

(iii) Reptilian fauna assessment

The "major transects" walked for mammalian species survey were also used for recording reptilian fauna survey. With given low detection probability of reptiles during day-time, simple strategy was adopted. Thus, for surveying reptiles along the "major transects", *Visual Encounter Surveys (VES)* were carried out. In this method, reptiles are actively and carefully searched under fallen leaves or branches of shrubs/trees, under rocks etc. In case of confusion in identifying a reptile, recognized books/research papers were used (e.g., one by Desai, A. 2019 and one by Patel & Vyas, 2019).

For all the three aspects of fauna mentioned above, apart from the transect-based surveys, the project area was also explored opportunistically for recording any avian or other kind of wildlife species (mammalian and reptilian) outside/beyond the established transects.

For all the localities of faunal observations, geographical coordinates (latitudes and longitudes) were recorded.

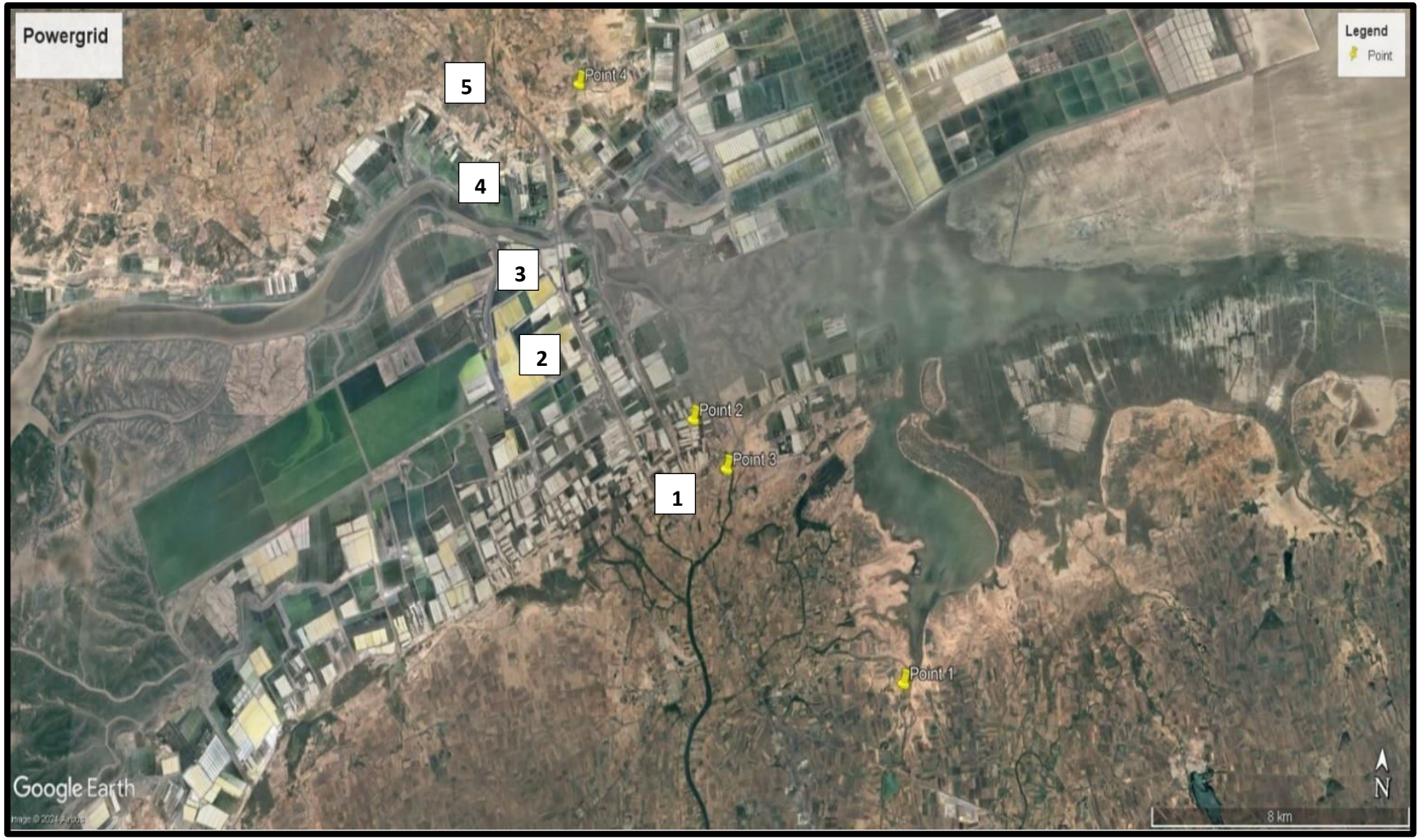


Fig. 2.5: Distribution of the sampling localities (1-5) in proposed overhead transmission line passing through Wild Ass Sanctuary.



Fig. 2.6a. Drone image of inundated mudflat of LRK near Khirai Village, WAS (Pt. 1 in Fig. 2.5)



Fig. 2.6b. Drone image of Herb-Grass-Scrub covered land near Haripar Village, WAS (Pt. 2 in Fig. 2.5)

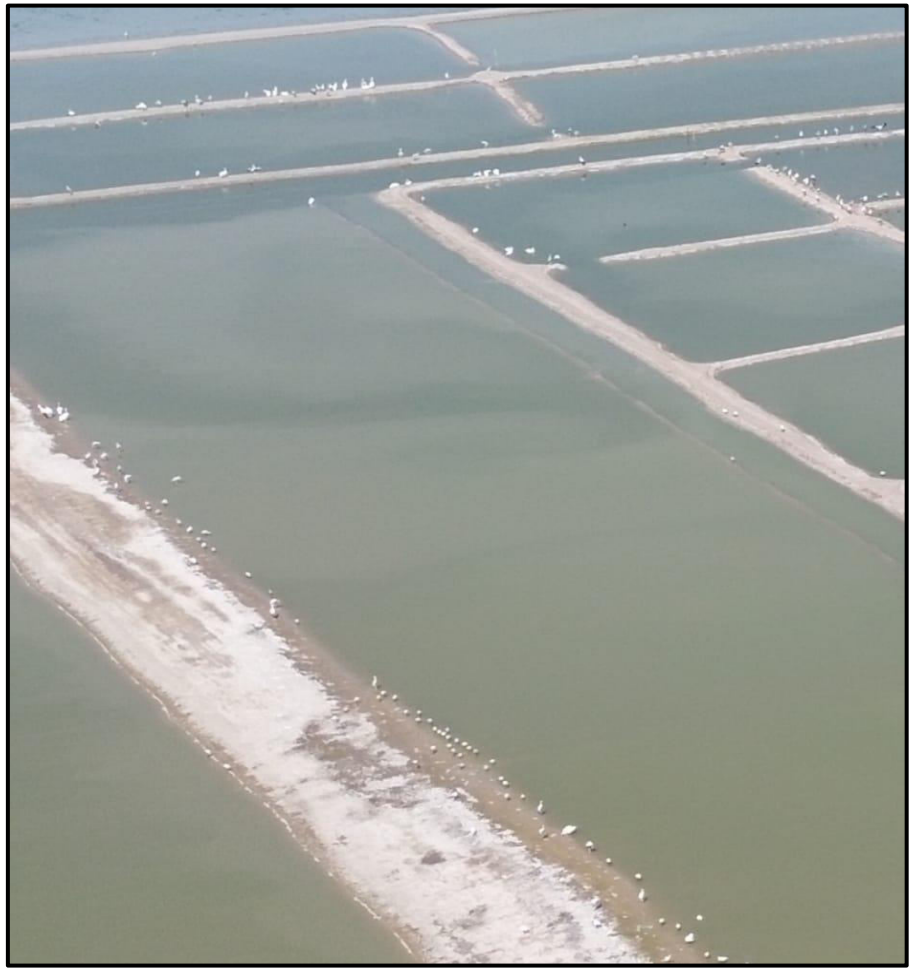


Fig.2.6c. Salt-work area in LRK towards Haripar (Point 3), WAS-a drone image



Fig. 2.6d Salt-work area in LRK towards Shikarpur (Point 4), WAS-a drone image



Fig. 2.6e. Drone image of barren land-cum-Castor cultivation area of Shikarpur area, WAS



Fig. 2.7a Inundated mudflat area of LRK, WAS



Fig. 2.7b Dried mudflat area of LRK, WAS



Fig. 2.7c Salt-work (Salt-pan) area in LRK, WAS



Fig. 2.7d Pond with marshy vegetation in WAS



Fig. 2.7e Herb cover, WAS



Fig. 2.7f Scrub cover, WAS



Fig. 2.7g Castor cultivation, WAS



Fig. 2.7h Coriander cultivation, WAS

2.2.3.1.2 Assessment of flora

In order to build inventory of plants (angiosperms) including trees, shrubs, herbs, climbers/creepers and grasses, the habitats tabularized in section 2.2.3.1.1 (i) were thoroughly surveyed randomly as also along the major transects of mammalian fauna [mentioned in 2.2.3.1.1 (ii)]. As far as possible, direct visual identification of plant species was carried out *in situ* to generate checklist of the higher plants of different habits. As far as possible, all the plants that were identified were photographed. The plants that were not identified *in situ* (especially some grasses and herbs) were intensively photographed from various angles covering its various parts. Such plants that were intensively photographed from were identified using "Flora of Gujarat State" (Shah, 1978).

2.2.3.2 Drone aerial survey



Fig. 2.8 Drone utilised in the present study

Drones have revolutionized wildlife research by providing an efficient, non-invasive means to study habitats and species across diverse landscapes. Their ability to capture high-resolution imagery and videos from various altitudes enables researchers to monitor and survey wildlife without direct human interference, minimizing disturbance. Drones are especially valuable for studying hard-to-access areas like wetlands, deserts, and dense forests, offering new perspectives on habitat use, species distribution, and population estimation. They are also instrumental in tracking

migratory species, assessing habitat changes, and supporting conservation planning with precise geospatial data.

A lightweight, remotely operated drone with a high-resolution camera is highly effective for wildlife surveys. The drone should ideally include adjustable altitude controls to facilitate flights at varying heights, enabling the capture of clear images and videos of habitats and wildlife with minimal disturbance. In this study, a DJI Mini 3 drone was used for flora-fauna field assessments. This drone features a 48-megapixel camera with horizontal and vertical modes, producing high-resolution images (8064 x 6048 pixels) and a 3-axis gimbal for stable footage. It performs well in various interference conditions: strong (urban areas, 1.5–3 km), medium (suburban areas, 3–6 km), and low (rural/seaside areas, 6–10 km). The drone's altitude limits include a hard-wired maximum of 500 m and a user-configurable limit, with a default setting of 120 m, adjustable up to 500 m. It can hover at desired points and heights, even in high winds, while recording precise GPS coordinates. These points are given below:

Sr. No.	**Spot (as lat.-long.) where the drone was made to hover in mid-air**	**Purpose of drone hovering at the spot**
1	23.08999 N, 70.83180 E (23° 5' 23.96" N, 70° 49' 54.48" E)	Assessment of number of Wild Ass grazing at distance
2	23.09060 N, 70.83118 E (23° 5' 26.16" N, 70° 49' 52.25" E)	Recoding synoptic view of habitats
3	23.15501 N, 70.76056 E (23° 9' 18.04" N, 70° 45' 38.02" E)	Getting synoptic view of construction impact on habitat
4	23.16345 N, 70.76615 E (23° 9' 48.42" N, 70° 45' 58.14" E)	Getting synoptic view of waterbird congregation and associated habitat
5.	23.21935 N, 70.72614 E (23° 13' 9.66" N, 70° 43' 34.10" E)	Scanning salt pans for detecting presence of waterbird congregation (if any).

Surveys were conducted in sections of the Wild Ass Sanctuary near Khirai, Haripar, Shikarpur villages, and the salt works between Haripar and Shikarpur in the Little Rann. The drone flew at altitudes of 100–200 meters to capture wide-angle

imagery and videos of habitats and microhabitats. These were analyzed to assess habitat status and estimate populations of large wildlife, such as Indian Wild Ass, and large waterbirds, including pelicans and storks. High-quality photographs and videos were carefully studied to count or estimate individuals in herds or flocks. Drone operations maintained a distance of 300–500 meters from target groups, with meticulously planned flight paths to avoid sudden movements and minimize wildlife disturbance.

2.2.4 Findings of the field survey-based Wildlife Investigations

2.2.4.1 Fauna

A total of 101 species of vertebrates (i.e., mammals, birds and reptiles) were recorded in the proposed overhead transmission line area passing through Wild Ass Sanctuary. They included 10 species of Mammals belonging to 9 families, 85 species of birds belonging to 35 families and 6 species of reptiles belonging to 5 families (Tables 2.2,2.3,2.4). It may be noted that some of the species of birds, mammals and reptile were adopted (and listed in above-mentioned tables) from the primary data collected by GEER Foundation for its project (in 2019) titled "Wildlife Mitigation Plan for the proposed Chotila-Anjar Natural Gas Pipeline passing through Wild Ass Sanctuary (WAS) and its Eco-Sensitive Zone" (sponsored by Gujarat State Petronet Ltd). The use of this secondary data is justified considering the fact that the study area of the above-mentioned project by GEER (i.e. area of Wild Ass Sanctuary laying between Haripar village of Maliya-Miana taluka of Morbi District and Shikarpur village of Bhachau taluka of Kachchh district) largely coincided with the field assessment area of the present project by SEED Foundation.

2.2.4.1.1 Avifauna

Family-wise species richness of birds:

A total 85 bird species belonging to 35 families were recorded in the proposed transmission line area passing through a portion of Wild Ass Sanctuary.

Highest number of species (i.e. 7-8 species) belonged to Ardeidae, Scolopacidae and Laridae families each. The families Muscicapidae, Columbidae, Alaudidae, Threskiornithidae, Accipitridae, Charadriidae and Anatidae families also had relatively high species representation (i.e., 3-4 species each). Several other families (e.g., Pelicaniidae, Phalacrocoracidae, Anhingidae, Pycnonotidae, Motacilidae, Hirundinidae, Laniidae, Sylvidae, Meropidae, Corvidae, Nectariniidae, Ploceidae, Cistocolidae, Cuculidae, Dicruridae, Sturnidae, Upupidae, Pteroclididae, etc.) were represented by only one or two species.



Fig.2.9 White-throated Kingfisher

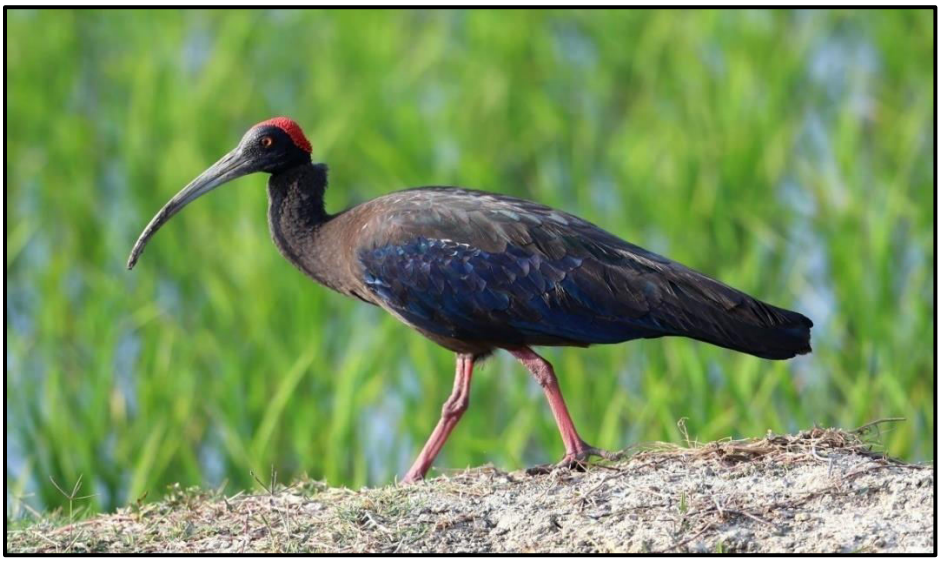


Fig.2.10 Red-naped Ibis

Table-2.2: Checklist of the bird species recorded in the proposed overhead transmission line area passing through Wild Ass Sanctuary (WAS).

