Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS) Project, Bhutan

Gelephu-Tareythang Road

Environmental and Social Impact Assessment Report (ESIA) – Executive Summary

Department of Surface Transport (DoST), Ministry of Infrastructure and Transport (MoIT), Royal Government of Bhutan

DATE
March 2025
(Revised Version)

[The image on the front page shows the Mau River in the project area]

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ABBREVIATIONS AND ACRONYMS

ACCESS	Accelerating Transport and Trade Connectivity in Eastern South Asia Project – Bhutan
AoA	Area of Analysis
BMP	Biodiversity Management Plan
CIA	Cumulative Impact Assessment
DoFPS	Department of Forests and Park Services
DoST	Department of Surface Transport
EC	Environmental Clearance
EHS	Environmental, Health, and Safety
E&S	Environmental and Social
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
GBV	Gender-Based Violence
GIIP	Good International Industry Practice
GMC	Gelephu Mindfulness City
GRM	Grievance Redress Mechanism
G-T Road	Gelephu–Tareythang Road
HEC	Human-Elephant Conflict
IAS	Invasive Alien Species
LMP	Labor Management Procedures
masl	Meters above sea level
MoIT	Ministry of Infrastructure and Transport
OHS	Occupational Health and Safety
OHSMP	Occupational Health and Safety Management Plan
PAH	Project Affected Household
PAP	Project Affected Person
PMU	Project Management Unit
PPE	Personal Protective Equipment
PWS	Phibsoo Wildlife Sanctuary
rCIA	Rapid Cumulative Impact Assessment
ROW	Right of Way
RMNP	Royal Manas National Park
SEA/SH	Sexual Exploitation, Abuse, and Sexual Harassment
SEP	Stakeholder Engagement Plan
SEWH	Southern East-West Highway
VEC	Valued Environmental and Social Component
WBG	World Bank Group

1. INTRODUCTION

This document summarizes the Environmental and Social Impact Assessment (ESIA) for the proposed 14 km Gelephu – Tareythang Road Project (G-T Road or the Project) in Bhutan. This road is a subcomponent of the Accelerating Transport and Trade Connectivity in Eastern South Asia Bhutan Project (ACCESS), funded by the World Bank, to improve trade and transport efficiency along selected corridors in Bhutan.

1.1 PROJECT DESCRIPTION

The G-T Road is part of the southern east-west highway (SEWH), serving as a key transport link that connects Gelephu's airport, dry port, and multimodal transport hub. The road is located in Sarpang *Dzongkhag* (district), centrally positioned in southern Bhutan. The proposed alignment crosses the lower-lying natural terrain of Sarpang, and it passes through parts of Gelephu *Thromde* (municipality) and partly through three (03) *Gewogs* (rural administrative blocks): Chhuzanggang Gewog, Umling Gewog and Tareythang Gewog. The location of the road is shown in **Figure E1**.

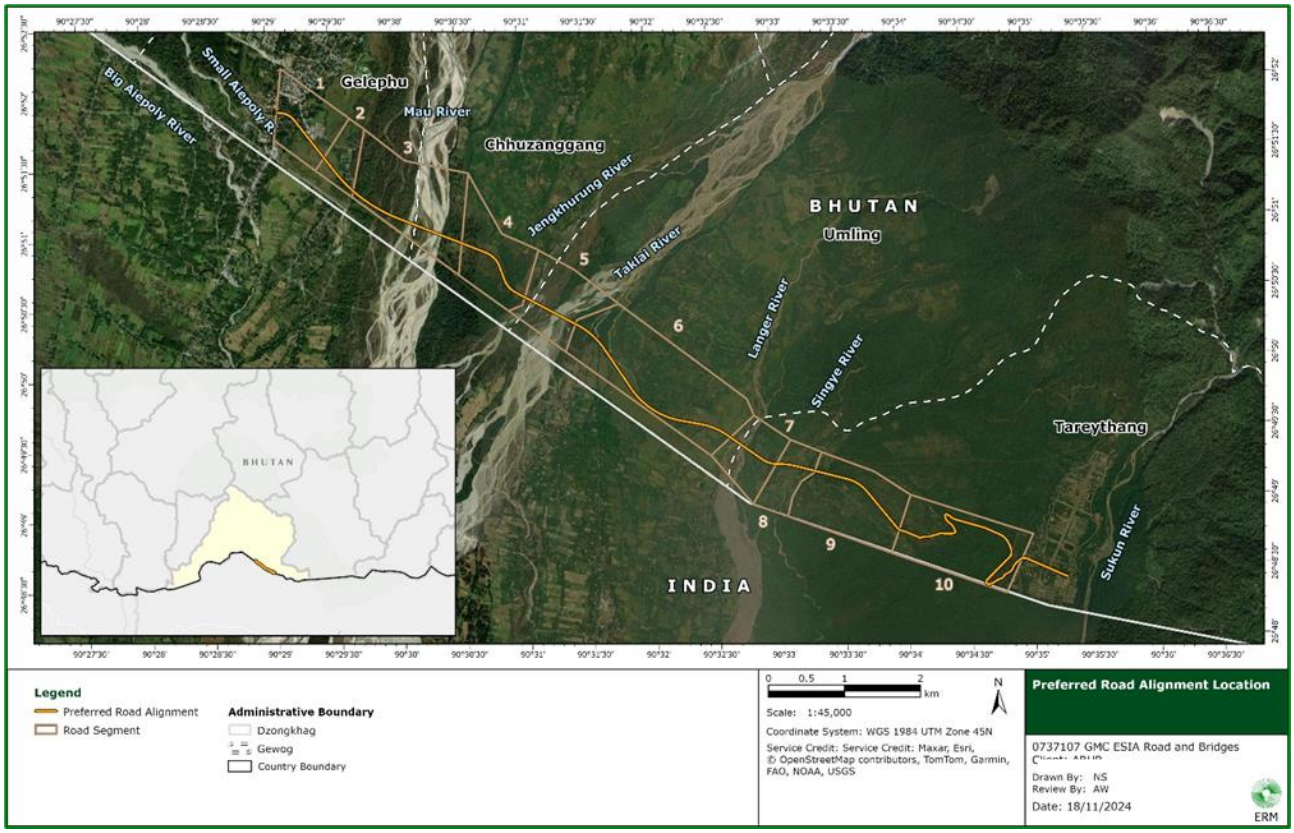

FIGURE E1: LOCATION OF THE G-T ROAD

The G-T Road includes the following components:

- **Road Works**: Construction of approximately 10.2 km of new greenfield highway (3.8 km section of this highway near Gelephu consists of dual carriageway and 9.8 km section is single carriageway) and a 3.4 km of widening existing highway at the tail end of the section near Tareythang.
    - **4-Lane Dual carriageway**: The total road width is 18 meters, with each side of the dual carriageway having a width of 7.5 meters, comprising two lanes, each

3.75 meters wide. A central median, 2.0 meters wide, separates the opposing directions of traffic and will be landscaped. This road design includes 0.5-meter-wide shoulders on either side of the carriageways. In addition, a 3.0-meter-wide cycleway or footpath on one side of the road is included to provide a secure pathway for pedestrians and cyclists. The right of way (ROW) of this road is 40 m, and the design speed is 60 km/hr.

- **2-Lane Single carriageway**: The road width is 8.5 meters, with one 3.5-meter lane in each direction and a 0.5-meter shoulder on each side. With the inclusion of a cycleway/footpath, the total road width is 11.5 meters. The ROW is 30m, and the design speed is 60 km/hr.

- **Four Bridges**:
  - The Mau River bridge design spans 1,005 meters, crossing both the river and floodplains, including a 250-meter elephant corridor with a vertical clearance of 8.15 meters (minimum 5.8 meters at the East abutment). The bridge will support two lanes of traffic in each direction and provide pedestrian access on one side. The design features a concrete box girder deck with 80-meter spans over the river and 50-meter spans on each side.
  - The other three bridges include: the Jengkhurung River and Taklai River Bridge (780 meters), the Langer River Bridge (390 meters) and the Singye River Bridge (382.5 meters). These bridges accommodate one traffic lane in each direction, including pedestrian access on one side. The bridge design features a concrete box girder deck with 60-meter spans and a consistent deck depth of 3 meters. The proposed form of this bridge is a concrete box girder with typical spans of 60 m in length. Those bridges have vertical clearances of 5-15 meters to allow movement of elephants.
- **River Training Works**: To control erosion on the riverbanks and limit the extent of flooding, and based on hydrological modelling conducted for the project, gabion basket walls are proposed upstream and downstream of the highway at all bridge crossings. For the Mau River, river training measures will extend approximately 300 meters upstream and 100 meters downstream on the eastern side, 500 meters upstream, and 250 meters downstream on the western side. For the other rivers, river training is planned for 400 meters upstream and 100 meters downstream.
- **Two Interchanges**: The 10.2 km greenfield alignment will connect to existing roads through two interchanges (T-junctions) at each end in Gelephu and Tareythang. Provisions are included for future interchanges with the Gelephu Mindfulness City (GMC) developments at Chhuzanggang Gewog and Umling Gewog.
- **Culverts and Small Bridge Crossings**: A minor bridge (80 long near the Gelephu STP plant) and culverts for cross-drainage along the alignment will also be built.
- **Ancillary Facilities**: A number of ancillary facilities will be required, including haul roads, quarry sites, crushing and batching plants, borrow pits, work areas, worker camps, and disposal areas.

2. LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 APPLICABLE LEGISLATION TO THE PROJECT

Bhutan's legal framework requires that the highway projects adhere to stringent environmental and social standards as defined by the following key regulations:

- Environmental Assessment (EA) Act, 2000: Mandates the preparation of Environmental Impact Assessments (EIA) for highway construction projects to evaluate and mitigate environmental impacts. Under this act, an EIA is to be submitted to the Department of Environment and Climate Change (DoECC) for the G-T Road for Environmental Clearance (EC).
- National Environmental Protection Act 2007 is a general legislation that provides a foundational basis for the country's environmental protection policies and legislation and strengthens the institutional framework for environmental protection.
- Forest and Nature Conservation Act, 2023: This act governs the protection of forested areas and biodiversity, with provisions to conserve critical habitats within project areas.
- Labour and Employment Act, 2007: Ensures the protection of labor rights, health, and safety during construction and operational phases.
- Land Act of Bhutan, 2007: Governs land acquisition, compensation, and related land management requirements.