SN	Common English Name	Scientific Name	Family	Residential Status (for Indian Subcontinent)	Aquatic/ Terrestrial	IUCN Threat Status	Schedule I/II WP(A), 1972	Feeding niche
PELICANS								
1	Dalmatian Pelican	*Pelecanus crispus*	Pelicaniidae	M	A	NT	II	Carnivorous (Piscivore)
2	Great White Pelican	*Pelecanus onocrotalus*	Pelicaniidae	RM	A	LC	II	Carnivorous (Piscivore)
CORMORANTS								
3	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	RM	A	LC	II	Carnivorous (Piscivore)
4	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	R	A	LC	II	Carnivorous (Piscivore)
5	Oriental Darter	*Anhinga melanogaster*	Anhingidae	R	A	NT	II	Piscivorous
HERONS & EGRETS								
6	Grey Heron	*Ardea cinerea*	Ardidae	RM	A	LC	II	Carnivorous
7	Indian Pond Heron	*Ardeola grayii*	Ardidae	R	A	LC	II	Carnivorous

8	Purple Heron	*Ardea purpurea*	Ardidae	RM	A	LC	II	Carnivorous
9	Little Egret	*Egretta garzetta*	Ardidae	R	A	LC	II	Carnivorous
10	Western Reef Egret	*Egretta gularis*	Ardidae	R	A	LC	II	Carnivorous
11	Intermediate Egret	*Mesophyox intermedia*	Ardidae	R	A	LC	II	Carnivorous
12	Great Egret	*Casmerodius albus*	Ardidae	R	A	LC	II	Carnivorous
13	Cattle Egret	*Bubulcus ibis*	Ardidae	R	AT	LC	II	Carnivorous
STORKS								
14	Painted Stork	*Mycteria leucocephala*	Ciconiidae	R	A	NT	II	Carnivorous
15	White Stork	*Ciconia ciconia*	Ciconiidae	M	A	LC	I	Carnivorous
16	Asian Openbill*	*Anastomus oscitans*	Ciconiidae	R	A	LC	II	Carnivorous
IBIS & SPOONBILL								
17	Red-naped Ibis	*Pseudibis papillosa*	Threskiornithidae	R	AT	LC	II	Omnivorous
18	Black-headed Ibis	*Threskiornis melanocephalus*	Threskiornithidae	R	A	NT	II	Omnivorous
19	Glossy Ibis	*Plegadis falcinellus*	Threskiornithidae	R	A	LC	II	Omnivorous
20	Eurasian Spoonbill	*Platalea leucorodia*	Threskiornithidae	RM	A	LC	I	Carnivorous
DUCKS								

21	Northern Shoveler	*Anas clypeata*	Anatidae	M	A	LC	II	Omnivorous
22	Northern Pintail	*Anas acuta*	Anatidae	M	A	LC	II	Herbivorous
23	Eurasian Wigeon	*Mareca penelope*	Anatidae	M	A	LC	II	Herbivorous
FLAMINGOS								
24	Greater Flamingo	*Phoenicopterus roseus*	Phoenicopteridae	R	A	LC	II	Omnivorous
RAPTORS								
25	Black-winged Kite	*Elanus caeruleus*	Accipitridae	R	T	LC	II	Carnivorous
26	Black Kite	*Milvus migrans*	Accipitridae	R	T	LC	II	Carnivorous
27	Shikra	*Accipiter badius*	Accipitridae	R	T	LC	I	Carnivorous
28	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	M	AT	LC	I	Carnivorous
FRANCOLINS								
29	Grey Francolin	*Francolinus pondicerianus*	Phasianidae	R	T	LC	II	Herbivorous (Granivore)
PLOVERS & LAPWINGS								
30	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	R	TA	LC	II	Carnivorous (Invertebrates)
31	Little Ringed Plover*	*Charadrius dubius*	Charadriidae	M	A	LC	II	Carnivorous (Invertebrates)

32	Kentish Plover*	*Charadrius alexandrinus*	Charadriidae	R	A	LC	II	Carnivorous (Invertebrates)
SANDPIPERS, STINTS, GODWITS								
33	Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	M	A	LC	II	Carnivorous (Invertebrates)
34	Wood Sandpiper	*Tringa glareola*	Scolopacidae	R	A	LC	II	Carnivorous (Invertebrates)
35	Common Redshank	*Tringa totanus*	Scolopacidae	M	A	LC	II	Carnivorous (Invertebrates)
36	Greenshank	*Tringa nebularia*	Scolopacidae	M	A	LC	I	Carnivorous (Invertebrates)
37	Marsh Sandpiper	*Tringa stagnatilis*	Scolopacidae	M	A	LC	II	Carnivorous (Invertebrates)
38	Black-tailed Godwit	*Limosa limosa*	Scolopacidae	M	A	NT	II	Omnivorous (Invertebrates)
39	Little Stint	*Calidris minuta*	Scolopacidae	M	A	LC	II	Carnivorous (Invertebrates)
STILT								
40	Black-winged Stilt	*Himantopus himantopus*	Recurvirostridae	R	A	LC	II	Carnivorous (Invertebrates)
TERNS & GULLS								
41	Gull-billed Tern	*Gelochelidon nilotica*	Laridae	M	A	LC	I	Carnivorous
42	Indian River Tern	*Sterna aurantia*	Laridae	R	A	VU	I	Carnivorous
43	Whiskered Tern	*Chlidonias hybrida*	Laridae	RM	A	LC	II	Carnivorous

44	Caspian Tern	*Hydroprogne caspia*	Laridae	M	A	LC	II	Carnivorous
45	Lesser Black-backed Gull	*Larus fuscus*	Laridae	M	A	LC	II	Carnivorous
46	Black-headed Gull	*Chronicocephalus ridibundus*	Laridae	M	A	LC	II	Carnivorous
47	Brown-headed Gull	*Larus brunnicephalus*	Laridae	M	A	LC	II	Carnivorous
SANDGROUSE								
48	Chestnut-bellied Sandgrouse*	*Pterocles exustus*	Pteroclididae	R	T	LC	II	Herbivorous (Granivore)
PARAKEETS								
49	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae	R	T	LC	II	Herbivorous (Frugivore)
PIGEONS & DOVES								
50	Blue Rock Pigeon	*Columba livia*	Columbidae	R	T	LC	-	Herbivorous (Granivore)
51	Laughing Dove	*Stigmatopelia senegalensis*	Columbidae	R	T	LC	II	Herbivorous (Granivore)
52	Eurasian Collared Dove	*Streptopelia decaocto*	Columbidae	R	T	LC	II	Herbivorous (Granivore)
53	Spotted Dove*	*Streptopelia chinensis*	Columbidae	R	T	LC	II	Herbivorous (Granivore)
COUCAL								

54	Greater Coucal/ Crow Pheasant	*Centropus sinensis*	Cuculidae	R	T	LC	II	Omnivorous
KINGFISHERS								
55	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	R	AT	LC	II	Carnivorous (Piscivore)
56	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	R	A	LC	II	Carnivorous (Piscivore)
BEE-EATER								
57	Green Bee-eater	*Merops orientalis*	Meropidae	R	T	LC	II	Carnivorous (Invertebrates)
58	Blue-cheeked Bee-eater	*Merops persicus*	Meropidae	M	A	LC	II	Carnivorous (Invertebrates)
ROLLER								
59	Indian Roller	*Coracias benghalensis*	Coraciidae	R	T	LC	II	Carnivorous (Invertebrates)
HOOPOES								
60	Common Hoopoe*	*Upupa epops*	Upupidae	RM	T	LC	II	Carnivorous (Invertebrates)
LARKS								
61	Ashy-crowned Sparrow Lark	*Eremopterix grisea*	Alaudidae	R	T	LC	II	Omnivorous
62	Rufous-tailed Lark	*Ammomanes phoenicurus*	Alaudidae	R	T	LC	II	Omnivorous

63	Greater Short-toed Lark	*Calandrella brachydactyla*	Alaudidae	M	T	LC	II	Omnivorous
64	Crested Lark	*Galerida cristata*	Alaudidae	R	T	LC	II	Omnivorous
MARTINS & SWLLOWS								
65	Barn Swallow	*Hirundo rustica*	Hirundinidae	M	TA	LC	II	Carnivorous (Invertebrates)
66	Wire-tailed Swallow	*Hirundo smithii*	Hirundinidae	R	T	LC	II	Carnivorous (Invertebrates)
SHRIKES								
67	Long-tailed Shrike	*Lanius schach*	Laniidae	R	T	LC	II	Carnivorous
68	Isabelline Shrike*	*Lanius isabellinus*	Laniidae	M	T	LC	II	Carnivorous
DRONGOS								
69	Black Drongo	*Dicrurus macrocercus*	Dicruridae	R	T	LC	II	Carnivorous (Invertebrates)
STARLINGS & MYNAS								
70	Bank Myna	*Acridotheres ginginianus*	Sturnidae	R	T	LC	II	Omnivorous
CROWS								
71	Large-billed Crow	*Corvus macrorhynchos*	Corvidae	R	T	LC	II	Carnivorous
72	House Crow	*Corvus splendens*	Corvidae	R	T	LC	-	Carnivorous
BULBULS								

73	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	R	T	LC	II	Omnivorous
74	White-eared Bulbul	*Pycnonotus leucotis*	Pycnonotidae	R	T	LC	II	Omnivorous
BABBLERS, ROBINS, PRINIAS, WHEATEARS & WARBLERS								
75	Desert Wheatear	*Oenanthe deserti*	Muscicapidae	M	T	LC	II	Carnivorous (Invertebrates)
76	Indian Robin	*Saxicoloides fulicata*	Muscicapidae	R	T	LC	II	Carnivorous (Invertebrates)
77	Common Babbler	*Argya caudata*	Muscicapidae	R	T	LC	II	Carnivorous (Invertebrates)
78	Variable Wheatear*	*Oenanthe picata*	Muscicapidae	M	T	LC	II	Carnivorous (Invertebrates)
79	Common Tailorbird	*Orthotomus sutorius*	Sylviidae	R	T	LC	II	Carnivorous (Invertebrates)
80	Ashy Prinia	*Prinia socialis*	Cistocolidae	R	T	LC	II	Carnivorous (Invertebrates)
WAGTAILS								
81	Yellow Wagtail	*Motacilla flava*	Motacilidae	M	AT	LC	II	Carnivorous (Invertebrates)
82	Grey Wagtail	*Motacilla cinerea*	Motacilidae	M	AT	LC	II	Carnivorous (Invertebrates)
SUNBIRDS								
83	Purple Sunbird	*Cinnyris asiaticus*	Nectariniidae	R	T	LC	II	Omnivorous
WEAVERS & MUNIAS								

84	Baya Weaver	*Ploceus philippinus*	Ploceidae	R	TA	LC	II	Granivorous
85	Indian Silverbill	*Lonchura malabarica*	Ploceidae	R	T	LC	II	Herbivorous (Granivore)

Note: R- Resident, RM- Resident with Migratory Population, M- Migratory, LC- Least Concern, CR- Critical Endangered, VU- Vulnerable, NT- Near Threatened, NA-Not Assessed

Carnivorous: Flesh eating birds including raptors(hunters), piscivores (fish eaters), invertebrate consumers

Herbivorous: Plant part consumers (frugivores, granivores)

Omnivorous: Feeding on both plant and animal matter



Birds in inundated mudflats (Northern Pintail, Eurasian Wigeon, White Pelican)



Birds at marshy pond (Great Egrets, Black-headed Ibis, Grey Heron, Painted Stork, White Stork)



Birds in Salt-pan area (Common Sandpiper, River Tern, Painted Storks, Pelicans, Great Egret, Grey Heron, Eurasian Curlew, Greater Flamingo)

Fig. 2.11 Glimpses of birds in different habitats encountered during field assessment for transmission line mitigation plan study in WAS



Fig. 2.12 A Great White Pelican (Juvenile)



Fig. 2.13 A pair of *Numenius* sp.

Residential Status of Birds:

The present study revealed the occurrence of 85 species of birds inhabiting the proposed transmission line area passing through Wild Ass Sanctuary. Of all the species recorded, 26(31%) species were extra-limital migrants, 52 (61%) species were Residents and 7 (8%) species were Residents with Migratory population for the Indian Subcontinent.

Bird species categorization as per IUCN Red List of Threatened Species and Wildlife (Protection) Amendment Act, 2022.

A total of 85 bird species were recorded during the faunal inventory surveys in the proposed transmission line area passing through Wild Ass Sanctuary. As per IUCN categories, a total of 79 (93%) species were Least Concern (LC), 1(1%) species (viz. Indian River Tern) was Vulnerable species (VU) and 5 species (i.e. 6%) species, viz. Black-headed Ibis, Black-tailed Godwit, Dalmatian Pelican and Painted Strok were Near Threatened (NT).

It was also found that out of total 85 species recorded, only 8 (10%) were Schedule I species and 75 (88%) species were Schedule II species as per Wildlife (Protection) Amendment Act, 2022. Two species, viz. House Crow and Blue Rock Pigeon were found to be without any schedule-status as per the Wildlife Act's Amendment of 2022.

Feeding Niches of Birds:

Birds play very important roles in many aquatic and terrestrial ecosystems. They play major roles like predators, herbivores, seed despersers, filter-feeders etc. Niche differences constitute a key to long-term co-existance of various aquatic and terrestrial birds and other organisams inhabiting the same ecosystems (Levine and Hilleris, 2009). Considering the importance of niches in ecosysytems, an analysis was done to understand proportion of birds belonging to different feeding niches. It was found that maximum proportion (i.e., 69%, n=59) of species belonged to Carnivorous niche (which included raptors, piscivores, invertebrate consumers, followed by Omnivorous niche (i.e., 18%, n=15), and Herbivorous (i.e., 13%, n=11) niches (which included grainivores, frugivores

etc.). Among carnivorous birds, invertebrate consumers (including insectivores) were maximum in number(n=27), whereas piscivores' number was minimumum(n=7). On the other hand, among herbivorous birds, grainivores were maximum in number(n=8).

Application of Drone Technology for Monitoring Medium to Large Waterbird Congregations

Drone technology enables the detection of medium to large waterbirds, particularly when they forage or rest in congregations across open landscapes or in remote and otherwise inaccessible locations. The drone used in the present study could contribute to waterbird baseline data collection by detecting the congregation of waterbirds in inundated areas of the Little Rann (with WAS) on the built-in monitor of the FPV remote controller (facilitated by the real-time feed feature of the drone). However, smaller-sized and drab-coloured birds could not be photographed properly, though larger sized birds like pelicans and Painted Storks could be seen in photographs in the form of dots (Fig.2.3). Nonetheless, based on the detection of congregation of waterbirds of any kind (including drab-coloured ducks, larger shorebirds) on the built-in monitor of the FPV remote controller (facilitated by the real-time feed feature of the drone), exact location of waterbird congregation was accessed for detailed observations aimed at species identification and abundance estimation using pairs of binoculars. This resulted into successful identification of species in inundated areas of LRK such as Great White Pelicans (up to 20 individuals scattered over different points), Dalmatian Pelicans (up to 7 individuals scattered over different points), Painted Storks (up to 25 individuals scattered over different points), Eurasian Spoonbills (15 individuals) and up to 40 egrets (Great Egret and Little Egret scattered over different points). Observation through pairs of binoculars also revealed approximately 1,500 migratory ducks (mainly Northern Shoveler, Northen Pintail, Eurasian Wigeon) and waders(like egrets and scolopacidae birds) in the congregation.