To meet these legislative requirements, the implementing agency, the Department of Surface Transport (DoST), must prepare and submit the necessary applications and assessments as specified in each relevant law and regulation.

Bhutan is also a signatory and party to Multilateral Environmental Agreements (MEAs) governing climate change, ozone depletion, biodiversity conservation, cultural heritage, human rights, and hazardous waste management. In particular, Bhutan and India have a strong relationship with cooperation in the field of biodiversity and environmental conservation, including Memorandums of Understanding (MoU) on the Field of Forestry and Biodiversity, MoU for Conservation of the Manas Tiger Reserve, and the South Asia Cooperative Environment Programme (SACEP) 1981.

2.2 APPLICABLE WORLD BANK ENVIRONMENTAL AND SOCIAL FRAMEWORK

All new projects funded by the World Bank through Investment Project Financing must adhere to the ESF[1]. ESF sets out the ten Environmental and Social Standards (ESS) that Borrowers must follow throughout the project life cycle. The ESSs relevant to the Project include:

- ESS 1. Assessment and Management of Environmental and Social Risks and Impacts: This standard applies to the G–T Road as it is a high-risk project, including approximately 10km of a greenfield road, requiring a comprehensive ESIA.
- ESS 2. Labor and Working Conditions: ESS 2 applies due to the large workforce anticipated during construction, with about 2,500 workers, including a high proportion of foreign labor.

[1] World Bank Environmental and Social Management Framework (https://thedocs.worldbank.org/en/doc/837721522762050108-0290022018/original/ESFFramework.pdf)

- ESS 3. Resource Efficiency and Pollution Prevention and Management: ESS 3 is relevant due to significant demand for construction materials and the generation of waste during the construction phase, necessitating resource efficiency measures and pollution prevention strategies to minimize environmental impacts.
- ESS 4. Community Health and Safety: This standard is relevant due to potential community health and safety risks arising from the construction activities and influx of workers, including Sexual Exploitation and Abuse/Sexual Harassment (SEA/SH).
- ESS 5. Land Acquisition, Restrictions on Land Use and Involuntary Resettlement: ESS 5 is relevant to the Project due to the land acquisition of 149 households, including the displacement of 34 households.
- ESS 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources: ESS6 applies given the Project's location within critical habitat (triggered due to the presence of the Asian Elephant and Golden Langur).
- ESS 7. Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities: A detailed screening was conducted to assess the applicability of ESS 7. Based on comprehensive consultations, site assessments, and demographic analyses, it was determined that ESS 7 is not relevant to the Project.
- ESS 8. Cultural Heritage: The standard is relevant to protect cultural heritage from project impacts.
- ESS 10. Stakeholder Engagement and Information Disclosure: DoST prepared a Stakeholder Engagement Plan (SEP) to address the requirements of ESS 10 and carried out extensive consultations during the Project preparation and on the draft ESIA and SEP.

In addition, the following World Bank Group Environmental Health and Safety (EHS) Guidelines and Good Practice Notes are considered in the development of Environmental and Social (E&S) assessments and management plans,

- General EHS Guidelines[2] and EHS Guidelines for Toll Roads[3]
- Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets[4], and
- and World Bank good practice and guidance notes on Labor Influx[5], Gender[6], and addressing Gender-based Violence (GBV)[7] and Sexual Exploitation, Abuse, and Sexual Harassment (SEA/SH) risks[8].

[2] WBG EHS Guidelines - General (https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf)
[3] WBG EHS Guidelines – Toll Roads (https://www.ifc.org/content/dam/ifc/doc/2000/2007-toll-roads-ehs-guidelines-en.pdf)
[4]IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (https://www.ifc.org/content/dam/ifc/doc/mgrt/ifc-goodpracticehandbook-cumulativeimpactassessment.pdf)
[5] https://thedocs.worldbank.org/en/doc/fc074f5b6cc1621dc65675bf83c9d0b8-0290032021/original/ESF-Labor-Influx-Good-Practice-Note.pdf
[6] https://thedocs.worldbank.org/en/doc/158041571230608289-0290022019/original/GoodPracticeNoteGender.pdf
[7] https://ppp.worldbank.org/public-private-partnership/sites/default/files/2022-02/Environment-and-Social-Framework-ESF-Good-Practice-Note-on-Gender-based-Violence-English.pdf
[8] https://thedocs.worldbank.org/en/doc/0e0825d39c28f61080380c6be9c40811-0290032022/original/SEA-SH-GPN-for-HD-Operations-CESSO-Issue-Version-September-26-2022.pdf

3. ANALYSIS OF ALTERNATIVES

Without Project Alternative. The "Without Project Alternative" involves retaining the existing 45 km road between Gelephu and Tareythang without significant upgrades, leaving current challenges unresolved. This mountainous, narrow corridor, only 3 to 5.5m wide, serves as a critical lifeline for approximately 11,346 residents in multiple gewogs but offers limited reliability and safety. The maximum travel speed of 50 km/h, combined with frequent landslides, flooding, and sharp turns, necessitates nearly two hours of driving time. Visibility issues at multiple stretches and susceptibility to monsoon disruptions further undermine its viability as a dependable route. The existing alignment's limited capacity also constrains broader regional development, particularly in light of the Gelephu Mindfulness City (GMC)[9] vision and potential cross-border trade with India and Bangladesh. Safety concerns, such as increased accident likelihood from narrow lanes and poor visibility, would go unaddressed, posing social and economic burdens. Ultimately, pursuing the No Project Alternative would mean continuing constraints on local economic opportunities and restricted connectivity, undermining Bhutan's goals of promoting sustainable growth and broader market access.

Alternate Alignments. Three alignment options were considered within a 1 km-wide corridor between the Indian border and steep mountain slopes. These three alignments (northern, southern, and central routes) were evaluated for environmental, social, and engineering factors using a multi-criteria analysis. The preferred route is a combination of the southern route, which transitions to the northern route to fit into the existing road. This preferred alignment minimizes habitat loss by avoiding a dense forest patch near the Indian border, reducing environmental disturbances and providing a sufficiently wide corridor for east-west elephant movement, thereby maintaining wildlife connectivity. It also minimizes river crossings by selecting the shortest possible route over the Jengkhurung and Taklai Rivers, reducing construction costs and environmental impacts. By following the contours of the southern edge of higher ground in Umling, the route reduces steep gradients and level differences, optimizing terrain transitions, road stability, and overall road safety.

Alternate Bridge Designs. Bridge designs were a key consideration among the design alternatives. For the Mau River Crossing, a concrete box girder was chosen over the steel truss due to the greater reliance on local materials, lower construction complexity and lower cost. For the Jengkhurung, Taklai, Langer, and Singye Rivers Crossings, the concrete box girder, with a typical span of 60m, was preferred for shorter channel crossings due to reduced hydraulic impact, greater robustness, and easier maintenance over the concrete beam and slab with 40m spans**.**

Alternate Wildlife Crossings. The entire southern plains of Bhutan serve as corridors for Asian elephants, leaving no viable alternative for the Project that would avoid impacting these wildlife corridors. For the elephant crossing at the Mau River bridge, alternatives were evaluated based on bridge length, vertical clearance, and alignment to ensure adequate passage within the natural elephant corridor. Options considered included varying the length and height of the bridge to balance floodplain span requirements with adequate clearance for elephants on the eastern riverbank. Ultimately, the selected design incorporated a 250-meter-wide corridor with an average vertical clearance of 8.15 meters, ensuring that the bridge structure would not impede

[9] The GMC is a proposed economic and urban development initiative in southern Bhutan, envisioned as a sustainable, smart city integrating trade, industry, and innovation hubs while promoting eco-friendly infrastructure, cross-border connectivity, and mindful living principles to enhance regional economic growth and socio-cultural harmony.

elephant movement. This option was favored for its effectiveness in providing both flood management and wildlife passage.

4. BASELINE E&S CONDITIONS

4.1 PHYSICAL ENVIRONMENT

Physiography. The G-T Road project area is located within the subtropical foothills of southern Bhutan, in Sarpang District, near the border with India. The terrain consists of floodplains, river terraces, and gently rolling hills, with elevations ranging from approximately 150 meters to 1,500 meters above sea level. The proposed G-T Road alignment passes through low-lying plains and floodplains of several seasonal braided rivers, including the Mau, Jengkhurung, Taklai, Langer, and Singye, and the rolling hills. An elevation along the proposed road varies from about 200 m above sea level (masl) in the plains to 280 ml in hilly terrain. East of the Taklai River, elevations rise steeply from 220 m to 280 m, while Tareythang features a ridge descending from 280 m to 230 m.

Climate. Influenced by the southwest monsoon, Gelephu has a warm, humid climate with heavy rainfall from June to September. Annual temperatures range between 20°C and 25°C, with the summer months of July-September usually around 27°C though extremes of 43°C have been recorded. Winter months (November-February) typically have temperatures of 18-23°C, though temperatures down to 6°C have been recorded. The rainfall patterns of Bhutan are determined by the Southwest monsoon circulation, with a seasonal cycle that results in wet summers that extend from June to September. The average yearly precipitation in the southern foothills ranges between 2,500 and 5,500 mm, with about 72% of the total yearly precipitation occurring between June and September.

Floods and Natural Hazards. The Project area faces natural hazards due to its location and environment, including seismic activity, heavy monsoon rainfall from June to September causing floods, and severe landslides due to the presence of loose sediments. The region's sub-tropical climate supports diverse vegetation, such as chir pine and broadleaf forests, which makes occasional forest fires a potential risk.