Fig.2.14 Drone image showing presence of pelicans and storks

2.2.4.1.2 Mammalian Fauna

Mammalian fauna constitutes charismatic wildlife of any wildlife sanctuary or national park. Ecotourists are often interested only in having sightings of a charismatic wild mammal or two like Asiatic lion, Bengal tiger, Leopard, Sloth Bear, deer or antelopes etc. In case of Wild Ass Sanctuary, Indian Wild Ass is the major attraction for the tourists visiting this Protected Area. Moreover, ecologists know that the Wild Ass alone does not exist in this area. Rather, it shares the unique ecosystem of the Rann with other mammals too which may not be very charismatic for tourists, but certainly playing important roles in the ecosystem. Considering this, rapid mammalian surveys were also undertaken by relying on direct sightings and indirect evidences. This effort resulted in knowing the existence of at least nine wild mammalian species ranging in size as big as the Wild ass to as small as field mouse. Table 2.3 summarises the inventory of mammalian species along with important information like families of each mammal, its feeding niche, and most importantly its status as per IUCN Red List of Threatened Species and Schedules of Wildlife (Protection) Amendment Act, 2022.



Monitor Lizard (left) and Indian Fox (right)



Common Grey Mongoose

Fig.2.15 Some small mammals and a reptile

Table-2.3: Checklist of the mammalian species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS).

SN	Species Name	Scientific Name	Family	IUCN status	Schedule I/II (IW(P)A -, 2022)	Feeding Niche
UNGULATES						
1	Indian Wild Ass	*Equus hemionus khur*	Equidae	NT	I	Herbivorous
2	Bluebull	*Boselaphus tragocamelus*	Bovidae	LC	II	Herbivorous
3	Wild/Feral Pig	*Sus scrofa*	Suidae	LC	II	Omnivorous
CARNIVORES						
4	Grey Mongoose	*Urva edwardsii*	Herpestidae	LC	I	Carnivorous
5	Golden Jackal*	*Canis aureus*	Canidae	LC	I	Omnivorous
6	Indian Fox	*Vulpes bengalensis*	Canidae	LC	I	Omnivorous
LAGOMORPHA						
7	Rufous-tailed Hare	*Lepus nigricollis*	Leporidae	LC	II	Herbivorous
RODENTIA						
8	Five-Striped Squirrel	*Funambulus pennantii*	Sciuridae	LC	-	Herbivorous
9	Indian Desert Jird*	*Tatera indica*	Muridae	LC	-	Herbivorous
10	Indian Field Mouse*	*Mus booduga*	Muridae	LC	-	Herbivorous

Note: Some of the mammalian species (like Wild Ass, Mongoose, Field Mouse, Five Striped Squirrel) were recorded through direct sightings, whereas rest of them (Bluebull, Wild/Feral Pig, Indian Fox, Hare) were recorded through indirect evidences like footprints and Scats/Droppings**)**

LC- Least Concern, **NT-** Near Threatened as per IUCN Red List of Threatened Species.

I-Schedule-I, **II-**Schedule-II as per IW (P) Amendment Act, 2022. – in sixth column indicates that the species in Not Listed in the Wildlife (Protection) Amendment Act, 2022

Table 2.3 indicates that mammals belonging to 8 families were recorded. No species belonged to any Threat Category (i.e. Vulnerable, Endangered, Critically Endangered) of the IUCN Red List. However, it was also found that out of 10 species, 4 species belonged to Schedule I [namely, Indian Wild Ass (Fig.2.9), Grey Mongoose, Golden Jackal and Indian Fox] and 3 species belonged to Schedule II (namely, Rufous-tailed Hare, Bluebull and Wild/Feral Pig). [It may be noted that Five striped squirrel, Desert Jird and Field Mouse are not clearly kept in Schedule I/II of the Amendment of 2022.].



Fig. 2.16a A flock of grazing Indian Wild Ass in WAS near Khirai village



Fig. 2.16b. Resting Indian Wild Asses in WAS near Khirai village

2.2.4.1.2.1 Use of Drone Technology in Assessing Wild Ass Population and Activity Patterns

The drone-based survey employed high-resolution aerial imaging and real-time monitoring mainly to estimate the population and observe the activity patterns of the Wild Ass (*Equus hemionus khur*) in the Little Rann. Secondarily, it was also intended to record numbers and activities/behaviour of other large/medium-sized mammals like Blue bull, Chinkara (if any) or Blackbuck (if any). No other mammal than Wild Ass was recorded using drone. Equipped with state-of-the-art GPS and imaging capabilities, the drone enabled precise enumeration of individuals even at considerable distance in/adjacent to the saline mudflat (initially detected through a pair of 10 x 40 pair of binoculars). The use of automated flight paths and pre-programmed altitudes ensured comprehensive area coverage while minimizing disturbance to the animals. The drone photographs and video clips had revealed that a flock of at least 9 Wild Asses occur in the barren mudflat area (with herbs/grasses like *Aeluropus lagopoides, Cressa cretica* and *Suaeda nudiflora* near Khirai village (Fig. 2.10A). A drone imagery/video clip has also indicated that juveniles do occur in the flock (see one juvenile in Fig. 2.10B). Drone videos have also revealed that Wild Ass either forage (graze) or rest (by standing or sitting) in this habitat.



Fig. 2.17a: A drone image indicating nine Wild Asses in the frame



Fig. 2.17b: A drone image indicating occurrence of juvenile Wild Ass

2.2.4.1.3 Reptilian Fauna

Reptiles also play important role in any natural ecosystem and Rann ecosystem (i.e., saline desert-cum-seasonal wetland) in Wild Ass Sanctuary is not an exception. Their main importance from ecological viewpoint lies in their ability to keep biological control on rodents and several insects, both which are prolific breeders. On the other hand, some of them contribute to the diet requirement of obligatorily/facultatively carnivorous (especially raptors) and mammals. Though secretive and often elusive, they should not be ignored in field assessments required for environment impact assessment. Therefore, efforts were made to record as many reptiles as possible for the present project. Though, no snakes could be recorded, half a dozen species of lizards could be recorded (Table 2.4). Except for Indian Flapshell Turtle having aquatic habitat requirements, other reptiles were terrestrial.

Table-2.4: Checklist of common reptile species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary (WAS).

SN	Common Name	Scientific Name	Family	IUCN Status	Schedule I/II/III/IV
1	Common Garden Lizard	*Calotes versicolor*	Agamidae	LC	-
2	Fan-throated Lizard	*Sitana ponticeriana*	Agamidae	LC	-
3	Northern House Gecko	*Hemidactylus flaviviridis*	Gekkonidae	LC	-
4	Brahminy Skink*	*Eutropis carinata*	Scincidae	LC	-
5	Common Indian Monitor	*Varanus bengalensis*	Varanidae	LC	I
6	Indian Flapshell Turtle	*Lyssemis punctata*	Trionychidae	VU	I

Note: LC- Least Concern, **VU**- Vulnerable as per IUCN Red List of Threatened Species; **I-**Schedule-I as per IW (P) Amendment Act, 2022. – in sixth column indicates that the species in Not Listed in the Wildlife (Protection) Amendment Act, 2022

2.2.4.2 Flora

During the present study a total 45 species of plants were recorded (Table 2.5) including 4 species of trees, 8 species of shrubs, 20 species of herbs, 3 species of climber/creeper and 10 species of grasses during survey. *Prosopis juliflora* was frequently

encountered as a common species growing very densely at places. *Salvadora* sp. and *Acacia* sp. were found to be uncommon in the area. Four species of emergent hydrophytes were also found to be commonly occurring (*Typha ungustifolia, Phragmites karka, Cyperus rotundus and Fimbristylis* sp.). Some species of halophytes were also recorded (e.g., *Suaeda nudifloira, Aeluropus lagopoides, Cressa cretica* etc.).



Fig.18 Marshy Emergent Vegetation



Fig.2.19 *Dichrostachys cinerea* – An uncommon shrub in the area

Herbs and Grasses in the Field Assessment Area in Wild Ass Sanctuary (Below)



Suaeda nudiflora



Cressa cretica



Aeluropus lagopides



***Celosia* sp.**



***Dachtyloctenium* sp.**



***Xanthium* sp.**

Shrubs/Trees in the Field Assessment Area in Wild Ass Sanctuary



Dichrostachys cinerea



Calotropis procera



***Tamarix* sp.**



Prosopis juliflora



Balanites roxbughii



Senna auriculata

Hydrophytes



Ipomoea aquatica



Phragmites karka



Fimbristylis sp.

Fig. 2.20 Glimpses of plants of different habits recorded during field assessment



Fig. 2.21 ***Tamarix troupii*****-A native shrub species which can adapt well to saline soil condition**



Fig. 2.22 Dense growth of an exotic invasive shrub-*Prosopis juliflora*

Table-2.5: Checklist of the plant species recorded from the proposed overhead transmission line area of Wild Ass Sanctuary(WAS)

Sr. No.	Scientific name	Common Name	Family	Habit
1.	*Abutilon indicum*	Khapat, Kanski	Malvaeceae	Shrub
2.	*Acacia nilotica* (L.) Del	Desi Baval	Mimosaceae	Tree
3.	*Achyranthus aspera*	Andhado	Amaranthaceae	Herb
4.	*Aeluropus lagopoides* (L.) Trin. Ex Thw	Dolri	Poaceae	Grass
5.	*Alternanthera sesellis*	Garundi	Amaranthaceae	Herb
6.	*Aristida adscensionis* Linn	Motu lapdu	Poaceae	Grass
7.	*Aristida depressa* Retz.	Lapdu	Poaceae	Grass
8.	*Balenites aegyptiaca*	Ingoriyo	Balanitaceae	Tree
9.	*Calotropis procera* (Ait) R.Br	Akado	Asclepiadaceae	Shrub
10.	*Capparis decidua*	Kerado	Capparaceae	Shrub
11.	*Celosia argentia*	Lamdi	Amaranthaceae	Herb
12.	*Chloris barbata*	Mindadiu	Poaceae	Grass
13.	*Cocculus hirsutus* (L.) W.Theob.	Vevdi	Menispermaceae	Climber
14.	*Corchorus* spp.	Bahufali, Chhuchh	Tiliaceae	Herb
15.	*Cressa cretica* L.	Bokno, Oin	Convolvulaceae	Herb
16.	*Cynodon dactylon*	Dharo	Poaceae	Grass
17.	*Cyperus rotundus* L.	-	Cyperaceae	Herb
18.	*Dactyloctenium aegypticum*	Madhanu	Poaceae	Grass
19.	*Datura mitel*	Dhaturo	Solanaceae (3)	Herb
20.	*Dichrostachys cinerea*	Mor dhundhiyu	Fabaceae	Shrub
21.	*Digeria muricata*	Kanajaro	Amaranthaceae	Herb

22.	*Digitaria adscendens*	Tarodiu	Poaceae	Grass
23.	*Enicostemma axillare*	Mamejvo	Gentinaceae	Herb
24.	*Eragrostis ciliaris* (L.)R. Br.	Chakladi	Poaceae	Grass
25.	*Ipomoea aquatica*	Nalavel	Convolvulaceae	Creeper
26.	*Pergularia daemia* (Forsk) Chiov	Chamardudheli	Asclepiadaceae	Climber
27.	*Prosopis juliflora* (Sw.) Dc.	Gando Baval	Mimosaceae	Shrub
28.	*Prosopis cineraria*	Khijado	Mimosaceae	Tree
29.	*Physalis minima*	Popti	Solanaceae	Herb
30.	*Saccharum spontaneum*	Kans	Poaceae	Grass
31.	*Salvadora persica* L.	Khari Pilu	Salvadoraceae	Tree
32.	*Scirpus littoralis* Flugge ex Rchb.	Chiyo	Cyperaceae	Herb
33.	*Senna auriculata*	Aaval	Caeasalpinaceae	Shrub
34.	*Sesbania sesbans*	Ikkad	Fabaceae	Shrub
35.	*Solanum xanthocarpum*	Bhony Ringani	Solanaceae	Herb
36.	*Sporobolus coromandelianus* (Retz.) Kunth	Bhimpdo	Poaceae	Grass
37.	*Suaeda nudiflora* (Willd.) D. Hou	Uud,Dolrimorad	Chenopodiaceae	Herb
38.	*Tamarix ericoides* Rottler & Willd.	Laiee	Tamaricaceae	Shrub
39.	*Taverniera cuneifolia* (Roth) Arn.	Jethimadh	Fabaceae	Herb
40.	*Tribulus terrestris*	Gokhru	Zygophillaceae	Herb
41.	*Tricholepis glaberrima*	Fasariu	Asteraceae (4)	Herb
42.	*Tridax procumbens*	Batkaniu	Asteraceae	Herb
43.	*Typha adomingensis* Pers.	Paan, Ghabajariyu	Typhaceae	Herb
44.	*Vernonia cinerea*	Sahadevi	Asteraceae	Herb
45.	*Xanthium strumarium*	Gadariu	Asteraceae	Herb

Table 2.4 indicates that all the plant-species recorded during the field assessment belonged to 22 families. The highest number of species belonged to the family Poaceae (10 species) followed by both Asteraceae and Amaranthaceae (each having 4 species). The families Mimosaceae, Solanaceae, Fabaceae and Convolvulaceae had 3 species each, whereas Cyperaceae and Asclepiadaceae families had 2 species each. Only 1 species belonged to each of Typhaceae, Zygophillaceae, Tamaricaceae, Chenopodiacea, Caeasalpinaceae, Salvadoraceae, Gentinaceae, Tiliaceae, Menispermaceae, Capparaceae, Asclepiadaceae, Balanitaceae and Malvaeceae.



Fig.2.23 *Cressa cretica* –A common halophyte in WAS



Fig. 2.24 *Phragmites karka* – a common emergent hydrophyte in the area

2.2.5 Salient findings derived from field observations for identification of mitigation measures:

- For the field assessments, the team of flora-fauna researchers, in consultation with and with logistic support of PowerGrid officials, assessed flora and fauna in the Wild Ass Sanctuary area associated with the villages Khirai, Haripar and Shikarpur. The team also surveyed the salt-work area in a portion of LRK located near Haripar village and Maliya town as also the salt-work area near Shikarpur village. The whole surveyed area was located in portions of Wild Ass Sanctuary, across which, the transmission line is going to be established. The field assessment sites (observation points) covered various habitats as follows: a) Marshy wetland and LRK area with/without shallow inundation near Khirai village, b) Upland terrain with herbaceous and shrub/scrub cover and agricultural fallow land and cropland in the areas of Khirai, Haripar and Shikarpur, c) Pile-cum-salt work area in a portion of LRK near Haripar village and Maliya where PowerGrid operation for establishment of transmission tower was being carried out, d) Salt-work area opposite to Shikarpur village site where PowerGrid operation for establishment of transmission tower was being carried out, and d) Upland and salt-work area at Shikarpur village site of PowerGrid operation.
- Field discussion with the site-level officials of PowerGrid was also carried out to verify specific areas through which the transmission line would be passing in the Wild Ass Sanctuary and to know basic technicalities of transmission line construction work.
- Wildlife in this area already seemed to have impacted and/or used to other infrastructural features like highway and other internal roads, Salt Pans and salt-work activities (including movements of trucks and other vehicles) , railway track and train movement on it. They have also been impacted and/or used to disturbance from moving/operating heavy machineries like JCBs that are commonly seen under operation.