Hydrology. The rivers in the Project area include the Mau, Jengkhurung, Taklai, Langer, and Singye. The rivers in the project area are mainly braided rivers with shifting channels and sand/boulder deposits. The Mau River, a significant tributary originating from Bhutan's Black Mountains, joins the Manas River in Assam. The G-T Road lies within the Aiechhu Basin, a subbasin of the Brahmaputra River, which generates 6,989 million m^3 in annual flow and extends to the Indian border. Seasonal variations in river discharges are notable, with the Mau River experiencing peak flows during the monsoon season, reaching 1,500–3,300 m^3/s, and significantly lower flows between 40 and 135 m^3/s in the dry season, typically from December to March.

Water and Soil Quality. Surface water sampling was conducted on August 20-21, 2024 (wet season) and November 12-13, 2024 (dry season) at five designated locations. Groundwater samples were also collected on the same dates at two sites. The analysis is compared with Bhutan's national standards and WHO guidelines. The total dissolved solids (TDS) in the surface water ranges from 73 to 89 mg/L and in the groundwater ranges from 65 to 74 mg/L. All water quality parameters were within acceptable standards. Soil quality assessments were carried out at seven locations, with samples taken from a depth of 10-15 cm to evaluate soil texture, fertility, and cation exchange capacity. These assessments confirmed compliance with international

standards and USEPA's Eco-SSLs for mammals. Sediment analysis from the Mau River indicated a high sand content, suggesting an increased risk of soil erosion.

Air Quality. Air quality monitoring in Gelephu was conducted over 23 days during the wet season (August 2024) and 31 days during the dry season (December 8, 2024 - January 7, 2025) at three locations. Measurements for PM10 and PM2.5 indicated that levels were within the World Bank Group's EHS Guidelines, with average concentrations of 4.14 µg/m³ and 4.73 µg/m³, respectively, significantly below permissible limits. Monitoring for NO_2, SO_2, and NO_x was undertaken using diffusion tubes for approximately 30 days across six locations, with recorded values of 3.21 µg/m³ (NO_2), 3.4 µg/m³ (NO_x), and 0.242 µg/m³ (SO_2), all remaining below standard thresholds. The highest pollution levels were recorded in Gelephu Thromde, particularly during the dry season, due to windblown dust from the Mau River. Overall, the ambient air quality meets acceptable standards for human health, and the airshed is not considered degraded.

Noise Quality. Baseline noise measurements were taken at seven locations, and results indicated compliance with Bhutan's national standards and the WBG's EHS Guidelines. Baseline noise measurements were taken at seven locations, and the results indicated compliance with Bhutan's national standards and WBG's EHS Guidelines. Noise levels varied by location, with residential outskirts and rural areas maintaining acceptable levels while industrial zones adhered to higher permissible thresholds.

4.2 BIODIVERSITY BASELINE

Area of Analysis (AoA). The geographic area of influence for biodiversity assessment has been developed separately for terrestrial and aquatic ecosystems and following good international industry practices.

The terrestrial AoA includes areas where cumulative impacts to biodiversity are envisaged to be significant, typically beyond the Area of Impact, and is commensurate with the scale of relevant practical conservation management activities.

The aquatic AOA covers both upstream and downstream sections of the Mau and Taklai Rivers. Siltation during high-water seasons, like the monsoon, could temporarily hinder the migration of species to upstream spawning sites. The delineation considered various habitat niches used by local fish species, such as smaller hill streams for spawning, deep waters, backwater pools, secondary channels, and areas with gravel and boulders.

Ecological Context. The Project's footprint is predominantly covered by agriculture and forests, with other land-use types occupying much smaller portions. While the forest has experienced minor disturbances, it continues to support a natural assemblage of species and maintains its natural ecological function.

Dominating much of the northern part of the project area, sub-tropical forests are found at altitudes ranging from 150 to 398 masl. The sub-tropical forests have dense canopy covers with a rich diversity of evergreen and deciduous trees, shrubs, and thick undergrowth.

Interspersed within the forests and riverbanks, grasslands are composed primarily of tall grasses that are adapted to periodic disturbances like flooding, grazing, and fires. Grasslands are crucial habitats for herbivores as well as predators, but many grasslands have become infested with invasive alien plant species.

Natural/ Modified Habitat. The project area is predominantly covered by forests (98.94%), and agriculture (0.33%), built-up areas (0.01%), with other land-use types occupying much

smaller portions, i.e., bare ground, built-up, successional rangeland, and riparian rangeland (grassland). Anthropogenic impacts in the region are considered pervasive. This has led to extensive agriculture and human settlements that have fragmented the natural habitats. Even though the western forest, contiguous with Phibsoo Wildlife Sanctuary, and southern forest, contiguous with Royal Manas National Park, have experienced disturbances, they retain their species composition, and their primary ecological functions remain intact and can be considered Natural Habitats as per the ESS6 definition.

Legally Protected Areas and Internationally Recognized Areas of High Biodiversity Value. The Project is located in proximity to several legally protected areas and internationally recognized areas of high biodiversity value, as defined under ESS6; however, the protected areas with particular relevance to the Project are the Phibsoo Wildlife Sanctuary (PWS, within Bhutan, 30 km east of the Project Road) and Royal Manas National Park, Bhutan (RMNP, within Bhutan, <1 km west of the Project Road).

Species. The terrestrial and aquatic baseline surveys yielded the following findings:

- **Flora:** The flora survey found 127 species of trees and shrubs, 69 species of herbs, 59 species of regenerating plants, and 37 species of epiphytes. Nine (09) plants were identified as invasive alien species.
- **Birds:** The avifauna survey findings suggest that the study area supports a diversity of bird species, with a total of 158 bird species recorded. No endangered birds were recorded.
- **Herpetofauna:** the presence of 12 amphibian species and 39 reptile species was recorded, which included one IUCN endangered species, Tricarinate Hill Turtle (*Melanochelys tricarinata)*.
- **Terrestrial mammal:** Camera trapping survey and transect surveys recorded t 13 mammal species, which include the following species of conservation:
    - Asian Elephant (*Elephas maximus*, IUCN EN),
    - Gee's Golden Langur (*Trachypithecus geei*, IUCN EN and endemic to Bhutan).
    - Hog Deer (*Axis porcinus*, IUCN EN),
    - Dhole (*Cuon alpinus*, IUCN EN),
    - Bengal Tiger (*Panthera tigris ssp. Tigris*, EN)
- **Fish:** Fish surveys recorded 32 species, with 29 species in Mau River and 24 species in Taklai river.

Critical Habitat. A critical habitat is defined as an area with very high biodiversity value that has been assessed for the AoA described above. A Critical Habitat Assessment was conducted using the five criteria provided within ESS6, which identified the following critical habitat features:

- **Asian Elephant:** The AoA supports more than 6% of the national elephant population, which is significant, and elephants are recognized as a critical habitat feature based on ESS6 critical habitat criterion (a). The impacts of the Project and the cumulative impact of the GMC area will adversely affect the elephant population over a wider area, which triggers ESS6 net gain requirements.
- **Gee's Golden Langur**: The AoA supports a population of 23 to 93 individuals of Golden Langur. This represents approx. 1.5% and 1.7% of the global and national populations, respectively, which is significant. This species is also restricted and recognized as a critical habitat feature based on ESS6 critical habitat criteria (a) and (b). Studies in India have shown this species is vulnerable to gene isolation as a consequence of population

fragmentation, which can lead to local extinction. Habitat fragmentation as a result of the project can adversely affect this species and trigger ESS6 net gain requirements.

- **Habitat Connectivity:** The AoA is central within the range of elephants in Bhutan. An analysis of movement data for two elephants revealed that the Project area and GMC area are important for connecting the elephant populations with those in adjacent protected areas, namely PWS and RMNP. The Project area, therefore, provides an important ecological function and potentially triggers ESS6 critical habitat criteria (e), but no additional net gains are necessary beyond the above requirements for Asian Elephant and Golden Langur.

4.3 SOCIO-ECONOMIC BASELINE

Demography. The Project is located in Sarpang District in the southern part of Bhutan, bordering the Indian state of Assam. The project area comprised Gelephu *Thromde* and six (06) *Gewogs* Gelephu *Gewog*, Samtenling *Gewog*, Umling *Gewog*, Chhuzanggang *Gewog*, Serzhong *Gewog*, and Tareythang *Gewog, covering* a population of approximately 25,869 people across 5,881 households. This accounts for 56% of Sarpang district's population, with an average household size of four people.

Socio-cultural Dynamics. The project area is home to multiple ethnic and linguistic groups, with Buddhism being the predominant religion, followed by Hinduism. The main ethnic groups include Ngalong, Sharchop, Lhotsham, Khengpa, Brami, Brokpa, and Saktenpa, each contributing to the area's rich linguistic and cultural fabric. While traditional identities remain strong, generational shifts, migration, and intermarriage have contributed to cultural blending and the adoption of widely used common languages like Lhotshamkha, Sharchopkha and Dzongkha. Migration patterns, including urban-to-urban and rural-to-urban movements, continue to reshape social structures.

Economics and Livelihoods. The highest urban density in the project area is in Gelephu Thromde, which has many commercial establishments, such as shops, small businesses, and service providers. Smaller urban centers like Umling and Tareythang have fewer businesses but accommodate pop-up stalls and micro-enterprises. Agriculture remains the primary livelihood in rural areas, particularly in Chhuzanggang and Umling, where areca nut is the dominant cash crop. Other major crops include paddy, maize, millet, ginger, and rice, supported by community-based cooperatives and farmer groups.

The labor force participation rate in Sarpang District is 63.4%, with men (68.3%) having higher participation than women (57.9%). Vulnerable employment is a critical issue, with 82.7% of women and 61.7% of men engaged in low-paying, informal jobs. The youth unemployment rate is 15.9%, significantly higher than the national 3.5% unemployment rate, contributing to high out-migration (approximately 15,000 Bhutanese youth emigrated in 2022). Influxes of lower-wage Indian laborers are common, facilitated by contractor-led employment systems. The poverty incidence in Sarpang District is 5%, while Gelephu Thromde records a slightly higher rate at 7.8%

Social and Physical Infrastructure. Bhutan has a free healthcare system that covers almost 90% of the population within 2 hours of travel distance, and the health infrastructure includes primary, secondary, and tertiary facilities. The Central Regional Referral Hospital in Gelephu Thromde is a key facility supported by other hospitals and clinics. Major health concerns are non-communicable diseases, high alcohol consumption, and rising rates of Hepatitis B and kidney issues. The project area has several public schools and vocational training institutions but lacks a local college. While electricity and internet access are generally good, water supply is

challenging, especially in dry seasons. However, women in rural areas face vulnerabilities and lack of opportunities to access comprehensive health services, particularly those that cater specifically to women's sexual and reproductive needs. Women from rural areas have a 17% higher unmet need for family planning than those from urban areas.