- The field assessment as a part of impact assessment has revealed occurrence of 101 species of vertebrate fauna (birds, mammals and reptiles) and 45 species of higher plants (angiosperms) of different habits.
- This field surveys revealed occurrence of 85 bird species belonging to 35 families in the proposed transmission line area passing through the Wild Ass Sanctuary (WAS).
- Of the total bird species recorded, maximum number of species (i.e. 7-8 spp.) belonged to 3 families (viz., Ardeidae, Scolopacidae and Laridae families), followed by 7 families (viz., Muscicapidae, Columbidae, Alaudidae, Threskiornithidae, Accipitridae, Charadriidae and Anatidae families having moderate number (i.e. 3-4) of species. A total of 25 families (e.g., Pelicaniidae, Phalacrocoracidae, Anhingidae, Pycnonotidae, Motacilidae, Hirundinidae, Laniidae, Sylvidae, Meropidae, Corvidae, Nectariniidae, Ploceidae, Cistocolidae, Cuculidae, Dicruridae, Sturnidae, Upupidae, Pteroclididae, etc.) had only 1-2 species.
- As per IUCN Red List of Threatened bird species, 77 (93.9%) species were Least Concern (LC), 1(1.2%) species (viz. Indian River Tern) was Vulnerable species (VU) and 4 species (i.e. 4.8%) species, viz. Black-headed Ibis, Black-tailed Godwit, Dalmatian Pelican and Painted Strok were Near Threatened (NT).
- It was also found that out of total 82 species recorded, only 7 (8.5%) were Schedule -I species and 73 (89%) species were Schedule II species as per Wildlife (Protection) Amendment Act, 2022. Two species, viz. House Crow and Blue Rock Pigeon were found to be without any schedule-status as per the Wildlife Act's Amendment of 2022.
- Considering various feeding niches of birds, maximum proportion (i.e., 69.5%) of species belonged to Carnivorous niche, followed by proportion of species with omnivorous niche (i.e., 18.3%). The lowest proportion (12.2%) of bird species belonged to herbivorous niche.
- The study also brought forth occurrence of 8 wild mammalian species belonging to 8 families in the aforesaid area. Indian Wild Ass - a flagship species that was found in small flock of upto 12 individuals - is known to be a Near Threatened (NT) species

as per IUCN Red List and it is categorised as Schedule-I species as per Wildlife (Protection) Amendment Act, 2022. Besides this Equuid, Indian Fox and Grey Mongoose recorded in the area are also a Schedule-I species as per the Amendment Act, 2022.

- During the present study, 6 reptilian species (5 lizard species and 1 freshwater turtle species) belonging to 5 families were recorded. The possible cause of the lower species richness of reptiles is that considerable proportion of the area with the proposed transmission line is salt-work area.
- A total of 45 species of plants belonging to 22 families were recorded including 4 species of trees, 8 species of shrubs, 20 species of herbs, 3 species of climbers and 10 species of grasses during survey. Poaceae family was represented by maximum number of species, families Asteraceae and Amaranthaceae were represented by 4 species each, families Mimosaceae, Solanaceae, Fabaceae and Convolvulaceae had 3 species, Cyperaceae and Asclepiadaceae families had 2 species each, whereas rest of the families were represented by just one species each.
- Based on all these field observations, various mitigation measures will be provided in the next chapter of this report.

2.3 Identification of Potential Impacts for Developing Mitigation Measures based on Field Assessment

The Wildlife Institute of India (WII) is a Centre for Excellence in Wildlife Sciences established by MoEFCC. In its publication "Eco-friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife" published in 2016, potential impacts are envisioned for the power transmission line erection projects. They are summarised in the following table (Table 2.6a):

Table 2.6a Envisioned potential impacts of transmission line erection project*

Phase	Impact	Causes	Type	Duration
Construction	Disturbance	Excavation of soil for foundation	Negative	Short Term
		Heavy machineries operation	Negative	Short Term
		Human and Vehicle presence	Negative	Short Term
	Habitat degradation	Vegetation clearance	Negative	Short Term
		Pollution	Negative	Short Term
Operational	Habitat loss and degradation	Conversion of habitats	Negative	Long Term
		Increased fire incidences	Negative	Long Term
		Soil erosion	Negative	Long Term
		Altered hydrology	Negative	Long Term
	Habitat fragmentation	Barrier effect on animal movements	Negative	Long Term
	Animal mortality	Collision of birds	Negative	Long Term
		Electrocution of birds and other animals	Negative	Long Term
	Disturbance	Constant crackling sound	Negative	Long Term
		Creation of electro-magnetic field	Negative	Long Term
	Aesthetic	Artificial structure in natural habitat/landscape	Negative	Long Term

*Main Source: Eco-friendly Measures to Mitigate Impacts of Linear Infrastructure on Wildlife (WII, 2016)

During the field surveys in transmission line project area in Wild Ass Sanctuary, observations by study team members gave indications that the field assessment area (that included the project impact area) had good status of wildlife (i.e. wild birds and other wild animals) and therefore, it is likely that the proposed overhead transmission line would impose one or the other undesirable (negative) impacts on wildlife species and/or their habitats. At each of the five sampling/observation sites [viz. mudflat and marshy pond near Khirai, herb-grass-scrub covered land of Haripar, salt-pan areas in LRK (one towards Haripar, Maliya and other towards Shikarpur, Bhachau) and barren-cum-castor cultivation land of Shikarpur] multiple wildlife species/taxa were recorded either through indirect evidences (i.e. foot-prints, scats/droppings etc.) and/or direct sighting of wildlife species. Thus, in dry mudflat area of Little Rann near Khirai, foot-prints and droppings of Wild Ass and Bluebull were recorded and direct sightings were also made. In addition, wherever the mudflats were inundated, numerous species of aquatic avian wildlife (e.g., storks, egrets, spoonbill, Great White and Dalmatian Pelicans, various shorebirds belonging to Scolopacidae family, anatids like Northern Shoveler, Northern Pintail and Eurasian Wigeon) were also recorded through careful observations using pairs of binoculars. In grass-herb-scrub cover upland area of Haripar with a reedy pond, foot-prints of Wild/Feral Pig and Indian Fox were recorded in addition to direct sightings of numerous terrestrial-cum-wetland dependent birds (like Purple Heron, Glossy Ibis, Marsh Harrier, Crested Lark, Bulbuls, Grey Wagtails, swallows etc.) and some lizards. In the salt-pan areas, though no mammals or reptiles were recorded, numerous aquatic birds(waterbirds) were recorded including gulls, terns, egrets, herons, storks, shorebirds etc. In the barren-cum-castor cultivation are of Shikarpur, terrestrial birds and reptiles like skinks and lizards were recorded.

Considering the richness of wildlife in the assessment area (that included the Impact Area) falling in WAS, potential impacts on flora-fauna, their habitats and ecology during construction and operational phases have been predicted for the proposed 14.9 km of 765KV overhead transmission line based on Table 2.5A that

summarised potential impacts of transmission line erection project in general. These impacts, their causes and their explanation are given in Table 2.6b below:

Table 2.6b Potential impacts, causes and concerns of proposed transmission line planned to pass through Wild Ass Sanctuary for 14.9 km *

Phase	Impact	Causes	Concerns
Construction	Disturbance (Short-term impact)	Excavation of soil for foundation	Disruption of benthic organisms, foraging grounds of birds, and native vegetation, affecting grazers and ground-nesting fauna. Noise and activity may lead to temporary displacement of wildlife. Concerns can be mitigated by restricting excavation to non-breeding seasons and restoring affected habitats post-construction.
		Heavy machineries operation	The noise and vibrations from machinery can disrupt the sensitive auditory and behavioural responses of wildlife, including the Indian Wild Ass, leading to stress, abandonment of key foraging areas, and disruption of daily activities. This concern can be addressed by scheduling machinery operations during daylight hours when wildlife activity is relatively lower, employing noise suppression technologies, and creating temporary buffer zones around critical habitats.
		Human and Vehicle presence	The movement of workers and vehicles introduces visual and auditory disturbances, increasing the risk of accidental wildlife encounters and altering the natural behavior of species. To mitigate this, restrict worker access to essential areas, establish designated pathways for vehicles with strict speed limits, and ensure ongoing monitoring of wildlife activity to adjust movement protocols in real-time.
	Habitat degradation (Short-term impact)	Vegetation clearance	Clearing vegetation for construction not only reduces the availability of food and shelter for herbivores like the Wild Ass but also exposes soil to erosion and increases vulnerability to invasive species. Mitigation measures should include limiting vegetation removal to absolutely necessary areas, conducting pre-construction surveys to mark ecologically significant zones, and implementing post-construction habitat restoration programs with native vegetation.
		Pollution	Dust from construction activities can coat vegetation, reducing its palatability and photosynthetic efficiency, while chemical spills can poison water bodies and soils. Use dust

			suppression methods such as water spraying and erect barriers around work zones to contain spread. Prepare a spill management plan with designated emergency response teams and ensure all machinery is well-maintained to prevent leaks.
Operational	Habitat loss and degradation (Long-term impact)	Conversion of habitats	Permanent alteration of habitats due to construction and operational infrastructure may reduce breeding and foraging grounds for key species, including migratory birds and herbivores. Address this by identifying degraded lands nearby for restoration as compensatory habitats and implementing a biodiversity offset program to support species reliant on affected ecosystems.
		Increased fire incidences	Overhead power lines can spark fires, particularly in dry grassland areas, posing a severe threat to the sanctuary's biodiversity. Regular inspections of lines and towers, installation of fireproof insulation, and community awareness programs on fire prevention can significantly reduce this risk. Firebreaks and emergency response systems should also be established in collaboration with forest departments.
		Soil erosion	Erosion from disturbed soils may degrade vegetation quality and lead to sedimentation in nearby water bodies, affecting grazing lands and aquatic habitats. Control measures like planting native grass species and installing erosion barriers can stabilize soil, while post-construction monitoring ensures early detection and resolution of erosion hotspots.
		Altered hydrology	Changes in water flow due to structures may lead to waterlogging or habitat desiccation, impacting wildlife that relies on wetlands. Designing proper drainage systems and restoring natural water pathways post-construction can minimize disruptions, ensuring water availability for key species like the Wild Ass.
	Habitat fragmentation (Long-term impact)	Barrier effect on animal movements	Linear infrastructure such as transmission lines can fragment habitats, impeding the natural movements of species like the Wild Ass and increasing their vulnerability to predators and resource shortages. Incorporate wildlife corridors and underpasses at strategic locations to ensure connectivity. Conduct regular monitoring to assess the effectiveness of these measures.
	Animal mortality	Collision of birds	Birds, particularly large migratory species, may collide with transmission lines, leading to injuries or fatalities. Install bird diverters, reflectors, and

	(Long-term impact)		high-visibility markers along cables to minimize collision risks. Conduct periodic bird mortality assessments and adapt mitigation measures accordingly.
		Electrocution of birds and other animals	Electrocution can be fatal to birds and arboreal animals coming into contact with live wires. Equip powerlines with insulated covers and use bird-safe designs for pylons, ensuring a safe distance between live wires and potential perches.
	Disturbance (Long-term impact)	Constant buzzing sound	Low-frequency noise from transmission lines can lead to chronic stress and avoidance behaviors in sensitive wildlife. Conduct environmental noise assessments and, where necessary, install noise-dampening systems. Avoid placing infrastructure near breeding or foraging hotspots.
		Creation of electro-magnetic field	EMF emissions can potentially interfere with the navigation and migratory behavior of certain species. To address this, conduct comprehensive EMF impact studies pre-installation and, if needed, adopt shielding technologies and maintain clear zones around key habitats.
	Aesthetic (Long-term impact)	Artificial structure in natural habitat/landscape	The visual disruption caused by transmission towers in the natural landscape may deter eco-tourism and affect public perception of the sanctuary's pristine nature. To minimize this, use camouflaged structures, design towers with less intrusive profiles, and initiate community engagement to promote co-existence of infrastructure with conservation efforts.



Chapter 3

Mitigation Measures-Their Identification and Implementation by Power Grid Corporation

3.1 Introduction to Basic Terms Pertaining to Mitigation

3.1.1 Mitigation

Mitigation means the elimination or reduction of the frequency, magnitude, or severity of exposure to risks, or minimization of the potential impact of a threat or hazard.

3.1.2 Mitigation goals: They are general guidelines that explain what the community wants to achieve with the plan. They are usually broad policy-type statements that are long-term, and they represent visions for reducing or avoiding losses from the identified hazards.

3.1.3 Mitigation actions: They are specific projects and activities that help achieve the goals. How the mitigation actions will be implemented, including how those actions will be prioritized, administered and incorporated into the community's existing planning mechanisms etc. have to be planned in advance.

3.1.4 Mitigation Plan

The Mitigation Planning process, and resulting hazard mitigation plan, includes hazard identification and risk assessment leading to the development of a comprehensive mitigation strategy for reducing risks to life and property. The mitigation strategy section of the plan identifies a range of specific mitigation actions and projects being considered to reduce risks to new and existing habitats and wildlife. This section includes an action plan describing how identified mitigation activities will be prioritized, implemented and administered.

Mitigation plan identifies impacts and provides a framework to avoid, minimize, or mitigate potential adverse impacts in areas where it is ecologically responsible and financially reasonable and to concomitantly foster an environmentally responsible community ethic. Each of the development phases is guided by the avoid, minimize and mitigate concept.

In a multi-jurisdictional plan, each jurisdiction must have an action plan specific to that jurisdiction and its vulnerabilities.

To continue to be an effective representation of the jurisdiction's overall strategy for reducing risk to natural hazards, the updated local mitigation plan must reflect current conditions and progress in mitigation efforts. The action plan for a specific period update is an opportunity for each jurisdiction to assess its previous goals and actions, evaluate progress in implementing the action plan, and adjust its actions to address current realities. The mitigation strategy should also be revised following disasters to determine if the recommended actions are still appropriate given the impacts of the event.

3.2 Mitigation Measures to be Implemented by PowerGrid Corporation

This section proposes mitigation measures which the Power Grid Corporation should implement for the safety of wildlife in the project area falling in the Wild Ass Sanctuary through which Lakadiya-Ahemedabad transmission line would be passing. The chapter also provides the plan for conservation measures which the Forest Department can implement for the well-being of wildlife and wildlife habitat in the project area with the help of funds that would be submitted by the Power Grid Corporation to the Gujarat Forest Department for conservation action in the project area. The sanctuary is a critical habitat for the endangered Indian Wild Ass (*Equus hemionus khur*), numerous wild birds (terrestrial and wetland-dependent) and other species of flora and fauna . The measures aim to minimize ecological impacts during construction and operation phases of the transmission line while aligning with recommendations derived from similar mitigation practices.

In addition to addressing immediate ecological concerns, these mitigation and conservation measures serve as a model for sustainable development in biodiversity-sensitive areas. They align with global and national biodiversity conservation goals. The chapter underscores the importance of balancing infrastructure development with ecological stewardship, providing a pathway for harmonious coexistence between development and nature.

3.2.1 Wetland and Mudflat Protection

Alignments have to be planned to minimize encroachment into wetlands and mudflats (e.g., in the wetland area beyond Khirai village settlement). Even if moderate habitat disturbances occur in the wetland area, wetland restoration efforts will have to be implemented post-construction. To ensure effective wetland and mudflat protection, pre-construction surveys should identify sensitive zones, enabling strategic alignment planning. Restoration efforts could include replanting native vegetation, controlling invasive species, and monitoring water quality to restore ecological functions. Emphasis should also be placed on minimizing soil erosion and sedimentation during construction to prevent further degradation of these habitats.

3.2.2 Measures for Safety of Wildlife and Their Movements

3.2.2.1 Avoidance of Disruption in Wildlife Corridors

Careful alignment design avoids disrupting critical wildlife corridors. However, complete clearance of scrub/tree cover would not be required in the corridor area for stringing purposes. Rather, an 18-meter ground clearance at mid-span shall be maintained for the 765 kV transmission line. Temporary measures such as ramps or passageways will be employed during construction to ensure the free movement of species like the Indian Wild Ass that were recorded during field assessments in the sanctuary area beyond Khirai village settlement.