In Bhutan, the primary level Net Primary Enrolment Rate is almost 100% for both boys and girls. The survival rate for girls at the primary level stands at 95.3%, exceeding that of boys at 86.5%. Furthermore, there is equal representation of girls at the secondary level; however, according to World Bank 2022 data, only 65.8% of girls and 53.6% of boys complete lower secondary school. Despite such parity at the primary and secondary level, the enrolment of girls at the tertiary level remains low (19.1% as compared to 23.7% of boys). Consultations revealed that as the level of education increases, girls' participation declines, with dropout rates being relatively high due to reasons such as poverty, early pregnancy, and domestic responsibilities. Girls tend to pursue general education more than technical or professional courses.

Cultural Heritage. A total of 26 cultural heritage resources were identified, including 17 temples, monasteries, and other religious structures significant to both the Buddhist and Hindu religions (such as Tharpaling Dratshang and Hindu Mandir). Community forests also hold cultural significance, with sacred spaces such as Devithans (sacred groves) and sacred trees serving as places of worship. Fifteen community forests cover approximately 1,840.59 hectares in the project area. Community forests are formally designated as per the Forest and Nature Conservation Act 2023. Local communities celebrate around 10 major festivals, ranging from gewog-level gatherings to larger national events.

Gender. The area has a higher male-to-female ratio, with 112 males per 100 females, compared to Sarpang District's overall ratio of 109.2. Gender disparities persist, particularly in literacy (66% for women vs. 79% for men), digital access, wages, and leadership roles. Women are overrepresented in subsistence employment, often engaging in unpaid labor, small enterprises, and informal work. Gender-based violence (GBV) is a growing concern, with 2 in 5 Bhutanese women experiencing violence from intimate partners. According to a 2021 report, around 900 domestic violence cases were reported to the National Commission for Women and Children (NCWC) between 2016 and 2021. Due to stigma and fear of retaliation, many cases go unreported. Alcohol abuse has been identified as a major contributing factor to domestic violence. Traditional gender norms and roles still influence women's mobility, decision-making, and economic participation.

Indigenous Peoples. The assessment by the World Bank did not find any distinct social and cultural groups in the project area that meet all the criteria of ESS7. Various ethnic groups have migrated to the area since 1976, but they identify more with their geographical origins rather than unique collective attachments. While certain groups, such as the Merak-Saktenpa, Brahmi, Kheng, and Rai, exhibit varying degrees of self-identification, they do not show exclusive territorial or resource-based attachments. However, a general connection to natural resources—such as community forests, sacred rocks, trees, and rivers—is observed across all communities as part of mainstream practices. Many cultural traditions are maintained within homes, while larger cultural expressions are integrated into mainstream society. Some groups travel back to their places of origin to uphold traditional practices.

5. E&S RISKS/IMPACTS AND MITIGATION MEASURES

5.1 SUMMARY OF OVERALL IMPACTS AND RISKS.

Overall E&S Impacts and Risks of the G-T Road: The E&S risk category of the G-T Road is assessed as high as the World Bank ESF based on the potential impacts and risks on the environment and community and the magnitude and capacity of DoST to manage these impacts. An assessment of these impacts and proposed mitigation measures are summarized in the following sections. The significance of these impacts, both before and after (residual) the implementation of mitigation measures, is assessed based on their severity (categorized as high, substantial, moderate, or low, and color-coded) and is presented in Table 1 across the construction and operational stages of Project implementation.

Mitigation Hierarchy: DoST has conducted a comprehensive E&S assessment and applied the mitigation hierarchy during project planning and design. The avoidance of E&S impacts is demonstrated in the section on Analysis of Alternatives while selecting the project locations and designs. Additional avoidance measures incorporated into the project design include wildlife crossing structures. DoST has developed several E&S instruments, including an ESIA with ESMP, SEA/SH and GBV Plan, and Resettlement Action Plan (RAP) to address the Project's E&S risks and a BMP to offset residual impacts on natural and critical habitat biodiversity values and ecosystem services. The ESMP will be included in the bidding documents, and DoST will monitor its implementation.

Environmental and Social Commitment Plan (ESCP). The DoST has developed an Environmental and Social Commitment Plan (ESCP) and agreed with the Bank on the actions, measures, and timelines necessary to ensure compliance with the ESSs throughout the project lifecycle.

Table 1: Significance of Road Project Impacts during Construction and Operational Phases

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Construction Phase E&S Impacts and Risks		
Labour/OHS Risks		
Labour and working conditions	Substantial	Low
Worker health and safety	High	Moderate
OHS risks during construction	High	Moderate
Impact on Natural Resources		
Use of Borrow and Quarry Materials	Moderate	Low
Erosion and sedimentation	Moderate	Low
Potential alteration of natural water flows.	Substantial	Low
Air, Noise, Water and Soil Pollution		
Dust from earthworks and vehicular movement	Substantial	Low
Emissions from construction equipment and traffic	Substantial	Low
Noise and vibration from construction	Substantial	Moderate
Water quality degradation/pollution	Moderate	Low
Soil compaction and damage	Moderate	Low
Contamination of soil and groundwater	Substantial	Low

Impact/Risks	Significance before Mitigation Measures	Residual Significance after Mitigation
Waste Generation		
Waste generated by workers	Substantial	Low
Waste from site clearance and exaction	Substantial	Low
Hazardous material waste	Substantial	Low
Community Health and Safety Risks		
Labor influx and in-migration	Substantial	Moderate
Community health and safety risks	Substantial	Moderate
Sexual exploitation and abuse, and sexual harassment	Substantial	Moderate
Increased traffic during construction	Substantial	Moderate
Climate- change induced risks - flood	High	Low
Resettlement Impacts		
Physical and economic displacement	High	Moderate
Biodiversity Impacts		
Loss of natural habitat	Moderate	Low
Impacts terrestrial biodiversity	Low	Negligible
Impact on aquatic habitat	Moderate	Low
Human-wildlife conflict	High	Moderate
Cultural Heritage		
Impact on cultural heritage	Low	Negligible
Operational Phase Impacts and Risks		
OHS Risks during Routine Maintenance	Substantial	Moderate
Impact on air quality from traffic during operation	Negligible	Negligible
Noise and vibration from traffic during operation	Moderate	Low
Habitat degradation and connectivity fragmentation for threatened mammals	High	Moderate
Road Safety and Community Health and Safety	Substantial	Low
Transboundary Impacts	Moderate	Low

5.2 E&S IMPACTS AND RISKS AND MITIGATION MEASURES DURING THE CONSTRUCTION

5.2.1 POTENTIAL LABOUR IMPACTS AND RISKS AND MITIGATION MEASURES

Project Workers. The Project workforce includes about 50 direct workers under the DOST and about 2,000-2,500 contracted workers to be engaged by the Contractors. The contracted workers comprise 600-700 skilled laborers and 1,400-1,800 unskilled laborers. About 90% of the construction workforce will be foreign workers, primarily from India, given the regional labor supply dynamics and project requirements. The remaining workforce will consist of local workers from the project area and other parts of Bhutan.

Potential labor Risks. The potential labor risks, other than Occupational Health and Safety (OHS) risks, include child labor, forced labor, and health risks due to inadequate working conditions. Vulnerable groups and migrant workers are particularly at risk. Other concerns include lack of formal contracts, excessive working hours, discrimination in hiring, delayed or

insufficient payments, and potential association with contractors or agents who do not adhere to legal and international labor standards, heightening the risk of labor exploitation. To address these, the DoST prepared labor management procedures (LMP), as part of ESMP, aligned with Bhutan's laws and ESS 2. The LMP includes robust processes such as formal contracts specifying terms of employment, non-discrimination clauses, a Workers' Grievance Redress Mechanism (GRM), prohibition of child and forced labor, and a Code of Conduct to prevent sexual exploitation, abuse, and harassment (SEA/SH). The workers' accommodation standards will follow the -IFC-EBRD Workers' Accommodation: Processes and Standards Good Practice Note[10], ensuring compliance with appropriate living conditions, hygiene, and worker welfare measures.

Occupational Health and Safety (OHS). The construction of roads and bridges will involve large-scale earthworks, excavation, slope cutting, handling of explosives, and work at heights and near water bodies, all of which expose workers to significant occupational health and safety risks. Planned road and bridge construction, involving activities such as large-scale earthworks, excavation, slope cutting, handling of explosives, and work at heights and near water bodies, all of which expose workers to significant occupational health and safety risks. The transport of construction materials through hilly terrain also introduces hazards related to vehicular accidents, driver fatigue, and improper material handling. Without appropriate safeguards in place, these risks may result in serious accidents, injuries, and fatalities. Workers may also be exposed to musculoskeletal disorders, noise-induced hearing loss, respiratory illnesses from dust exposure, infectious diseases, mental stress, and skin conditions due to prolonged exposure to construction materials. Additionally, the region's proximity to wildlife habitats poses risks of human-elephant conflict, particularly as elephants are known to traverse the project area.

To mitigate these risks, the project will implement a comprehensive Occupational Health and Safety Management Plan (OHSMP) applicable to all workers, including direct employees, contract workers, and community workers. Key mitigation measures will include:

- Risk-based safety training and induction for all workers, covering safe work practices, use of Personal Protective Equipment (PPE), hygiene, infectious disease prevention, and emergency response protocols.
- Strict protocols for handling explosives and conducting blasting operations, ensuring compliance with national and international safety guidelines.
- Implementation of fall protection measures for work at heights, including guardrails, harnesses, and controlled access zones.
- Excavation safety measures, such as benching, shoring, and trench support, to prevent cave-ins and collapses.
- Traffic and transport safety plans, ensuring safe transport of workers and materials, speed controls, vehicle maintenance, and driver training.
- Wildlife conflict mitigation measures, including awareness training on elephant movement patterns, speed restrictions in wildlife-prone areas, and proper waste management to minimize attractants.
- Medical screening before mobilization, on-site healthcare services, and coordination with local health authorities for emergency care.
- Regular safety inspections, anonymous grievance reporting for OHS concerns, and enforcement of a safety-first work culture.