Sites like Haripar have several scrubs and trees. Terrestrial avian wildlife use trees

and scrubs for foraging, resting, and roosting, whereas wetland-dependent birds like those belonging to Ardeidae, Threskiornithidae, Ciconiidae, etc., use trees for resting and roosting. As per norms, for 765 kV transmission lines, about 9 m of clearance needs to be maintained between trees and conductors. Special attention should also be given to seasonal migration patterns, as these could affect the movement of species such as the Indian Wild Ass, birds, and other fauna in the area. Ensuring safe passage during migration seasons will require additional planning, including the installation of wildlife-friendly structures. Moreover, the use of ramp designs for wildlife movement should be periodically reviewed to ensure they are effective and do not inadvertently create barriers. Post-construction monitoring will be essential to assess the long-term success of these measures.

3.2.2.2 Minimum/Restricted Tree-removal(cutting)

Through proper design and/or design modifications, the need for cutting trees/scrubs will be minimized. Where unavoidable, only trees that would be directly impeding construction (of pylons, etc.) will be removed. Efforts will be made to transplant such trees rather than felling them. Thus, tree felling will have to be considered as the last option. Where tree removal is unavoidable, preference should be given to species that are less critical to local wildlife or biodiversity. Transplantation efforts should be conducted during the off-season for wildlife to minimize disturbance. Additionally, soil and root ball health should be prioritized in transplantation to ensure successful re-establishment. The restoration of habitats post-construction should include planting native species to encourage the return of local fauna and flora, promoting long-term ecological balance.

3.2.2.3 Disturbance Reduction during Construction Phase of the Transmission Line

Construction activities will have to be restricted to daylight hours to minimize disruption to nocturnal species. Seasonal considerations will guide the timing of high-impact activities to avoid breeding and migration periods. The transmission line should be aligned parallel to existing roads and/or salt-work areas for minimum disturbance during the construction phase, not only to minimize impacts on the aesthetic value of the

Little Rann landscape but also to minimize the impact of construction noise and human and machinery movement on wildlife, as wildlife is already accustomed to these factors in such areas. In addition to limiting construction to daylight hours, noise barriers or buffers can be deployed near sensitive wildlife areas to further reduce disturbance. Dust control measures, such as water spraying, should be implemented to prevent air quality degradation and ensure the health of surrounding flora and fauna. Furthermore, access to construction sites should be carefully controlled to minimize human-wildlife interactions and prevent wildlife from entering hazardous areas. Surveillance during construction can also ensure that any unforeseen disturbances are promptly addressed.

3.2.2.4Physical Risk Reduction for Mammals and Reptiles during Construction & Operation Phases

The excavated pits will have to be properly barricaded and fenced during the construction phase to prevent accidental falling of mammals. The physical safety of mammals and reptiles that might attempt to climb towers (pylons) can be ensured during the operational phase by installing Anti-Climbing Devices (ACDs) at the four corner gates of the towers. These devices should include two gated openings and two fixed, non-opening sections, enclosed with barbed wire and appropriate accessories, effectively preventing animals from accessing the tower structure. Special attention will have to be given to the safety measures of wildlife species against accidental leakage of electricity, collapse of tower, or breaking of wire, mainly during the construction phase. In addition to fencing around pits, regular inspections should be conducted to ensure that barricades are intact and effective, especially in areas with high mammal and reptile activity. The installation of escape ramps or safe passages around construction sites can further reduce the risk of accidental falls. During operation, wildlife monitoring programs should be implemented to track the effectiveness of Anti-Climbing Devices (ACDs) and other safety measures, ensuring they are functioning as intended. Moreover, proper training for construction and operational staff on safety measures and wildlife interaction will help minimize accidental harm to animals.

3.2.2.5 Bird Safety Measures

3.2.2.5.1 Installation of Bird Diverters

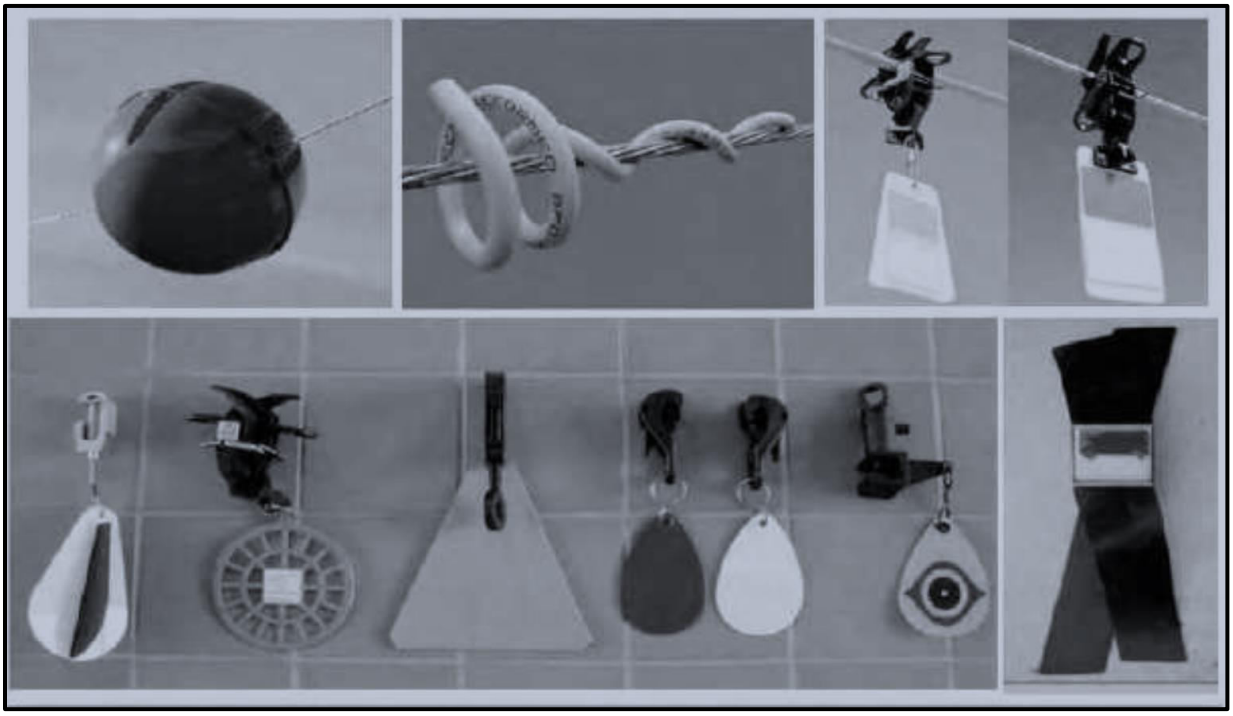


Fig. 3.1a. Different types of markers used as bird diverters for transmission lines
(Source: Anon. (2024): Wildlife Conservation & Management Plan for 765 KV D/C Transmission Line from Khavda-II PS to Lakadia PS)



Fig. 3.1b. Indicative illustration of a bird diverter on transmission line
(Source: BIA Report of 220 KV Transmission Lines passing through the Karakorum Shayok Wildlife Sanctuary, Ladakh (under PMDP-15)

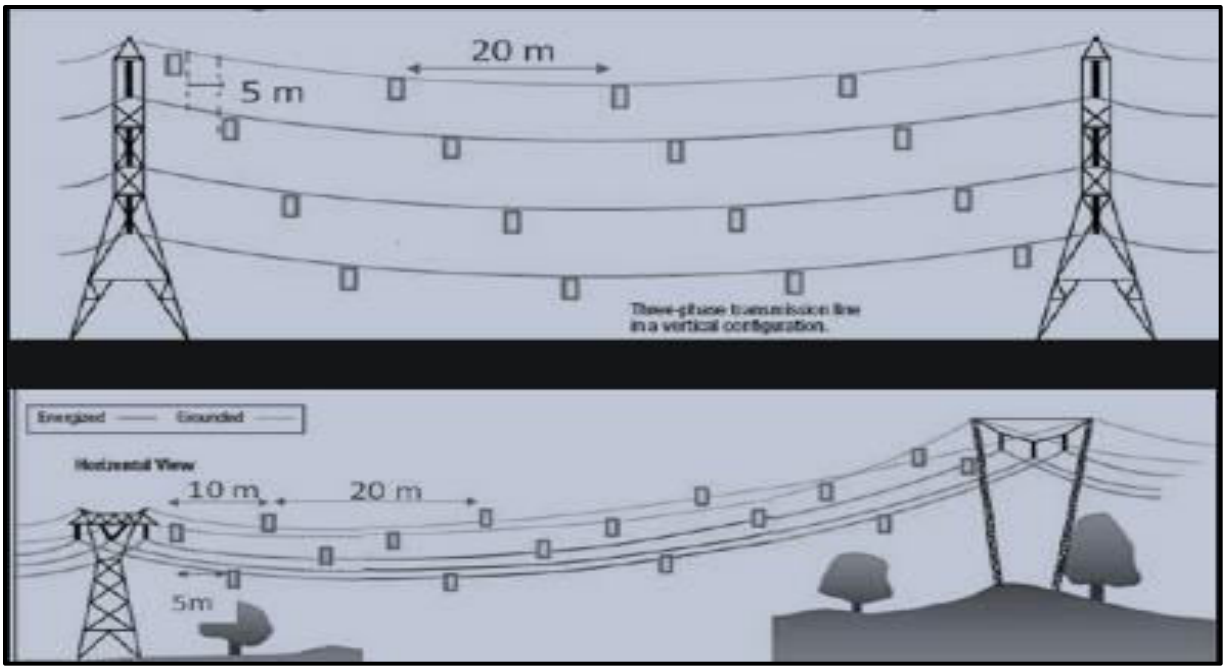


Fig. 3.2. Diverter installation indicative designs (Source: WII, 2018)

3.2.2.5.2 Installation of Bird Diverters

To prevent bird collisions with the transmission lines, bird diverters will be installed at strategic locations along the line. These devices have proven highly effective in similar habitats, including the Khavda to Lakadiya segment, where they successfully reduced bird mortality. Bird diverters are particularly important in the project area due to its proximity to key bird habitats such as wetlands, mudflats, and migratory pathways used by a variety of species. The diverters will be designed with consideration for the diverse bird species in the region, particularly migratory and large-bodied species that are more vulnerable to collisions.

The installation of these diverters will be strategically planned, focusing on areas where birds are most likely to fly at lower altitudes, such as near wetlands, salt pans, and other high-risk zones, where birds often congregate. The exact positioning and frequency of the diverters will be based on a detailed survey of bird movement patterns and risk zones, in consultation with local ornithologists and wildlife experts. This collaborative approach will ensure that the diverters are placed in the most effective locations and designed to

mitigate collision risks for a variety of bird species, including both terrestrial and wetland-dependent birds.

In addition to installation, the bird diverters will be monitored annually to assess their effectiveness and durability over time. Regular inspections will be conducted by designated wildlife experts and local ornithological groups to evaluate the performance of the diverters in reducing bird collisions. This monitoring program will include the tracking of collision incidents, if any, and adjustments to diverter placement or design as necessary to address emerging risks. If any diverters are found to be malfunctioning or need replacement, the Power Grid Corporation (K2ATL) will bear the full cost of the replacement and maintenance of the devices.

Furthermore, the monitoring results will be shared with relevant wildlife conservation authorities and local NGOs to ensure transparency and collaboration. Any new developments in bird behavior or migratory patterns identified during monitoring should be incorporated into the ongoing mitigation efforts, making it a dynamic and adaptive process. The assessment process should also include reviewing the effectiveness of the diverters in relation to different bird species, to ensure that the measures remain relevant and effective as wildlife populations and migration patterns evolve.

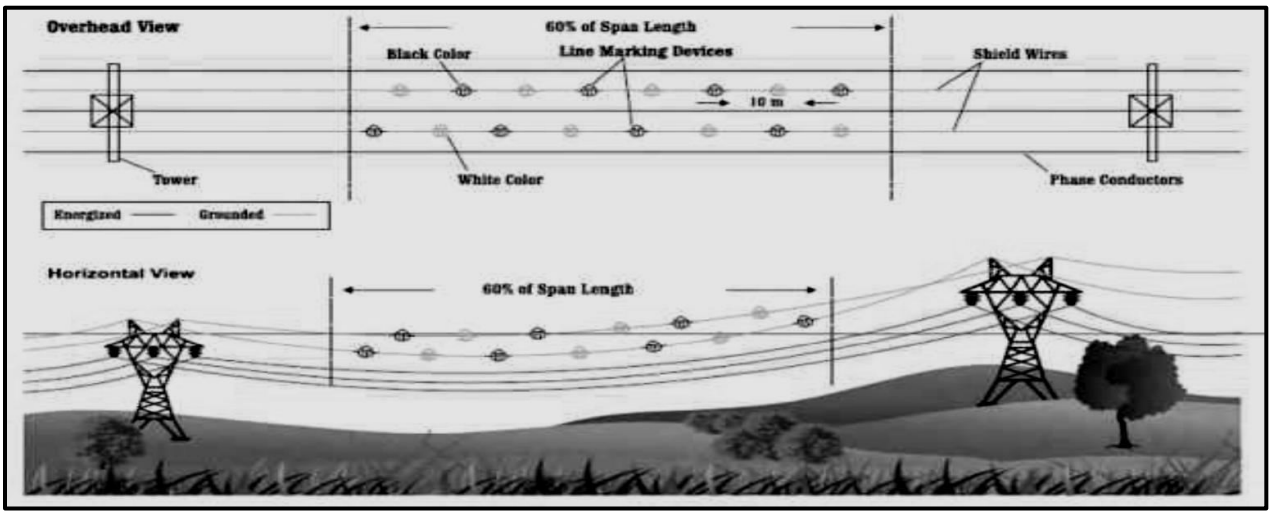


Fig.3.3 Indicative design & configuration of bird markers to be installed to reduce bird collision on transmission line passing through selected WLS/ forest stretch
(Source: a WII report & Wildlife Conservation & Management Plan for 765 KV D/C Transmission Line from Khavda-II PS to Lakadia PS).

3.2.2.5.3 Installation of Bird Guards

In addition to the installation of bird diverters, bird guards will be equipped on all insulators to significantly reduce the risk of avian electrocution. Bird electrocution is a major concern, especially in areas where birds, including large raptors and waterfowl, tend to perch on transmission lines. The bird guards will be designed to prevent birds from coming into contact with live parts of the transmission line, ensuring their safety while also maintaining the integrity of the power infrastructure.

The bird guards will be installed across all critical points where birds are most likely to perch, particularly in areas near known bird habitats or migration routes. The design will be tailored to fit the specific needs of local bird species, ensuring that the guards are large enough to accommodate different sizes of birds and prevent electrocution incidents.

In addition to the installation of these bird guards, regular maintenance schedules will be established to inspect and ensure the continued effectiveness of the safety measures. This includes periodic checks for wear and tear, cleaning, and any required repairs. Monitoring of bird mortality will be conducted post-construction, with a focus on identifying and documenting any electrocution incidents, particularly in the first few years following installation. Adaptive management measures will then be implemented to address any identified risks or gaps in the current bird protection measures. These could include redesigning bird guards, installing additional protective structures, or adjusting the alignment of transmission lines to minimize risks to vulnerable species.

Post-construction monitoring will also involve collaboration with local ornithologists, wildlife experts, and NGOs to ensure that the mitigation measures remain effective over time. The monitoring data will be used to refine and improve safety measures, ensuring that they evolve in response to changes in bird populations, behavior, or environmental conditions. The adaptive management approach will ensure that bird mortality is minimized and that the safety measures continue to meet the needs of both wildlife and infrastructure**.**

3.2.2.5.4 Noise Abatement

To minimize the impact of construction-related noise on the environment and wildlife, low-noise machinery will be prioritized wherever possible. High-noise activities such as excavation and piling will be scheduled during specific daytime hours and limited to designated zones, reducing disturbance to nocturnal and crepuscular species. Noise barriers, such as acoustic panels or vegetative screens, will be installed in ecologically sensitive areas to shield wildlife from excessive sound. Regular maintenance of machinery will be carried out to prevent unnecessary noise due to faulty equipment. Additionally, monitoring devices may be used to measure noise levels and ensure compliance with permissible limits. Awareness and training programs will be conducted for workers to emphasize noise control measures. Together, these efforts will help maintain a quieter environment, safeguarding both the local fauna and the well-being of nearby communities.

3.2.2.5.5 Solid Waste Management during Construction

Effective solid waste management is essential to minimize environmental impacts during the construction of towers and transmission lines in the sanctuary. Construction debris, including cement, wires, and cables, will be carefully managed to prevent accumulation and harm to wildlife. Waste will be segregated at the source into recyclable, reusable, and non-recyclable categories. Recyclable materials will be sent to authorized recycling units, and reusable items will be stored for future use. Non-recyclable waste will be responsibly disposed of in compliance with environmental regulations.

Designated waste collection points will be established, and debris will be promptly removed to avoid interference with wildlife or habitats. Biodegradable waste will be processed to reduce environmental impacts, and workers will be trained in proper waste disposal practices. Regular monitoring will ensure compliance with protocols, creating a safer environment for the sanctuary’s wildlife while preserving its ecological balance.

Chapter - 4

Conservation Measures to be Implemented by Gujarat Forest Department

4.1 Introduction

In line with the prevailing norms and rates under the Forest Conservation Act, the company will deposit the Net Present Value (NPV) to compensate for the ecological loss caused by the diversion of forest and sanctuary areas. These actions are essential to mitigate the environmental impact of the project and ensure the conservation of the region's unique biodiversity.

4.1.1 Compensatory Afforestation

Replacing the lost tree and shrub cover is a crucial step in minimizing the ecological impact. Compensatory afforestation (CA) will be implemented to restore the lost native vegetation by planting ecologically appropriate species.

Compensatory Afforestation for Overhead Transmission Line in the Wild Ass Sanctuary

The installation of a 14.9 km-long overhead transmission line within the Wild Ass Sanctuary, which spans approximately 1 sq. km and impacts areas near villages such as Khirai, Haripar, and Shikarpur in Maliya taluka, Morbi district, requires effective ecological conservation strategies, with compensatory afforestation being a key measure. The sanctuary, known for its saline soil, shallow wetland habitats, salt pans, and xerophytic/halophytic vegetation, hosts unique flora and fauna that have adapted to these harsh conditions.

The construction activity will involve excavation of 31 pylons with foundations of 500 sq.m each, leading to the removal of some xerophytic and halophytic trees and shrubs.

To offset this ecological damage, compensatory afforestation should be undertaken in accordance with the Forest (Conservation) Act, 1980, and relevant guidelines.

Key Recommendations for Compensatory Afforestation:

1. **Site Selection**: Prioritize degraded or barren saline lands within the sanctuary's buffer zone or nearby areas to maintain ecological connectivity. Collaboration with the Forest Department is necessary to identify areas suitable for reforestation.

2. **Species Selection**: Native halophytic and xerophytic species, such as *Prosopis cineraria*, *Salvadora persica*, *Salvadora olioides*, *Tamarix aphylla*, etc., should be chosen to mimic the natural habitat. Avoid planting *Prosopis juliflora* due to its abundance in the region.

3. **Plantation Strategy**: Employ a mix of tree and shrub species in varying densities to replicate the natural structure of the affected vegetation. This will ensure habitat availability for native wildlife and promote ecological balance.

4. **Soil Preparation and Water Management**: Since the soil is saline, treat planting pits with gypsum and organic manure to reduce salinity. Implement rainwater harvesting structures such as small bunds to maintain moisture levels.

5. **Protection and Maintenance**: New plantations should be protected from grazing and human disturbance using fencing. Continuous monitoring and maintenance, including replanting where necessary, should be ensured for at least five years.

6. **Community Involvement**: Engage local communities, especially those from affected villages, in afforestation activities to foster a sense of ownership and enhance plantation maintenance.

This compensatory afforestation will not only offset the loss of vegetation but also contribute to biodiversity enhancement, carbon sequestration, and improved soil stability

within the sanctuary. A comprehensive action plan, including budgetary provisions, should be developed by the Forest Department to ensure the success of this measure.

4.2.2 Habitat Improvement

Post-project restoration efforts will focus on enhancing habitats for both wildlife and avifauna. Key measures include planting native vegetation, creating artificial waterholes, and establishing shaded resting areas.

4.2.2.1 Establishing Native Herb and Grass Cover for Habitat Restoration

Alongside compensatory afforestation, establishing native herb and grass cover is an important ecological intervention. Restoring ground vegetation serves several purposes: providing fodder for herbivores like the Indian Wild Ass, seeds for grainivorous birds, and habitat for insects that support insectivorous bird species. This restoration is especially suited for saline and arid landscapes near Surajbari Bridge and villages like Khirai, Haripar, and Shikarpur.

Key Considerations for Establishing Native Herb and Grass Cover:

1. **Species Selection**: Prioritize salt-tolerant (halophytic) and drought-resistant (xerophytic) species adapted to the region. Examples include *Suaeda nudiflora*, *Suaeda fruticosa*, *Cressa cretica*, *Aeluropus lagopoides*, *Sporobolus helvolus*, and *Chloris gayana*.

2. **Seed Collection and Sowing**: Collect seeds locally to ensure genetic compatibility. Seeds should be sown during the monsoon season for optimal germination and minimal water requirements.

3. **Soil Preparation**: Light tilling and the addition of organic matter such as farmyard manure can improve soil texture and fertility. Gypsum can be applied to reduce salinity in severely degraded areas.

4. **Water Management**: Create micro-catchments or shallow bunds to capture rainwater and enhance moisture retention, particularly during the dry season.

5. **Maintenance and Protection**: Protect the newly established vegetation from overgrazing and trampling using fences or natural barriers. Periodic monitoring for invasive species and reseeding in sparsely vegetated patches will help maintain uniform ground cover.

Ecological Benefits:

1. **Fodder Provision**: Grasses like *Aeluropus lagopoides* and herbs like *Suaeda* spp. serve as essential fodder for herbivores, supporting their nutrition and population stability.

2. **Bird Habitat and Food**: These plants produce seeds that feed grainivorous birds and support insects that benefit insectivorous species, promoting avian biodiversity.

3. **Erosion Control**: The ground vegetation will stabilize the soil, reduce erosion, and prevent nutrient loss, crucial for maintaining habitat quality.

4. **Enhanced Ecosystem Services**: Native plant cover will enhance carbon sequestration, improve soil health, and create a resilient habitat for diverse species.

A detailed action plan for this restoration, alongside compensatory afforestation, should be developed to ensure a balanced approach that benefits both wildlife and the ecosystem in the Wild Ass Sanctuary.

4.2.2.2 Creation of Artificial Wetlands for Habitat Improvement

To further enhance habitat quality in the Wild Ass Sanctuary, the Forest Department can develop artificial wetlands in suitable terrestrial zones such as Haripar and Shikarpur, where soil conditions are favorable. These wetlands will provide a reliable source of

drinking water for wildlife, including the Indian Wild Ass, sandgrouse, and various bird species, while improving overall biodiversity.

Key Considerations for Creating Artificial Wetlands:

1. **Site Selection**: Choose areas with compact, less permeable soils near wildlife trails or grazing grounds, away from salt pans and waterlogged Rann mudflats.

2. **Excavation and Design**: Create shallow depressions with varying depths (0.5–1.5 meters) to form water-retaining basins. These varied depths will support diverse wildlife, from waders to grazing animals.

3. **Water Retention Techniques**: To minimize seepage, line the basins with clay or compact the soil base. Construct bunds around the periphery to retain water during the monsoon season.

4. **Vegetative Buffer**: Plant native halophytic grasses and sedges such as *Cynodon dactylon* and *Cyperus rotundus* to stabilize the soil, reduce evaporation, and provide shelter for small fauna.

5. **Maintenance and Monitoring**: Regular desilting and bund maintenance will ensure long-term functionality. Water quality should be monitored to prevent salinity build-up or contamination.

Ecological and Wildlife Benefits:

1. **Drinking Water Source**: Reliable freshwater availability during the dry season will reduce stress on wildlife, particularly the Indian Wild Ass, blackbuck, and other ungulates.

2. **Bird Habitat**: Wetlands will attract diverse bird species, including sandgrouse, lapwings, and waterfowl, enhancing the sanctuary's avifauna.

3. **Aquatic Biodiversity**: Over time, wetlands will support aquatic vegetation, insects, and small organisms, contributing to the food web.

4. **Climate Resilience**: Wetlands will act as natural sponges, absorbing and slowly releasing water, thereby mitigating the impacts of extreme weather events like droughts.

This measure will significantly improve habitat quality within the sanctuary. A detailed implementation plan, incorporating community involvement, should be prepared to ensure its success.

4.2.2.3 Shelterbelt Development for Wildlife in Open Landscapes

Shelterbelt development in open landscapes is a practical habitat improvement measure that provides shade, shelter, and wind protection for wildlife, especially in arid and semi-arid regions like the Wild Ass Sanctuary. These linear plantations act as ecological buffers and corridors, offering diverse benefits to wildlife and the environment.

Design and Implementation:

1. **Site Selection:** Choose areas near wildlife trails, grazing grounds, and waterholes where wildlife movement is frequent. Avoid salt pans and waterlogged regions.

2. **Plant Selection:** Use native, drought-resistant species like *Prosopis cineraria* (Khejri), *Acacia senegal* (Gum Arabic Tree), *Salvadora persica* (Toothbrush Tree), and *Ziziphus nummularia* (Jharber). These species are adapted to arid conditions and provide food, shade, and nesting opportunities.

3. **Spacing and Density:** Plant trees in rows with a spacing of 2-3 meters to ensure adequate growth and canopy development. Shrubs can be interspersed for additional cover.

4. **Protection:** Use fencing or thorny branches to protect saplings from grazing and trampling during the initial stages of growth.

Ecological Benefits:

- Provides shade for ungulates like the Indian Wild Ass during hot summers.
- Acts as windbreaks, reducing soil erosion and creating microclimates favorable for vegetation.
- Serves as shelter and nesting sites for birds like sandgrouses and larks.
- Increases biodiversity by supporting insects and small mammals that contribute to the food web.

Maintenance:

Regular monitoring, watering, and replacement of dead plants during the first two years are crucial. Over time, the shelterbelt can become self-sustaining, requiring minimal intervention.

Shelterbelt development enhances the habitat quality of open landscapes, ensuring the ecological and climatic resilience of the region.

4.2.2.3 Shelterbelt Development for Wildlife in Open Landscapes

Shelterbelt development in open landscapes (like that in Wild Ass Sanctuary) is an effective habitat enhancement strategy, particularly in arid and semi-arid regions like the Wild Ass Sanctuary. These linear plantations provide essential benefits to wildlife by offering shade, shelter, and protection from harsh winds. Acting as ecological buffers and corridors, shelterbelts contribute to the overall health of the ecosystem.

4.2.2.3.1 Design and Implementation

1. **Site Selection:** Opt for locations near wildlife trails, grazing areas, and waterholes where animal movement is frequent. It is important to avoid areas such as salt pans or waterlogged regions that are unsuitable for planting.

2. **Plant Selection:** Choose native, drought-tolerant species such as *Prosopis cineraria* (Khejri), *Acacia senegal* (Gum Arabic Tree), *Salvadora persica* (Toothbrush Tree), and *Ziziphus nummularia* (Jharber). These species are well-adapted to arid conditions, providing food, shade, and nesting sites for a variety of wildlife.

3. **Spacing and Density:** Space trees 2-3 meters apart to allow sufficient room for growth and canopy development. Interspersing shrubs will further enhance cover, offering more shelter for wildlife.

4. **Protection:** Protect young saplings from grazing and trampling by surrounding them with fencing or thorny branches during their early growth stages.

4.2.2.3.2 Ecological Benefits

- **Shade and Cooling:** Shelterbelts provide shade, particularly benefiting ungulates like the Indian Wild Ass, which require relief from the intense heat during summer.

- **Windbreaks:** Acting as windbreaks, shelterbelts reduce soil erosion and create microclimates conducive to the growth of vegetation.

- **Habitat Creation:** These plantations offer vital shelter and nesting opportunities for birds such as sandgrouses and larks.

- **Increased Biodiversity:** By supporting insects and small mammals, shelterbelts contribute to the broader food web and overall ecosystem health.

4.2.2.3.3 Maintenance

Regular monitoring, watering, and replacing any dead plants during the first two years are essential to ensure the success of the shelterbelt. Once established, the shelterbelt can become self-sustaining with minimal intervention.

Overall, shelterbelt development significantly enhances the habitat quality in open landscapes, improving both ecological stability and climatic resilience in regions like the Wild Ass Sanctuary.

4.2.2.4 Invasive Species (Mainly *Prosopis juliflora*) Management

The spread of invasive species like *Prosopis juliflora* poses a significant threat to the native ecosystems of the Wild Ass Sanctuary. This invasive tree outcompetes native flora, reducing habitat diversity and limiting resource availability for wildlife.

4.2.2.4.1 Management Approach

1. **Mapping and Assessment:** Identify and map areas with dense *Prosopis juliflora* infestations to prioritize removal efforts.

2. **Mechanical/Manual Removal:** Use mechanical or manual methods to uproot the plants. Focus on young saplings and ensure complete root removal to prevent regrowth.

3. **Alternative Uses:** Utilize harvested *Prosopis juliflora* wood for fuel, charcoal, or bioenergy, providing economic benefits to local communities.

4.2.2.4.1 Restoration

- Replant native species such as *Salvadora persica*, *S. oleoides*, *Prosopis cineraria*, *Capparis decidua*, and *Tamarix* species to restore native vegetation.

- Condition the soil and enhance moisture retention in severely degraded areas before planting.

4.2.2.4.2 Monitoring

Ongoing surveillance of cleared areas is critical to prevent reinfestation. Encourage local community involvement in the maintenance of restored areas.

Managing *Prosopis juliflora* helps improve native biodiversity, enhance habitat quality, and restore ecological balance within the sanctuary.

4.2.2.5 Wildlife Monitoring and Research

Wildlife monitoring and research are integral to effective habitat management in the Wild Ass Sanctuary. These activities provide critical data for conservation planning and adaptive management.

4.2.2.5.1 Monitoring Techniques

1. Field Surveys: Conduct regular transect walks and point counts to monitor bird, mammal, and plant diversity. Include phyto-sociological studies to assess vegetation health.

2. Camera Traps: Deploy camera traps along wildlife trails, waterholes, and shelterbelts to observe species distribution, behavior, and population trends.

3. Drone Surveys: Use drones to map habitats, monitor vegetation cover, and identify areas requiring intervention.

4. GPS Tracking: Equip key species like the Indian Wild Ass with GPS collars to track their movement patterns and habitat use.

4.2.2.5.2 Research/Monitoring Focus Areas

- Impact of habitat improvement measures (e.g., waterhole development, invasive species management) on wildlife populations.
- Population trends and distribution of rare, threatened, and/or flagship species.
- Interaction between wildlife and human activities, including grazing and salt pan operations.
- Effects of climate change on habitat and species behaviour.

4.2.2.5.3 Applications

Monitoring data supports decision-making by helping to identify critical conservation areas, assess the success of habitat interventions, and mitigate emerging threats.

By prioritizing wildlife monitoring and research, the Forest Department can ensure informed management decisions and sustainable conservation outcomes for the sanctuary.

4.2.3 Awareness, Education and Ecotourism Activities by Forest Department

The Forest Department can play a pivotal role in raising awareness and fostering community engagement in wildlife conservation around the project area, which includes Khirai, Haripar, Shikarpur, and Maliya town. Given the ecological significance of the region, innovative and inclusive approaches can ensure sustainable development while protecting its biodiversity.