10 https://www.ifc.org/en/insights-reports/2000/publications-gpn-workersaccommodation

- Establishment of a GRM to allow workers to anonymously report health and safety concerns

5.2.2 IMPACT ON NATURAL RESOURCES AND PROPOSED MANAGEMENT MEASURES

Resource Efficiency. The G-T Road construction requires a significant amount of construction materials, including 52,510 m^3 of general fill, 14,880 m^3 of boulders/rock fill, 400 m^3 of bitumen, 14,060 tonnes of cement, 25,600 tonnes of sand, 139,570 tonnes of aggregates, 9,350 tonnes of steel reinforcement, 1,370 tonnes of prestressing steel, and 260 tonnes of steel wire. The aggregates, sand and fill materials will be sourced locally from the government-approved quarry and borrow areas and licensed crushing plant operators located near Gelephu. The rivers near Gelephu provide abundant construction materials due to their steep gradients, seasonal flow changes, and braided channel systems with coarse alluvium deposits. These materials will be extracted from deposited materials outside actively flowing channels to ensure natural river flows remain unobstructed and environmental damage is minimized. To improve resource efficiency, the project will reduce reliance on borrow materials by maximizing the reuse of excavated materials on-site and balancing cut and fill operations to avoid unnecessary earthworks. Contractors will be required to maintain accurate records of material use, tracking quantities generated on-site, reused, and disposed of off-site, ensuring efficient use of resources while complying with environmental regulations.

Erosion and Sediment Control. Given the moderate to steep slopes in the hilly terrain along the project alignment, topsoil is highly susceptible to erosion, particularly in areas undergoing earthworks and land clearing for road expansion. Unchecked erosion from these works could lead to significant sediment runoff into adjacent rivers and water bodies, increasing the risk of habitat degradation, loss of agricultural productivity, and long-term land instability. To mitigate these risks, the project will implement strict erosion control measures before initiating any land-disturbing activities. Contractors will be prohibited from clearing or disturbing land beyond approved limits, and all affected areas will have sediment control structures, such as bund walls, silt fences, and vegetative buffer strips, installed to prevent runoff from reaching water bodies.

Potential Alternation of Natural Water Flows: The construction of bridge piers, foundations and embankments poses a potential risk to natural water flows, increasing the likelihood of erosion, sedimentation, and flood hazards. However, hydrological modelling using HEC-HMS confirms that the project's bridge designs will maintain natural flow patterns, provided that key mitigation measures are implemented. The bridge structures have been optimized to minimize the number of piers, reducing sediment deposition and disruption to water currents. Additionally, gabion walls and riparian buffer zones will be installed to reinforce river banks, control erosion, and maintain aquatic ecosystem integrity. Climate resilience has been incorporated into the project by ensuring 100-year return period drainage capacity, robust culverts, and other stormwater management systems that will help control high-flow events during the monsoon season. The design of bridge structures and drainage infrastructure prioritizes long-term hydrological stability and flood risk reduction, ensuring that the project does not negatively impact local water resources. These measures will contribute to protecting both natural water systems and communities living downstream.

5.2.3 AIR, NOISE, WATER AND SOIL POLLUTION

Construction impacts include dust from earthworks, noise pollution, soil erosion and sediment runoff, slope stability, soil compaction and contamination of surface and groundwater due to

stormwater pollutants, wastewater discharge, and improper waste handling. Vehicle and equipment emissions further pose risks to air quality and public health. Mitigation measures include dust suppression techniques, such as regular watering of exposed surfaces, covering construction materials, and ensuring proper maintenance of machinery. Noise from construction activities will be minimized by restricting noisy operations near sensitive receptors during daylight hours, maintaining equipment regularly, and conducting noise monitoring at key locations. The Project will implement erosion control measures and construct sediment retention structures and bund walls/barriers to reduce sediment flow into water bodies.

5.2.4 GENERATION OF WASTE

The construction activities will generate various types of solid and hazardous waste, including domestic waste from worker camps, construction and demolition debris, and hazardous materials such as fuel and lubricants. Waste materials have the potential to cause adverse environmental impacts during generation, storage, transport, and disposal. The quantities of waste estimated are: 1,250 kg/day of domestic solid waste, 1,000 kg/day of construction solid waste, 5.8 kg/day of hazardous waste from oil-soaked rags and grease waste, 4.35 L/day liquid hazardous waste and 11.9 kg/day hazardous waste from non-oil and grease-related hazardous waste. The project will implement a comprehensive Waste Management Plan (WMP) to minimize environmental pollution and public health risks associated with domestic construction, and hazardous waste. Waste management measures will include segregation of waste at the source, ensuring that organic waste is composted or sent to vermicomposting facilities in Gelephu, while recyclable materials are collected for reuse or recycling. Hazardous waste will be stored in designated areas with secondary containment and returned to vendors or authorized waste disposal facilities. Construction debris will be reused wherever possible, with non-recyclable waste transported to approved landfills or disposal sites. Waste from worker camps will be collected and transported weekly to the Gelephu landfill, ensuring proper disposal and preventing uncontrolled dumping.

5.2.5 COMMUNITY HEALTH AND SAFETY RISKS AND IMPACTS

Health and Safety Risks During Construction. Local communities face potential health and safety risks from geohazards associated with road construction, including slope failures, which could negatively impact downstream settlements if not properly managed. Heavy machinery operations, transportation of materials, and increased traffic pose risks of accidents, injuries, and potential fatalities, particularly near villages, schools, and other community facilities. Traffic disruptions and access constraints during construction may affect local mobility, emergency response times, and daily activities. The construction will involve the use of hazardous materials, such as explosives and chemicals, increasing risks of accidental exposure and contamination if not handled safely. The air, noise, and vibration pollution from construction activities could negatively impact residents' quality of life, diminishing the amenity value of the area. Detailed mitigation measures to address these risks are detailed in the ESMP, which includes strict traffic and road safety management plans, air quality and noise control measures, and compliance with the standards.

Impact on Local Resources from Labor Influx. The influx of approximately 2,500 workers at peak construction will introduce significant social and economic risks, including increased pressure on local resources, social tensions, and potential strain on community services. Communities that depend on forest resources may experience competition over land and natural assets, leading to conflicts if not managed effectively. The majority of migrant workers are expected to be from India, given their experience in heavy construction and willingness to work

for lower wages. However, the DoST has committed to hiring and training Bhutanese workers, aiming to increase local workforce participation. The influx of workers will strain essential services, particularly healthcare, which is critical for managing occupational hazards and infectious disease outbreaks. To address these risks, the Contractor will implement a code of conduct and establish adequate health facilities within the camps and water supply facilities, ensuring minimal disruption to local services. The project GRM will allow communities to raise concerns, ensuring timely intervention and mitigation of potential labor-related challenges.

GBV/SEA-SH Risks. The construction of the G-T Road will take place near local communities, potentially increasing risks of SEA/SH from labor influx if not effectively mitigated. Existing GBV concerns in the region, linked to alcohol abuse, harmful social norms, and weak reporting mechanisms, may be exacerbated by the presence of a predominantly male workforce. Limited access to GBV support services in rural areas further worsens conditions for survivors, making prevention and response mechanisms critical. Gelephu Thromde has recorded higher GBV cases due to its urban setting, dense population, entertainment venues, and transient labor presence. The increased population influx from project activities and new economic opportunities may also create additional social tensions, potentially reducing safety for women and vulnerable groups. If not addressed, these risks could limit women's mobility, restrict economic participation, and deepen gender inequalities.

To mitigate SEA/SH risks, the project will implement a SEA/SH Action Plan and engage a third-party GBV service provider to support incident response and enforcement of mitigation measures. A dedicated SEA/SH-specific GRM will be linked to the project-level GRM and managed by DoST PMU, ensuring a survivor-centred approach to grievance handling. The project will also prioritize hiring women, support training programs, and introduce targeted economic opportunities, such as women-managed enterprises, financial literacy programs, and digital skills training, to enhance women's resilience and independence.

5.2.6 LAND ACQUISITION AND RESETTLEMENT AND PROPOSED RAP

Land Acquisition. The Project will require both permanent and temporary land acquisition, impacting private properties, agricultural land, community forests, and non-residential structures. A total of 203 land plots will be acquired for the construction of roads, bridges, and ancillary facilities, with 182 plots falling within the project's right ROW and ancillary facilities. The total land area of community forests within the ROW is 71.067 acres, comprising Phunsumthang (12.102 acres), Taklaithang (52.262 acres), and Chuzhingtae (6.696 acres) blocks. To address the impacts of land acquisition, a Resettlement Action Plan (RAP) has been prepared in accordance with ESS5 and Bhutan's Land Act (2007). The plan identifies affected households, structures, and livelihoods and establishes a comprehensive entitlement framework that includes compensation at full replacement cost, relocation assistance, coverage of transaction costs, and administrative charges. The RAP ensures the best efforts will be made to provide like-for-like or alternate land with full development support, including improved infrastructure and services at resettlement sites. The RAP will be finalized after the completion of the G-T Road detailed design, and a RAP implementing agency, such as a consulting firm or a third-party organization, will be hired to support DoST in implementing the RAP prior to commencing relevant works.

Physical Displacement. A total of 34 Project Affected Households (PAHs), comprising 184 Project Affected Persons (PAPs), will be physically displaced due to land acquisition. The highest number of physically displaced households (17) are in Gelephu Thromde. As physical relocation

disrupts socio-cultural and economic stability, affected individuals will be relocated within their villages, Gewogs, or Thromdes, ensuring they remain within familiar environments. Consultations will be conducted to assess relocation preferences and ensure that alternative housing and land options align with community needs. The RAP includes housing assistance, infrastructure support, and compensation to facilitate a smooth transition for displaced households.