Outreach and Awareness:

- Organize regular awareness programs in local schools and other educational institutions to educate students of various age-groups and their teachers about the unique flora, fauna, and ecological importance of the area.

- Conduct workshops and training sessions for front-line staff of the Forest Department on birds and other wildlife and their conservation (including rescuing troubled/injured wildlife) as also emphasizing their role in protecting and caring wildlife and maintaining ecological balance.

- Develop engaging materials such as pamphlets, posters, and videos in local languages to make the information accessible and relatable.

Ecotourism Initiatives:

- Train local youth to lead birding and wildlife viewing excursions for ecotourists. They can be trained to identify bird and wildlife species and develop soft skills for interacting with ecotourists who may come from India or other developed countries to observe wildlife, including the Indian Wild Ass, birds, and other local species. Training local youth as guides will create employment opportunities for local youth and inculcate a sense of ownership among them.

- Promote guided birdwatching and wildlife-viewing tours for ecotourists (by involving local trained eco-guides), not only focusing on iconic species like the Indian Wild Ass, but also on lesser-known mammals, reptiles and birds.

- Establish educational eco-trails that highlight the region's biodiversity, including plants along with other conventional forms of wildlife.

- Create observation points or bird hides near wetlands and other appropriate points to facilitate responsible wildlife viewing without undue disturbance to wildlife and their habitats.

Education Programmes:

- Partner with not-for-profit NGOs to organize nature camps, where their members (especially student-members) can learn about the ecosystems, wildlife, and conservation needs of the concerned area.

- Celebrate key environmental days, such as World Wildlife Day and Wetlands Day, through events like various nature-related competitions and native plantation drives using native plants.

Sustainable Practices:

- Ensure that ecotourism activities follow a strict code of conduct to minimize environmental impact. For instance, limit visitor numbers, promote waste segregation, and discourage single-use plastics.
- Collaborate with local artisans to sell eco-friendly souvenirs, emphasizing traditional crafts that reflect the region's culture and biodiversity.

These initiatives not only increase awareness but also generate alternative livelihoods, reducing dependence on activities that harm the environment, such as overgrazing or deforestation. By integrating awareness, education, and ecotourism into its strategy, the Forest Department can create a model for sustainable conservation and community development in the region.

4.3 Summing Up

The proposed conservation measures to be planned and executed aim at balancing development with ecological preservation in the project area. Key activities include a) compensatory afforestation mainly using native and non-invasive trees, scrubs, herbs and grasses, b) wetland creation, and c) shelterbelt development to enhance habitat quality. Invasive species management will restore ecological integrity, while wildlife monitoring by front-level Forest Dept. staff and with involvement of selected local youth will help deciding dynamic conservation strategies.

Chapter-5

Implementation, Monitoring and Evaluation of Mitigation-cum-Conservation Measure Plan

5.1. Implementation of Mitigation Plan

5.1.1 Implementation of regulatory compliances: Mitigation measures to be implemented by the project proponent in consultation with Gujarat Forest Department include, payment of Net Present Value (NPV), Payment for Compensatory Afforestation, payment for Plantation Scheme for plants below transmission line. Details of such measures are provided in the Table-6.1. The mitigative measures shall be implemented by the concerned Forest Division in a time bound manner after approval of the proposal by the competent authorities of Central and State Govts.

5.1.2 Implementation of wildlife mitigation measures by project proponent:

Mitigation measures to be implemented by the project proponent during construction and postconstruction includes, safety measures for animals & birds, Installation of Bird Diverters on transmission line earth wires, and Bird Guards & Anti Climbing Devices on towers. These costs would be as per actuals and borne by the project proponent as part of the project costs. Details of such measures are provided in the Table-6.1.

5.1.3 Implementation of wildlife mitigation measures by Forest Department:

Other wildlife mitigation measures proposed by the project proponent include habitat restoration in wildlife sanctuary area, contribution for habitat improvement measures for birds and biodiversity, support conservation & awareness activities, support to eco-tourism promotion activities etc. These activities would also be implemented by the concerned forest division and payment for the same would be made as demanded. Details of such measures, costs and are provided in the Table-6.2. and the schedule is provided in Table-6.3.

Monitoring of Wildlife Conservation Plan activities: Monitoring of effectiveness of the wildlife conservation plan would be carried out by the concerned forest division.

5.2 Monitoring and evaluation responsibility

The responsibility of monitoring and evaluation of the implementation of the mitigation and conservation measure plan (MCMP) will primarily rest with the Gujarat Forest Department, with active facilitation and collaboration by the project proponent. To ensure accountability, transparency, and effectiveness, a third-party independent monitoring mechanism will be instituted. This third-party monitoring will be carried out at regular intervals throughout the project lifecycle and will utilize a maximum of 5% of the total budgetary provision. The monitoring will aim to verify the implementation of prescribed measures and evaluate their effectiveness in achieving intended environmental and conservation objectives.

5.2.1 Monitoring Programme for Wildlife Mitigation Measures

The wildlife mitigation measures monitoring program will systematically assess the impacts of the transmission line project on species of conservation concern within the Wild Ass Sanctuary (WAS). Monitoring activities will span the construction, operation, and post-closure phases of the project, focusing on the following specific objectives:

- Objective 1: Assess levels of habitat disturbance caused by project activities such as excavation, heavy machinery operation, and human presence. Evaluate impacts on wildlife behaviour, habitat use, and movement patterns.
- Objective 2: Monitor wildlife mortality incidents related to the project (e.g., bird collisions, electrocutions), and identify high-risk zones or hotspots for targeted mitigation.
- Objective 3: Track movement patterns and habitat use of key species, such as the Indian Wild Ass (*Equus hemionus khur*), in areas where pylons and transmission lines may act as barriers.

5.2.1.1 Monitoring Methodology

The monitoring program will adopt a combination of systematic and incidental observation techniques to achieve its objectives:

1. Systematic Surveys: Regularly scheduled surveys will document wildlife presence, behavior, and interactions with project infrastructure. These will include:
    - Direct observations using trained field personnel.
    - Camera traps to monitor nocturnal and elusive species.
    - Drone surveys for inaccessible or sensitive areas.
2. Incidental Observations: Field personnel and third-party monitors will record wildlife activity, mortality incidents, or habitat changes observed during routine work.
3. GIS and Remote Sensing: Advanced spatial analysis tools will be employed to:
    - Map changes in habitat patterns.
    - Track species movements.
    - Monitor vegetation health and regeneration across the sanctuary.

5.2.2 Adaptive Management Approach

The monitoring program will incorporate an adaptive management framework to address unforeseen impacts and continuously improve mitigation strategies. The framework will include:

- Impact Verification: Comparing predicted impacts with actual observations to identify deviations and refine mitigation measures.
- Effectiveness Assessment: Evaluating whether implemented measures meet conservation objectives, such as reducing disturbance or mortality rates.

- Continued Improvement: Refining existing strategies and developing new approaches based on monitoring results and stakeholder feedback.

5.2.3 Specific Monitoring Activities

To ensure targeted and measurable outcomes, the following specific activities will be undertaken:

- Habitat Restoration: Post-construction monitoring of revegetation efforts, focusing on herbaceous and grass vegetation critical for the Indian Wild Ass and other species.
- Avian Interaction: Monitoring bird activity near pylons and transmission lines to:
    - Detect collision hotspots.
    - Assess the effectiveness of mitigation measures like bird diverters or reflectors.
- Wildlife Movements: Deploying GPS collars on select individuals of the Indian Wild Ass and other key species to:
    - Study movement patterns.
    - Identify disruptions caused by infrastructure.
- Noise and Electromagnetic Impact: Measuring sound levels and electromagnetic fields near wildlife habitats to assess indirect impacts and their implications for sensitive species.

5.3 Conservation Measures Monitoring Program

The conservation measures under the MCMP aim to offset project impacts through habitat enhancement, species-specific interventions, and community engagement. Monitoring of these measures will focus on the following components:

- Habitat Quality Assessment: Periodically evaluate the quality and availability of critical habitats, including mudflats, grasslands, and salt-pan edges.
- Community Engagement: Assess the effectiveness of community-driven conservation initiatives, such as awareness programs and participatory habitat management.
- Biodiversity Indices: Track changes in biodiversity metrics, including species richness, abundance, and ecosystem health indicators, to gauge the overall ecological health of the sanctuary.

5.4 Evaluation and Reporting

A robust evaluation and reporting framework will underpin the monitoring and evaluation process. Reports will be prepared as follows:

- Quarterly Reports: During the construction phase, providing detailed updates on progress and observations.
- Biannual Reports: During the operational phase, summarizing ongoing monitoring efforts and findings.

Each report will include:

- A summary of monitoring activities conducted.
- Key findings on wildlife impacts, habitat changes, and mitigation effectiveness.
- Recommendations for corrective actions or enhancements to existing measures.
- Visual documentation, including photographs, maps, and GIS analyses.

5.5 Integration with Regional Initiatives

To maximize conservation outcomes, the monitoring program will align with broader regional conservation initiatives and databases. Key steps include:

- Facilitating information exchange with regional and national biodiversity monitoring programmes.
- Collaborating with stakeholders on conservation initiatives to leverage synergies and enhance effectiveness.
- Contributing data to national repositories to support long-term planning.

Conclusion

The comprehensive monitoring and evaluation framework detailed above ensures that mitigation and conservation measures under the MCMP are systematically implemented, rigorously evaluated, and continuously refined. This approach not only minimizes the ecological footprint of the project but also contributes to the broader conservation goals of the Wild Ass Sanctuary and its unique biodiversity.

Chapter-6

Financial Allocation

The financial outlay worked out for the Conservation Plan shall be deposited to Forest Department by the user agency (project proponent) for the implementation of the Plan by the Forest Department. The approved amount for this purpose shall be deposited by the user agency in the account as per the demand raised by the concerned officials of the Forest Department.

In this chapter, three important financial allocation tables are provided. Table 6.1 provides the details of mitigation measures proposed for the project area. Table 6.2 provides details of proposed conservation measures to be implemented by the Forest Department at the cost of the user agency (project proponent) along with finanacial outlay. Table 6.3 provides details of yearly financial outlay schedule for implementation by Forest Department in 3 years towards conservation measures.

Table: 6.1 Mitigation Measures proposed for the Project Area

No.	Mitigation Activity	Amount (Rs. In Lakhs)
I.	**Safety Measures for Birds and Other Wildlife (Mammalian, Reptilian)**	
a)	Mounting multiple Bird Diverters along the length of the transmission line (14.9 km) within the Sanctuary area to divert the flying birds away from the transmission line and to prevent their collision with the transmission line. Bird diverters can be mounted at 30-60m interval.	Based on Actual Costs to be Incurred
b)	Placing multiple 'Bird Guards' to safeguard birds (that may land on transmission line) from electrocution, and affixing 'Anti-Climbing Devices' (ACDs) for the protection of mammals and reptiles.	Based on Actual Costs to be Incurred

II.	Regulatory Compliances for Vegetation Loss	
a)	**Compensatory Afforestation:** As per MoEFCC letter FP/GJ/TRANS/434476/2023, 69.5597 hectares (0.69559 sq.km) of forest land is proposed for diversion for the 765 kV D/C Lakadia-Ahmedabad Transmission Line in Gujarat. Under the Forest Conservation Act (FCA), compensatory afforestation is required over twice the diverted area, totaling 1.39 sq.km. For the Wild Ass Sanctuary, a 14.9 km stretch of the line passes through, affecting 1 sq.km. Typically, compensatory afforestation would cover twice this area, i.e., 2 sq.km. However, given the total afforestation requirement of 1.391194 sq.km, the area in the sanctuary will need afforestation over about 0.199 sq.km to ensure ecological restoration.	Based on Actual Cost to be borne by the User Agency. (Compensatory afforestation scheme over degraded forest land on twice area (with respect to extent of Impact Area) shall be prepared and implemented by Forest Dept. as a part of forest diversion proposal under FCA at the cost borne by the User Agency. CA scheme amount shall be deposited by the User Agency as a part of FCA compliance.
b)	**Low-Height Native Plantation:** The User Agency shall carry out the plantation of native low-height plant species, some of which have medicinal properties, along the Right of Way (RoW) under the transmission line, as per the approved scheme by the Forest Department under the Forest Conservation Act (FCA), if applicable, at the Agency's expense. Existing low-height plant species in the Wild Ass Sanctuary (WAS) include *Tamarix, Suaeda, Cressa, Aeluropus*, and *Salvadora*, among	As per the Actuals by the User Agency. Plantation of low-height (dwarf species; preferably those having medicinal properties) in the RoW of diverted land below transmission line shall be prepared and implemented by Forest Department as a part of forest diversion proposal under FCA at the cost borne by the User Agency. The Plantation Scheme amount shall be deposited by the User Agency as a part of FCA compliances.

	others, many of which possess medicinal properties. Additionally, species such as Gugal (Commiphora wightii) may also be considered for plantation.	
c)	**Ecological Compensation:** The company (User Agency) shall deposit the monetary value assigned to the long-term ecological impact of land diversion (i.e., Net Present Value of NPV) for the diversion of Forest and Sanctuary areas, as per the prevailing norms and rates under the Forest Conservation Act (FCA).	Based on Actual Cost to be borne by the User Agency. (NPV shall be calculated by the Forest Dept. as a part of forest diversion proposal under FCA and the amount shall be deposited by the company (User Agency) as a part of FCA compliances.

Table-6.2 Conservation measures proposed for the project area to be implemented by the Forest Department at the cost borne by the User Agency along with financial outlay

	Conservation Activity	**Amount (Rs. in lakhs)**
A	**Habitat Improvement & Restoration**	
i.	*Prosopis juliflora* control (Uprooting & Pruning)	30
ii.	Restoration/improvement of existing wetlands	15
iii.	Native Plant Nurseries	10
iv.	Management measures for area below the transmission line in WAS (plantation of low-height native plants at suitable locations)	25
v.	Construction of watet holes/havadas for supporting drinking water needs of wild ass and other wild mammals	15
vi.	Van talavdies	10
vii.	Sagar pala/Aad bandh	20
viii.	Mounds (with stone pitching) serving as dual purpose as refuge for Wild Ass and other mammals during monsoon inundation and resting/roosting spots for birds (Especially, large waterbirds)	20
ix.	Development of grass plot	25
x.	Wolf Breeding Centre	25
B	**Support Conservation & Awareness Activities**	

i.	Wildlife Rescue Centre (Equipped with Vehicles, Manpower, Instruments etc.)	30
ii.	Watch towers for wild animal observation	25
iii	Utility Vans	20
iii.	Sensitisation/Awareness Activities	15
iv.	Staff training	15
v.	Research/Monitoring	10
vi.	Nature education camp sites (strengthening)	15
C.	**Support to ecotourism promotion activities and Infrastructure**	
i.	Ecotourism facilities (Physical)	**25**
ii.	Eco-guide training for selected youth from local communities	**10**
iii.	Improvement in tourism infrastructure (interpretation/information centres at ecotourism sites and waste management arrangements)	**30**
	Grand Total (Rs. In lakhs)	**390**

Table-6.3 Proposed year-wise financial outlay schedule for conservation measures in the Project Area

	Conservation Activity	**1ST Yr. (lakh)**	**2nd Yr. (lakh)**	**3rd Yr. (lakh)**	**Total (lakh)**
A	**Habitat Improvement & Restoration**				
i.	*Prosopis juliflora* control (Uprooting & Pruning)	15	10	05	30
ii.	Restoration/improvement of existing wetlands	07	05	03	15
iii.	Native Plant Nurseries	06	03	01	10
iv.	Management measures for area below the transmission line in WAS (plantation of low-height native plants at suitable locations)	12	08	05	25
v.	Construction of water holes/havadas for supporting drinking water needs of wild ass and other wild mammals	07	05	03	15
vi.	Van talavdies	05	05	-	10
vii.	Sagar pala/Aad bandh	10	06	04	20
viii.	Mounds (with stone pitching) serving as dual purpose as refuge for Wild Ass and other mammals during monsoon inundation and resting/roosting spots for birds (Especially, large waterbirds)	10	06	04	20
ix.	Development of grass plot	10	10	05	25
x.	Wolf Breeding Centre	15	10	-	25