Economic Displacement. The project will cause economic displacement for 112 Project Affected Households (PAHs), comprising 508 Project Affected Persons (PAPs), particularly impacting agricultural and pastoral activities, local businesses, and community forest access. The affected lands primarily support semi-commercial and subsistence farming, including rice paddies, maize, vegetables, and areca nut plantations. Permanent economic displacement will require the implementation of Livelihood Restoration Plans (LRPs) to assist affected persons in regaining stable incomes through training, employment support, and alternative livelihood options. Temporary economic displacement may occur due to restricted access to grazing lands and community forests and disruptions to small commercial establishments during construction. To mitigate these impacts, the project will implement livelihood restoration programs, including vocational training, financial support, and skills development initiatives, with a particular focus on supporting vulnerable groups, including women. These measures will ensure continued access to essential services and markets while restoring livelihoods to pre-displacement levels.

5.2.7 IMPACT ON CULTURAL HERITAGE AND PROPOSED MITIGATION MEASURES

The proposed alignment of the G-T Road avoids direct impacts on tangible cultural heritage sites; however, labor and population influx may affect intangible cultural heritage, particularly for groups with distinct cultural practices, such as Merak-Saktenpa, Brahmi, Khengpa, and Rai. Construction-related noise and vibration may have short-term effects on nearby sites, but no relocation is required for the 17 identified Lhakhangs (temples). Access restrictions to cultural sites during construction may also temporarily affect community participation in religious or cultural practices. To mitigate these impacts, a Cultural Heritage Management Plan (CHMP) has been developed, incorporating community consultations conducted in local languages in a culturally appropriate and inclusive manner, addressing gender, age, and vulnerability considerations. The CHMP includes measures such as delineating cultural site boundaries with signage, raising awareness about intangible cultural heritage preservation, and supporting ceremonies and rituals to appease nature-linked deities as advised by local stakeholders. The ESMP includes standard Chance Find Procedures, with a mandatory Chance Find Clause in all works contracts. Contractors will be required to halt construction upon encountering physical cultural heritage and coordinate closely with relevant national authorities for salvaging and restoration efforts.

5.3 E&S IMPACTS AND RISKS AND MITIGATION MEASURES DURING THE OPERATION

OHS Risks during Operation: During the Operation and Maintenance (O&M) stage, key OHS risks may arise from proximity to live traffic and exposure to elevated noise levels while conducting routine maintenance tasks. Workers may face hazards such as collisions, excessive noise, and visibility issues. O&M Manuals require risk assessments to be in place, as well as associated OHS Plans. Mitigation measures include establishing clear work zones with protective barriers, rerouting traffic when required, and using channeling devices (e.g., cones) to separate vehicles from personnel. Controlled traffic flow, reduced speed limits in work areas, and

appropriate warning lights reduce risks. Comprehensive risk assessments and worker training will emphasize safe practices, especially during low-visibility conditions, and high-visibility clothing will be used to enhance visibility and safety.

Air and Noise Pollution during Operation: Air and noise quality modelling was done for anticipated traffic in 2035 and 2053. The analysis revealed negligible effects on air quality due to the anticipated adoption of electric vehicles, which reduce exhaust emissions. Noise modelling indicated elevated levels under maximum capacity, driven primarily by tire-road interaction at higher speeds, but overall impacts are expected to moderate with ongoing mindful city planning efforts and fleet electrification. Proposed mitigation measures include land use buffers, vegetation strips, speed limits and regular road maintenance to address tire noise.

Road Safety During Operation. During the O&M phase, road safety will be greatly improved compared to the existing roads. However, community health and safety risks arise from traffic-related hazards, including increased traffic volumes, high speeds, abrupt maneuvers, and potential conflicts with pedestrians or slower vehicles. Routine maintenance activities add hazards through lane closures, workers' proximity to live traffic, and reduced visibility. To mitigate these risks, effective signage, speed enforcement, barrier placement, and clear work zones are essential, as will be periodic inspections to ensure proper lighting and prompt removal of roadway obstructions. Clear communication, targeted training, and high-visibility attire for maintenance crews further enhance safety. Road safety audits and public awareness campaigns will be regularly conducted to uphold community health and safety standards.

5.3.1 TRANSBOUNDARY IMPACTS ON DOWNSTREAM FLOWS AND WATER QUALITY

The G-T Road includes four major bridges, the largest being a 1 km-long bridge over the Mau River, a tributary of the Manas River. The Mau River has a small catchment in Bhutan and is a seasonal, braided river with flows diminishing to only a few cubic meters per second during the dry season between October and March/April. The bridge design incorporates limited piers to minimize flow obstruction and sediment deposition, reducing potential impacts on river hydrodynamics. Additionally, gabion walls and riparian buffer zones have been proposed to stabilize river banks and reduce erosion. Hydrological modelling confirms that natural flow patterns will be maintained with the implementation of appropriate design measures, ensuring that downstream flows will not be affected by bridge construction. Other rivers crossed by bridges are significantly smaller than the Mau River, and the potential impacts from bridge construction and operation are expected to be even less significant. Based on detailed hydrological modelling, bridge design analysis, and impact assessments, as well as the comprehensive mitigation measures outlined in the Feasibility Study and ESIA/ESMP, the construction and operation of the road will not have adverse effects on downstream water quantity or quality.

5.4 BIODIVERSITY IMPACTS AND RISKS AND BIODIVERSITY MANAGEMENT PLAN

Loss of Natural Habitat. The project will impact approximately 0.2 km² of terrestrial habitat due to land clearance for road construction, including 0.07 km² of natural habitat loss. This triggers ESS6 requirements for no net loss and, where feasible, a net gain in biodiversity over the long term.

Habitat Fragmentation. Habitat loss as a result of road construction and installation of fencing along the road during the operations may lead to the fragmentation of habitats for the Asian

Elephant and Gee's Golden Langur. These are critical species, and their impacts trigger ESS 6 requirements for net of the affected biodiversity.

Construction Impacts on Terrestrial Biodiversity. Construction activities can negatively affect terrestrial biodiversity through construction-related nuisances such as noise, dust, chemical spills, and road kills. Wildlife may also be harmed by falling into trenches or encountering workers. Increased workforce presence could lead to resource depletion and poaching.

Impact on aquatic habitat and species. The impact of construction on aquatic habitats will be limited but could include sedimentation, increased total suspended solids (TSS) and reduced dissolved oxygen, potentially harming fish and macroinvertebrate species and the overall ecological integrity of the river. River training works may also temporarily adversely impact the riparian and floodplain habitats.

Human-Wildlife Conflict (HWC). Asian elephants frequently traverse the project area, with HWC peaking in summer and autumn due to food availability and breeding patterns. Habitat fragmentation and loss caused by the road will force elephants to alter their range, potentially increasing human-elephant conflicts, crop damage, and property destruction. During operation, higher vehicle speeds may increase wildlife mortality from road collisions.

Mitigation Measures Biodiversity Management Plan (BMP)

A draft BMP is developed as a standalone document to present mitigation to address potential project impacts and a Biodiversity Net Gain Strategy to achieve the above ESS6 net gain requirements.

A robust mitigation hierarchy has been applied to avoid, minimize, and compensate for biodiversity impacts. The avoidance measures include careful selection of the road alignment to reduce clearance of high-quality forests, maintain wildlife connectivity, and limit disturbances to river and riparian habitats. The road designs include provisions wildlife underpasses for elephants, canopy bridges for golden langurs, and culverts for lesser species. Further mitigation measures include speed limits in high-risk areas, strategic fencing to prevent wildlife-vehicle collisions, reduced nighttime construction to minimize light and noise pollution, and habitat rehabilitation efforts to restore degraded areas.

Net Gain Strategy: To ensure biodiversity net gain, the BMP includes five key components to be implemented by the Department of Forests and Park Services (DoFPS):

- **Habitat Enrichment Program**: Rehabilitation of 150 hectares of degraded grasslands over five years, improving elephant and wildlife habitats by reseeding areas, restoring waterholes, and rehabilitating mineral licks.
- **Safeguarding Elephant Movement Corridors**: Protecting future wildlife corridors beyond the road alignment, ensuring long-term elephant movement and habitat connectivity.
- **Promoting Human-Wildlife Coexistence**: Implementing fencing, rapid response teams, and community engagement programs to reduce human-elephant conflicts.
- **Wildlife Movement Research**: GPS collars, camera traps, and observational studies will track elephant and golden langur movements. Up to 12 elephants will be fitted with GPS collars, and camera traps will monitor golden langur crossings.
- **Partnerships and Capacity Building**: Collaboration among DoST, DoFPS, local communities, conservation NGOs, and cross-border agencies, with training and coordination to strengthen biodiversity conservation efforts.

Next Steps in BMP Finalization: The BMP provides a provisional analysis of net gain which suggests that ESS6 requirements are technically and financially feasible. However net gains need to be measured based on metrics that still need to be developed. The wildlife movement research program will be planned in a manner to yield data that serve as metrics for measurement of net gain. A research planning workshop will be held prior to finalizing the BMP. The BMP also requires consultation with internal government stakeholders and external stakeholders, led by DoST with DoFPS involvement. This consultation will guide the finalization of the BMP.

5.5 CUMULATIVE IMPACT ASSESSMENT AND MANAGEMENT

A rapid cumulative assessment (rCIA) was conducted as part of this ESIA following the WBG GPH on CIA[11]. This Rapid Cumulative Impact Assessment (RCIA) was limited in scope and focused on the Gelephu-Tareythang Road. A full Cumulative Impact Assessment and Management (CIA) will be carried out during project implementation.

This rCIA offers an initial evaluation of potential cumulative effects arising from the G-T Road's interaction with other nearby developments—such as the Gelephu Mindfulness City (GMC), Gelephu International Airport, planned Railway and Dry Port, Municipal Boundary Wall, Gyalsung Academy, and GMC energy initiatives—and broader external stressors including climate change, natural disasters, and population in-migration. The Valued Environmental and Social Components (VECs) identified in the CIA were air quality, water resources, wildlife resources (including elephant movement), community wellbeing (including reduction of wildlife-human conflict), community forests and socio-cultural conditions.

The G-T Road, in conjunction with other ongoing and planned developments, as well as external pressures, will have cumulative impacts on VECs. Air quality will be affected by increased dust and emissions from concurrent construction activities, although its overall cumulative impact remains low. Water resources face substantial risks due to potential erosion, sedimentation, and land-use changes that degrade water quality. Wildlife resources, especially elephant movement corridors, bear the highest cumulative impacts from habitat fragmentation and reduced movement opportunities, heightening human-wildlife conflict. Community wellbeing and socio-cultural conditions experience substantial impacts: land acquisitions and shifts in livelihoods can intensify displacement risks, alter social cohesion, and strain local infrastructure. Community forests face moderate adverse effects where multiple projects converge on forested lands, impacting resource availability and traditional uses. Taken together, these overlapping developments magnify each other's effects, underscoring the urgency of comprehensive management and collaborative mitigation strategies to safeguard the region's environmental integrity and community welfare.

The BMP will be a key project-driven measure to mitigate its contribution to cumulative impacts on the wildlife corridor, wildlife resources, biodiversity values, ecosystem services, and potential increase in human-wildlife conflict. The BMP will also develop metrics, indicators, and a well-structured set of management measures that will help to influence the mid and long-term multi-

11 International Finance Corporation (IFC) Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (www.ifc-goodpracticehandbook-cumulativeimpactassessment.pdf)

stakeholder and multi-agency cumulative impacts management plan expected as a key outcome of the CIA proposed as an integral component of project implementation.

In addition to the implementation of BMP, a series of targeted measures will be designed as part of the detailed CIA study and will be implemented. Dust and noise controls will be incorporated into construction activities to minimize air pollution and disturbances to communities and wildlife. Sustainable water management strategies will be adopted to prevent erosion, sedimentation, and degradation of water quality. To address habitat fragmentation and human-wildlife conflict, wildlife corridors, passages, and habitat offsets will be established to maintain ecological connectivity. Coordinated land-use planning will be undertaken to prevent encroachment into sensitive ecosystems and ensure development aligns with biodiversity conservation objectives. Collaboration with government agencies, local communities, and other stakeholders will strengthen resource management, monitoring efforts, and capacity-building initiatives. Information-sharing between planned development projects will improve efficiency and minimize overlapping impacts, while integrating GMC objectives, such as promoting public transport and the adoption of electric vehicles, will help reduce long-term environmental pressures. Additionally, real-time hydrological monitoring and improved early warning systems will be deployed to enhance climate resilience and disaster preparedness. Active community engagement programs will ensure that local populations are informed, included in mitigation planning, and supported through socio-economic initiatives, creating a more sustainable and balanced development framework that prioritizes both environmental protection and community wellbeing.

6. IMPLEMENTATION OF ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN (ESMP)

6.1.1 Institutional Arrangements

Figure E2 outlines the overarching arrangement dedicated to E&S risk management during the project implementation. This arrangement includes three entities: (i) the PMU at the DoST, (ii) the Supervision Engineer, and (iii) the Contractors.

- **Project Management Unit (PMU).** The DoST is well advanced in the process of establishing a Project Management Unit (PMU) tasked with the day-to-day coordination and on-site implementation of Project activities. The PMU will engage E&S consultants (an environment, a social and a Gender/GBV consultant) and depute its staff as dedicated E&S officers (an environmental officer, an OHS officer, a social officer and a gender officer) to ensure adequate implementation of the ESMP. In addition, the DoFPS will depute its in-house staff to work as a biodiversity specialist in the PMU. DoST will also engage an RAP Implementing Agency to support the implementation of the RAP. DoST will ensure that the ESMP and E&S requirements are adequately reflected in the project bidding documents, ensure all the administrative approvals are in place for all the plans and documents on related E&S aspects, and prepare quarterly reports on the Project's E&S performance. DOST will also ensure that the Project is constructed and operated in conformance with World Bank ESS's and ESCP commitments.

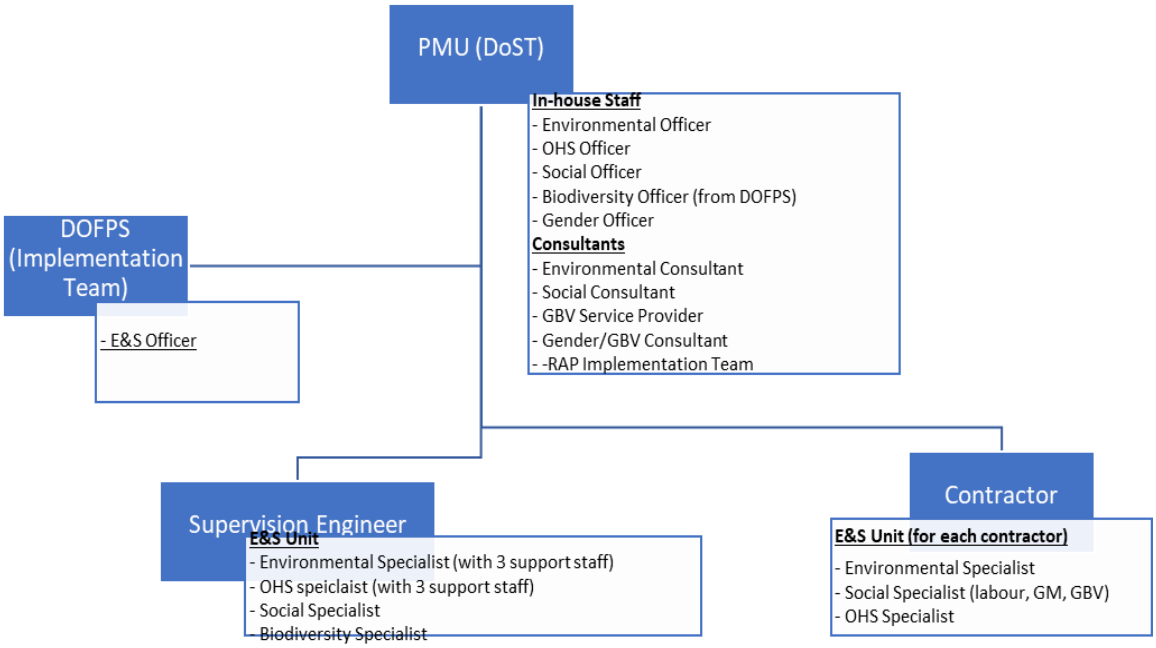

FIGURE E2: IMPLEMENTATION ARRANGEMENTS AND E&S STAFFING

Supervision Engineer. The Supervision Engineer will support the PMU in supervising the Contractor's implementation of ESMP by monitoring compliance, conducting site inspections, reporting on E&S performance, and conducting required E&S training. They also provide recommendations for corrective actions and support training to build capacity for managing environmental and social risks throughout the Project. The Supervision Engineer's team will include a dedicated E&S Unit with 4 environmental, 4 OHS, a biodiversity and a social specialist employed throughout project implementation.

Contractor. DoST will engage 3 contractors, and each Contractor's team will have an environmental, an OHS and a social specialist with adequate site inspectors to support these specialists. The Contractor's role in the ESMP involves ensuring that all environmental and social requirements are implemented during project construction. They will work closely with the Supervision Engineer to address environmental or social concerns during the Project's execution.

Capacity Building. Environmental and social training will ensure all project personnel understand and adhere to the ESMP requirements. The training will be provided on E&S risk management, biodiversity and critical habitat species management, occupational health and safety (OHS), construction monitoring and auditing, stakeholder engagement, prevention and response to SEA/SH, management of Grievance Mechanism, implementation of livelihood restoration activities, occupational and Community Health and Safety, incident reporting procedures, and emergency preparedness and response procedures. This training will be initially provided by the PMU's E&S Consultants, followed by the Supervision Engineer's E&S staff. Contractors will also provide similar induction and continuous training to their staff for effective ESMP implementation.

6.2 ESMP IMPLEMENTATION BY CONTRACTORS

6.2.1 E&S CONDITIONS IN BIDDING DOCUMENTS

The DoST will require that all contractors engaged in the Project operate in a manner consistent with the requirements of the ESSs, including the specific requirements set out in the ESCP. The DoST will manage all contractors in an effective manner, including (a) Assessing the environmental and social risks and impacts associated with such contracts; (b) Ascertaining that contractors engaged in connection with the Project are legitimate and reliable enterprises and have knowledge and skills to perform their project tasks in accordance with their contractual commitments; (c)Incorporating all relevant aspects of the ESCP into tender documents; (d) Contractually requiring contractors to apply the relevant aspects of the ESCP and the relevant management tools, and including appropriate and effective non-compliance remedies; (e) Monitoring contractor compliance with their contractual commitments; and (f) In the case of subcontracting, requiring contractors to have equivalent arrangements with their subcontractors.

The DoST will include the following E&S conditions, including cost implications, in the bidding documents: (a) Past performance of the Contractor on E&S aspects, including OHS, SEA and GBV; (b) Requirement of E&S Performance Guarantee; (c) Required E&S staff with the Contractor; (d) Inclusion of ESMP and ESMP implementation costs into the bidding documents; (e) Code of Conduct for the Contractor's personnel; (f) Contractor's proposed management strategies and implementation plans to manage the E&S risks; (g) Requirement to prepare a C-ESMP with site-specific management plans, including an OHS plan; (h) Labor Management Procedures and (i) Penalties for non-compliances.