B	**Support Conservation & Awareness Activities**				
i.	Wildlife Rescue Centre (Equipped with Vehicles, Manpower, instruments, etc.)	20	07	03	30
ii.	Watch towers for wild animal observation	15	07	03	25
iii	Utility Vans	10	10	-	20
iv.	Sensitisation/Awareness Activities	05	05	05	15
iv.	Staff training	05	05	05	15
v.	Research/Monitoring	03	03	04	10
vi.	Nature education camp sites (strengthening)	10	05	-	15
C.	**Support to ecotourism promotion activities and Infrastructure**				
i.	Ecotourism Facilities (Physical)	**15**	**05**	**05**	**25**
ii.	Eco-guide training for selected youth from local communities	**05**	**05**	**-**	**10**
iii.	Improvement in tourism infrastructure (interpretation/information centres at ecotourism sites and waste management arrangements)	**10**	**10**	**10**	**30**
	Grand Total (Rs. In lakhs)	**195**	**130**	**65**	**390**

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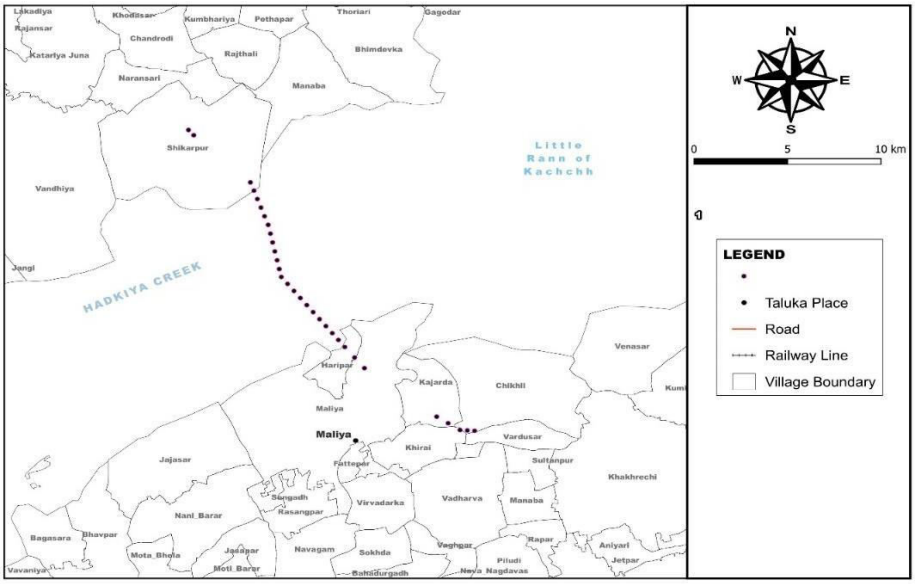
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ANNEXURE-1

Geographical points of the finalized demarcation of the proposed 765 KV D/C overhead transmission line passing through a portion of the Wild Ass Sanctuary (WAS)

1	Shikarpur	23°15'36.48"N	70°41'18.57"E
2	Shikarpur	23°15'26.26"N	70°41'28.37"E
3	Shikarpur	23°13'55.12"N	70°43'13.79"E
4	Rann of Kutch	23°13'39.07"N	70°43'20.18"E
5	Rann of Kutch	23°13'23.18"N	70°43'26.50"E
6	Rann of Kutch	23°13'6.58"N	70°43'33.10"E
7	Rann of Kutch	23°12'50.07"N	70°43'39.67"E
8	Rann of Kutch	23°12'33.53"N	70°43'46.25"E
9	Rann of Kutch	23°12'16.72"N	70°43'50.18"E
10	Rann of Kutch	23°11'59.75"N	70°43'54.15"E
11	Rann of Kutch	23°11'42.66"N	70°43'58.16"E
12	Rann of Kutch	23°11'25.70"N	70°44'2.13"E
13	Rann of Kutch	23°11'8.86"N	70°44'6.0"E
14	Rann of Kutch	23°10'53.69"N	70°44'9.62"E
15	Rann of Kutch	23°10'40.35"N	70°44'21.24"E
16	Rann of Kutch	23°10'26.73"N	70°44'33.10"E
17	Rann of Kutch	23°10'13.08"N	70°44'44.99"E
18	Rann of Kutch	23°9'59.43"N	70°44'56.87"E
19	Rann of Kutch	23°9'45.91"N	70°45'8.65"E
20	Rann of Kutch	23°9'32.29"N	70°45'20.51"E
21	Rann of Kutch	23°9'18.82"N	70°45'32.23"E
22	Rann of Kutch	23°9'5.25"N	70°45'44.05"E
23	Rann of Kutch	23°8'52.21"N	70°45'55.40"E
24	Haripar	23°8'38.61"N	70°46'7.24"E
25	Haripar	23°8'18.17"N	70°46'25.47"E
26	Maliya	23°7'57.73"N	70°46'43.69"E
27	Kajarda	23°6'23.42"N	70°48'58.20"E
28	Kajarda	23°6'10.71"N	70°49'19.57"E
29	Rann of Kutch	23°5'57.49"N	70°49'41.81"E
30	Rann of Kutch	23°5'56.52"N	70°49'55.48"E
31	Rann of Kutch	23°5'55.55"N	70°50'9.14"E

(Source: PowerGrid Corporation, Halwad Office)



Geographical coordinates (shown above) of the finalized demarcation of 765 KV D/C overhead transmission line passing through a portion of the Wild Ass Sanctuary (WAS)

ANNEXURE II

Animal Passage Plan for the Area Below 765 kV Overhead Transmission Line in WAS

The animals for which the animal passage plan for the area below the Transmission Line is developed may include wild mammals and wild birds.

Passage Plan for Mammals

The proposed 14.9 km long 765 kV Double Circuit overhead transmission line that would passing through Wild Ass Sanctuary (WAS) is configured to maintain minimum 18 metres (approx. 60 ft) of ground clearance. No wild (or even domestic) mammal that exists in the Wild Ass Sanctuary would have height even one seventh of this ground clearance (i.e., over 2.5 m). This is because, maximum height of the tallest wild mammal, viz. Nilgai can be as tall as 1.7m. The flagship mammal, viz. Indian Wild Ass is known to have maximum height of 1.4 m. Some other mammals that were recorded in the field assessment area (including the transmission line's impact area) included Wild/Feral Pig, Jackal and Indian Fox. These mammals have very low height at shoulder (i.e., fox-0.35m, jackal-0.45m and wild/feral pig-1.1 m). Thus, there is no possibility of hindrance to the movement of such wild mammals below the transmission line. Even if we consider domestic mammals like camel (4.1 m high), buffalo (1.5 m high), cow (1.4 m), Donkey (1.2 m), sheep (0.75m high) and goat (0.75 m high), no question arises about their movement getting hindered due to the transmission line. Thus, if minimum ground clearance of 18m at mid span would be maintained for the proposed transmission line passing through a portion of WAS, it would be sufficient for safe and unhindered passage/movement of mammalian species. It will neither cause hindrance to the movement nor will it cause electrocution. There would be 31 towers within the portion of the WAS through which 14.9 km long transmission line would be passing. The distance between any two consecutive towers will be about 350-400m, and therefore, they will not divide/fragment any habitat and hence they

would not affect movement of wild mammals. The entire line of 14.9 km will be constructed in multiple phases so that at any one place, the construction impact will be relatively short-termed in nature. Therefore, transmission line will not create any barrier to movement of mammalian species either in construction or operation phase of the proposed transmission line.

Anti-Climbing Devices (ACDs) for safety of mammals:

To ensure the safety of mammals (and reptiles) that may attempt to climb tower structures (such as cats and monkeys), Anti-Climbing Devices (ACDs) will be installed at the four corner gates of each tower. The gates will include two opening and two non-opening sections, all enclosed with barbed wire and appropriate accessories, designed to prevent animals from climbing the tower structure.

Barricading of Excavated Pits:

During the construction phase, all excavated pits shall be securely barricaded and fenced to prevent accidental falls of passing/moving wild (and domestic) mammals, as well as certain reptiles that are in movement.

Buzzing Sound of Transmission Line:

The transmission lines generate a continuous buzzing or humming noise due to electrical currents and corona discharge, which could potentially disrupt the movement of noise-sensitive mammalian species on the ground. However, since the transmission lines are strung on towers with a height of 72 meters, the sound intensity at ground level is expected to be minimal, reducing the likelihood of affecting animals passing beneath.

Passage Plan for Birds:

For birds that fly below the transmission lines (below18 meters of ground clearance), the strategies would indeed differ from the birds that fly at the level of the

transmission line (and for which bird diverters are commonly used to deter such birds), as the risk to these birds is less about collision with the lines themselves and more about preventing accidents related to ground-based activities or collision with lower-hanging lines in specific areas. Here's a refined approach to protect birds flying in the area below 18 meters:

1. Lowering Risk of Collision with Ground-Based Infrastructure:

Since birds flying below 18 meters are not directly at risk of hitting the transmission lines, ensuring that other ground-based elements of the transmission infrastructure (e.g., towers, pylons, or other structures) are not obstacles is important. If there is any low-lying structure or equipment within this area, marking or adjusting the placement of those elements to avoid creating hazards could be necessary.

2. Bird-Friendly Tower Designs:

Ensure that transmission towers and associated structures are not built in ways that attract birds to perch or roost, particularly in areas below 18 meters. Avoid placing structures where birds may feel inclined to land near the lower parts of the towers, as this can expose them to risks of electrocution or falling.

Consider adding anti-perching devices or bird deterrents on the lower sections of the towers to prevent birds from roosting or landing in unsafe areas.

ANNEXURE III

Management Plan For the Area Below 765kV Overhead Transmission Line

Management Plan for Area Below Transmission Line

A. Need For The Management Plan Below Transmission Line

As per Minutes of 79th Meeting of the Standing Committee of National Board for Wildlife issued by the MoEF&CC (F.No.6/88/2024-WL, dated: 28th August, 2024), "Management plan for the area below the transmission line" is required to be prepared along with animal passage plan(point 3). Animal passage plan (for mammals and birds) has already be provided in previous section, so in this section Management plan for the area below the transmission line passing through a portion of Wild Ass Sanctuary(WAS) is provided here.

Management Plan For Area Below Transmission Line Passing Through Wild Ass Sanctuary:

Scope & Objective of The Management Plan

Scope: Since about 14.9 km of the transmission line has been proposed to pass through a portion of the Wild Ass Sanctuary (WAS) and requires clearance from Standing Committee of NBWL, hence present management plan below the transmission line is prepared for 14.9 km length of the proposed transmission line.

Objectives:

- To restore the disturbed & damaged vegetation due to construction of transmission line in RoW falling in the WAS.
- To maintain vegetation below transmission line in RoW falling in the WAS, to avoid any electrical hazard

Approach & Methods For Management Plan

The present management plan is developed based on the project details (transmission line configuration etc.) and the existing vegetation types, habitat conditions etc. The species and maintenance measures are prescribed in view of the above-mentioned facts for the project and the biogeographic.

Baseline Vegetation Status of the area in Proposed RoW

The proposed line falls in western/south-western portion of the Wild Ass Sanctuary (WAS). The area has typical halophytic, xerophytic, hydrophytic and mesophytic vegetation including several native species of plants (mainly shrub/scrubs, herbs and grasses). Common species include *Prosopis juliflora, Prosopis cineraria, Salvadora, Capparis decidua, Acacia sps., Suaeda nudiflora, Cressa cretica, Tamarix* sp., *Aeluropus lagopoides* etc. As per the forest classification of Champion and Seth (1968), this area has predominance of Desert Thorn Forests. Existing habitat types in the project area include dry and inundated saline mudflats, scrub-herb-grass covered land adjacent to the mudflat, salt-work areas, castor cultivation area, and marshy/reedy freshwater ponds.

Proposed Restoration In RoW

The RoW area in the WAS will be required to be restored post-construction of the proposed transmission line. The restoration activities shall include plantation of native dwarf species in RoW growing in sanctuary area. The species to be planted shall are carefully selected using transmission line configuration and habitat characteristics.

Plantation Species Height

The proposed transmission line having ground clearance of 18.0 at midspan. As per FCA Guideline (F.N.5-2/2017-FC dated 28-03-2019), for 765 kV transmission line minimum clearance maintained between conductor & trees is 9.0 meters. Therefore, the height of the vegetation/plant species proposed for restoration under the transmission line

could be ideally less than 9.0 meters from the ground. However, keeping in mind the characteristics of landscape i.e., waterlogging, high-wind area etc. the dwarf species up to maximum 5-to-6-meter heights can be considered for plantation in WLS area falling under RoW of transmission line to avoid any electrical hazard. Shrub/scrub(barring *Prosopis juliflora*), herbs and grasses mentioned earlier (under Baseline Vegetation Status of the area in Proposed RoW) should be preferred.

Species Prescribed For Row Restoration

As per prevailing guidelines, plantation of native/local dwarf species shall be carried out for restoration of the RoW below transmission lines. Since there are variations in the habitat types along the entire length of the proposed transmission line in WAS, each section of the area should be wisely prescribed with different species for restoration of the area. As per Mishra (2023), total 35 rows of plants with maximum height of 6.0 meters at 2x2 meters could be planted in the RoW. In view of the available plant height limit and the habitat/soil conditions in the project area, following species may be used for restoration below the transmission line: *Salvadora spp., Tamarix* sp., *Prosopis cineraria, Acacia spp., Balanites sp., Capparis decidua, Suaeda nudiflora, Cressa cretica, Aeluropus lagopoides* etc.

Implementing Agency & Period

The plan is prepared for 10 years including 7 years maintenance for restoration activities post-construction period during the operational phase of transmission line. Since this plan is prepared for the areas of RoW falling in Wild Ass Sanctuary (WAS) area, it would be implemented by the concerned forest division. The payment for the same shall be deposited by the user agency as per the directions of the concerned forest authorities.

Cost of Species Plantation Below Transmission Line In WAS

For meeting the cost of plantation of native/local species below transmission line appropriate payment shall be deposited by the user agency as per the directions of the concerned forest /wildlife authorities.

Maintenance of the Transmission Line

The project proponent (user agency) has applied for diversion of land for use of RoW of forests and sanctuary land. They would continue to operate in this area for regular maintenance, operations, monitoring purposes as per term and condition of respective clearances. User agency would ensure that there are no additional impacts on the restored areas are done during their regular operation and maintenance activity.

Other important measures to be adopted by the User Agency (Project Proponent) based on MoEFCC's guidelines [mentioned in the minutes of the 79th Meeting of the Standing Committee of National Board for Wild Life (Source: Letter F.No. WL-6/88/2024-WL dated 23rd August 2024)]:

1. The User Agency shall not violate any provision of the Wildlife (Protection) Act, 1972.
2. The User Agency shall not harm or destroy wildlife habitat and flora and fauna of the Sanctuary.
3. The User Agency shall not use the area for any work other than the work permitted.
4. The User Agency shall not establish temporary or permanent labour camps in the Sanctuary.
5. The User Agency or its contractor shall not create any fire places inside the Sanctuary
6. The User Agency shall make it sure that all the material required for the work shall be prepared outside the Sanctuary.
7. The User Agency shall carry out work in the Sanctuary only in the day time from 8 am to 6 pm.

8. Approval under Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980, wherever required, shall be obtained by User Agency for the use of forest land.
9. The User Agency shall deposit NPV for the use of land of Protected Area as per the existing rates before initiating any work on the land.
10. The User Agency shall restore the land in its original form after completion of the work.