6.2.2 CONTRACTOR'S ESMP

The Contractor will submit a C-ESMP with a site-specific mitigation plan and an OHS Management Plan (OHSMP) before the start of the construction works for approval from the PMU and Supervision Engineer and implement them during the construction. The OHSMP will be submitted as a standalone plan. The C-ESMP and OHS plans will be updated at least every six months. The C-ESMP will consist of the following site-specific plans:

- Dust Management Plan, Air Quality Management Plan, Water Management Plan (with Water Use/Extraction Plan and Stormwater Management Plan), Waste Management Plan, Hazardous Material Spill Response Plan and Employee Grievance Mechanism.
- Erosion and Sediment Control Plan, Muck Disposal Planning and Management Plan, Quarry Management Plan
- Vegetation Clearing Plan, Landscaping and Re-vegetation Plan, Biodiversity Protection Plan
- Occupational Health and Safety Plan, OHS Training for Construction Workers Plan
- Management of Construction Worker Camps, Site Cleaning and Rehabilitation Management Plan
- Emergency Preparedness and Response Plan (or Emergency Response Plan), including Fire Prevention Plan.
- Traffic Management Plan, Communities Health and Safety Management Plan

6.3 MONITORING

The proposed monitoring during the implementation of the ESMP and the key performance indicators are summarized below:

- Worksite Inspections and Compliance Monitoring: Daily inspections by the Supervision Engineer's E&S staff on adherence to the ESMP implementation by the Contractors.
- Environmental Monitoring: Environmental quality monitoring targets compliance with water, air, and noise quality standards, dust, wastewater quality, sediment control, and erosion prevention.
- Community Health and Safety Performance: Community and worker health indicators emphasize training in hygiene, STD prevention, GBV awareness and SEA/SH risk.
- OHS Performance: OHS performance is tracked using metrics like Lost Time Injury Frequency Rate, Total Recordable Incident Rate, accident rates against industry benchmarks, OHS training, inspections and risk assessments. Regular emergency preparedness drills and training ensure readiness, with annual emergency preparedness and response drills and bi-annual reporting on readiness, Lock-Out/Tag-Out procedures for electrical safety, and maintaining machinery through regular checks.
- Resettlement: The Project will establish both an internal and external system to ensure that affected households and communities maintain or improve their livelihoods throughout the project lifecycle. The process emphasizes consultations, inclusivity, and the meaningful involvement of local communities, with a focus on community development programs that address the needs of impacted groups, particularly vulnerable populations and gender-specific concerns. Efforts will include increasing women's involvement and addressing their vulnerabilities related to land security and safety.

6.4 REPORTING

The following reports will be prepared by PMU and contractors during the project implementation.

- Incident and Non-Compliance Reporting: Any incidents or non-compliance related to environmental and social incidents will be documented and reported promptly as per the ESCP. Incident reports are required to include a description of the incident, immediate corrective actions, and preventive measures to avoid recurrence. Major incidents or those with significant environmental or social impacts are reported immediately to the PMU and relevant stakeholders, including regulatory authorities and the WB, as necessary and as per the ESCP.
- Monthly and Quarterly Reporting: Monthly reports on environmental and social performance are prepared by the Contractors' teams on-site. These reports are consolidated into quarterly reports by PMU that provide a comprehensive overview of the Project's adherence to the ESMP. The quarterly reports serve as critical tools for the PMU to review the Project's compliance status and decide on any additional interventions or modifications in the management plan. Quarterly reports will be presented to the WB as per the ESCP.

6.5 BUDGET FOR IMPLEMENTATION OF ESMP

The total cost of ESMP implementation for the Project is estimated to be USD 13.36 million. This includes USD 5 million for BMP and USD 5.5 million for RAP.

7. STAKEHOLDER CONSULTATIONS AND DISCLOSURE

7.1 PROJECT STAKEHOLDERS

Affected Parties. Affected Parties are individuals, groups, or entities subject to direct impacts from constructing the Gelephu–Tareythang road. Landowners may lose legal holdings and structures, while land users risk losing primary income sources or grazing areas. Community forest users could face restricted access to resources essential for subsistence or economic activities. Small businesses located near the project site may experience operational disruptions or permanent relocation. Local communities adjacent to the alignment may endure structural damage to properties, increased dust and noise, and possible obstructions to vital services. These direct impacts necessitate targeted measures to mitigate economic, social, and environmental risks and disruptions.

Other Interested Parties. Other Interested Parties encompass groups or individuals who do not directly experience physical or economic effects from the Project but maintain an interest in its outcomes. They include the general public, who may anticipate broader benefits; institutional stakeholders like media or academia monitoring impacts; and NGOs or CSOs concerned with environmental protection or community welfare. They also include providers of social infrastructure such as schools, health centers, religious organizations, and government bodies at local, regional, and national levels. Although their interests differ from those of directly affected parties, their participation can affect public perceptions and influence the Project's overall progress.

Vulnerable groups. Disadvantaged or vulnerable groups may face heightened hardships from project-related displacement or land acquisition. Women-headed households, single mothers, and domestic violence survivors risk exclusion from compensation due to gender biases and limited property rights. Older people and individuals with disabilities face mobility and documentation challenges. Youth lacking stable livelihoods could be disproportionately affected by disruptions. Poor households may lack resources to navigate compensation mechanisms, while landless families risk losing leased or communal lands. Small-scale landowners can face precarious outcomes if acquisition fragments their already limited plots. Socio-cultural groups, including minority communities, require tailored engagement to ensure their inclusion and protection.

7.2 PROPOSED STAKEHOLDER ENGAGEMENT

DoST has prepared a Stakeholder Engagement Plan (SEP) that covers the entire project lifecycle and remains a living document. During planning, finalizing alignments, and acquiring land, DoST will engage stakeholders—such as landowners, communities, and relevant authorities—through targeted consultations. DoST will share project information, management plans, and local employment opportunities, with special attention to vulnerable groups and socio-cultural practices. Construction activities will involve close coordination with contractors, sub-contractors, and local communities to address site safety, worker influx, and possible disruptions to daily life. Regular toolbox talks, gender sensitization programs, and health awareness campaigns will ensure worker welfare and limit negative community impacts. DoST will also collaborate with local media, NGOs, and public offices to provide timely updates on construction, potential hazards, and the grievance redress mechanism (GRM). In the operation and maintenance phase, DoST will maintain transparent communication with local communities regarding repairs, ongoing work, and adherence to safety standards. Throughout all phases,

DoST will protect stakeholder rights and promote meaningful participation, upholding a zero-tolerance policy against retaliation for expressing concerns.

7.3 GRIEVANCE REDRESSAL

DoST will establish a project-specific GRM to promptly address complaints and concerns from affected households. The GRM operates at two levels: local by the Chief Engineer Office of Sarpang, which is responsible for project implementation and houses E&S specialists and at the national DoST office in Thimphu. At the local level, a committee composed of the Chief Engineer, environmental and social specialists, community representatives, and other stakeholders will receive, document, and resolve grievances within a defined timeframe. Grievances are classified as low, medium, or high risk. Low-risk complaints are resolved immediately, medium-risk complaints are resolved within seven days, and high-risk complaints are resolved within 10 to 14 days. Unresolved cases are escalated to a national-level Grievance Redressal Cell, which will resolve them within 14 working days.

All incoming grievances are logged and tracked, with data reported monthly to the Project Director. Quarterly reviews assess the GRM's effectiveness and capture feedback from complainants. The mechanism includes special provisions for socio-cultural groups, recognizing traditional dispute resolution practices, and is sensitive to Sexual Exploitation and Abuse/Harassment (SEA/SH) issues in line with World Bank guidelines. Grievances may be submitted verbally, online, or in person at the DoST office. Training will be provided to staff and contractors, covering GRM procedures, documentation, and timelines, ensuring clarity and prompt action throughout the Project.

7.4 STAKEHOLDER CONSULTATIONS CONDUCTED AND FEEDBACK RECEIVED

Several rounds of consultations were undertaken during the preparation of the ESIA and on the draft ESIA. The first round was undertaken during the scoping phase of the Project, from 18 to July 24, 2024. This served to help better understand the local context, including the stakeholders' initial concerns about the Project.

A second round of consultations was conducted from August 30 to September 3, 2024, during primary data collection, including information to inform the identification of risks and impacts associated with the Project. As part of the site visit, key informant interviews and focused group discussions were undertaken with community members representing various demographics of the project impact area. This included women, adolescent girls, youth groups, NGOs, business owners, farmers/cultivators, teachers and healthcare practitioners. The consultations served to assess current stakeholder understanding of the Project, stakeholder engagement preferences, grievance tools currently being used, and strategies needed to ensure that vulnerable groups can access stakeholder engagement opportunities.

Additionally, the GMC Governor undertook an additional stakeholder consultation on September 27, 2024, at various locations in the Project area, such as in Gelephu Thromde, Umling Gewog and Gelephu Gewog. About 70% of the landowners in the Project area attended the consultations. Moreover, elected officials of the local governments attended. Landowners from nearby areas were also encouraged to participate in the consultations. Key points discussed were disclosure about the Project, existing compensation, potential resettlement options, compensation rates (based on market value and not the existing rate as given under the Land Act 2007), and consideration of exceptional cases for benefits under the land acquisition and

resettlement process. Further, pertinent questions raised by the communities were also answered by the Governor and relevant officials.

Another round of consultation was from October 13 to October 31, 2024, and was conducted by the Social Specialist, DoST and Gender Expert, World Bank. They consulted with diverse stakeholders in Thimphu and Gelephu, including the government, private, and CSOs. The discussions focused on the easiness of business and trade, targeted skilling and capacity building of women, existing challenges for businesses, clearing agents and traders, especially women, and understanding of general gender issues and concerns in the community and skills and capacity of service providers.

A Final round of consultations was conducted from December 2 to 4, 2024, to share the draft SEP and ESIA findings with the communities and to seek their feedback on the proposed engagement strategies and mitigation measures.

During the consultations, most community queries focused on land rates and compensation arrangements. Overall feedback was positive, with many participants expressing willingness to contribute their land for broader economic benefit, including developments such as the GMC and the road project. Some raised concerns about livelihood impacts, access to grievance mechanisms, disruptions to local businesses and farmlands, and environmental issues such as dust, noise and traffic. Stakeholder feedback was actively incorporated into the project design, and relevant mitigation measures have been integrated into the ESMP.

7.5 DISCLOSURE

DoST disclosed the draft ESIA and the Executive Summary of the ESIA (including the Bhutanese version) on its website on November 22, 2024. This updated Executive Summary will also be translated and disclosed on the DoST website along with other E&S instruments.